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# THESIS

**BRIDGING THE GAP: ENHANCING SNA WITHIN THE MARINE CORPS INTELLIGENCE COMMUNITY**

by

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June 2015

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The United States Marine Corps and the Marine Corps' intelligence community recognize that future adversaries are likely to be adaptive and complex. Both the Expeditionary Force 21 (EF 21) Capstone Concept and the Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise (MCISRE) Roadmap identify the need for advanced intelligence analysis. This thesis argues that social network analysis (SNA) is a worthwhile method, but one that is not currently used within the MCISRE.

The purpose of this research is to determine the SNA knowledge level within the MCISRE and to recommend ways to bridge the gap between current knowledge with the knowledge required by the EF 21 and MCISRE Roadmap. A mixed-method approach combines a quantitative survey, meant to determine current SNA knowledge and proficiency, and qualitative interviews with various subject matter experts to determine corrective recommendations.

Survey results and interviews indicate that Marine Corps intelligence personnel are not proficient in SNA and that SNA is often confused with other forms of intelligence analysis, such as link analysis and social media analysis (SMA). Causal factors for these deficiencies are discussed using the Doctrine, Organization, Training, materiel, Leadership/Education, Personnel, Facilities (DOTmLPF) pillars as a template, and recommendations are given to correct them. Recommendations requiring further research are also explored and discussed.

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# BRIDGING THE GAP: ENHANCING SNA WITHIN THE MARINE CORPS INTELLIGENCE COMMUNITY

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# LIST OF ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AFIT | Air Force Institute of Technology |
| ANAT | Advanced Network Analysis and Targeting |
| ASCOPE | Areas, Structures, Capabilities, Organizations, People, Events |
| AtN | Attack the Network |
| ATP | Army Techniques Publication |
| CCLEB | Commandant's Career-Level Education Board |
| COIN | counterinsurgency |
| CONOPS | concept of operations |
| CORE Lab | Common Operational Research Environment Lab |
| COTS | commercial off-the-shelf |
| CPIB | Commandant's Professional Level Intermediate Level Education Board |
| DCR | DOTmLPF Change Recommendation |
| DOD | Department of Defense |
| DOTmLPF | Doctrine, Organization, Training, materiel, Leadership and Education, Personnel, Facilities |
| EF 21 | Expeditionary Force 21 |
| FM | Field Manual |
| FOUO | For Official Use Only |
| I2 | Identity Intelligence |
| IAS | Intelligence Analysis System |
| IPB | Intelligence Preparation of the Battlespace |
| JCIDS | Joint Capabilities Integration Development System |
| JCS | Joint Chiefs of Staff |
| JP | Joint Publication |

| | |
|---|---|
| MAGTF | Marine Air-Ground Task Force |
| MARSOC | Marine Corps Forces Special Operations Command |
| MCIA | Marine Corps Intelligence Activity |
| MCIP | Marine Corps Interim Publication |
| MCISRE | Marine Corps Intelligence, Surveillance, and Reconnaissance Enterprise |
| MCPP | Marine Corps Planning Process |
| MCRP | Marine Corps Reference Publication |
| MCWP | Marine Corps Warfighting Publication |
| MEU | Marine Expeditionary Unit |
| MIC | MAGTF Intelligence Center |
| MOS | military occupational specialty |
| MSTP | MAGTF Staff Training Program |
| NE | Network Engagement |
| NPS | Naval Postgraduate School |
| NRC | National Research Council |
| ORA | Organizational Risk Analyzer |
| PMESII | Political, Military, Economic, Social, Information, Infrastructure |
| ROMO | range of military operations |
| SMA | social media analysis |
| SMAT | Structured Models, Approaches, and Techniques |
| SNA | social network analysis |
| TBOC | Training Brain Operations Center |
| T&R | Training and Readiness |
| USA | United States Army (U.S. Army) |
| USMC | United States Marine Corps (U.S. Marine Corps) |

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# I. INTRODUCTION

*Expeditionary Force 21 (EF 21)*, the Marine Corps' Capstone Concept, provides guidance for how the Marine Corps Total Force will be postured, organized, trained, and equipped to fulfill assigned public law and national policy responsibilities (United States Marine Corps [U.S. Marine Corps], 2014, p. 4). It describes a future operating environment "characterized by volatility, instability and complexity," noting "the majority of these challenges and opportunities will be in the congested and diverse areas where the sea and land merge—the littorals" (p. 9). In recognition of this, the concept notes that the Marine Corps must enhance its "ability to operate in an increasingly complex environment characterized by the growth of social media, availability of information technology, importance of signature management, challenges to electromagnetic spectrum (EMS) access, and the globalization of cyberspace capabilities" (p. 13).

To help confront these challenges, the *Marine Corps Intelligence, Surveillance, and Reconnaissance-Enterprise's (MCISRE) Roadmap*, and the *MCISRE Plan 2015–2020*, set goals for the future of the Marine Corps Intelligence Community. The documents outline the need to professionalize the intelligence workforce and institutionalize predictive analysis, and set forward a path to doing so. Specifically noted in *EF 21*, is the idea of Advanced Intelligence Analysis, which recognizes that "decision advantage in combat is a function of rapidly acquiring high-value information, performing quick and accurate analysis, and achieving immediate dissemination in the language of operations to generate speed in decision, higher-tempo operations, and combat effectiveness" (p. 39).

One such field of study that is undoubtedly necessary for the threats predicted in *EF 21* and is commensurate with the goals of the MCISRE, is social network analysis (SNA). Perhaps the key feature of SNA is that it is grounded in empirical data and it potentially has predictive qualities—or, at the very least, offers a method to explain social phenomena. The rigorous and empirical methodology makes it an excellent tool for military intelligence personnel—when done correctly, SNA may be useful in predictive

analysis and may reveal several facets about an organization that are not otherwise observable. There are at least three reasons why SNA should be adopted and implemented by the Marine Corps intelligence community. First, its descriptive and explanatory tools are a necessary step in the *MCISRE Road Map*, particularly as it relates to professionalization and predictive analysis. Second, current intelligence doctrine is sorely lacking empirical rigor. Third, SNA is applicable to the range of military operations (ROMO), and can inform operations, planning, targeting, information operations, and more.

Presently, SNA theories and techniques are rapidly being explored within the civilian sector, but their usage by the Marine Corps intelligence community remains unrealized. While some software programs facilitate SNA, the use of such tools does not translate into effectiveness or proficiency. Rather, it requires education and training to produce Marines capable of understanding what SNA is, what its capabilities and limitations are, and how to apply its methods within their analyses.

## A. PURPOSE OF RESEARCH

Ultimately, the goal of this research is to determine the current level of SNA knowledge within the MCISRE, and bring forth recommendations to bridge the gap between current SNA knowledge and that proposed by the *MCISRE Roadmap***,** *MCISRE Plan 2015–2020*, and the advanced intelligence analysis framework proposed in *EF 21***.**

## B. METHODOLOGY

This study uses a mixed-method, quantitative and qualitative approach, to fulfill the purpose of this research. A survey provides a means to determine SNA knowledge within the MCISRE, and it allows for both quantitative and qualitative feedback. Augmenting survey data are in-person interviews, which help explain causal factors in the survey results. In-person interviews also serve as a primary means of gathering information to make recommendations for how to improve SNA knowledge. Additionally, outside surveys and interviews, analysis of current military doctrine and training documents provide additional support in explaining survey results and formulating recommendations.

### 1. Quantitative Approach

A survey provides a quantitative means to evaluate current SNA knowledge within the MCISRE. This research focuses specifically on active-duty intelligence personnel of the rank of corporal (E-4) and above. The decision to keep the survey population at corporal and above is primarily to avoid skewing results. That is, if one were to include all active duty intelligence military occupational specialties (MOSs), to include those in intelligence training, there are over 6500 intelligence Marines. Of that 6500, a significant number of certain MOSs are skewed heavily to the rank of lance corporal (E-3) and below. Furthermore, those of the rank of lance corporal and below are typically recent graduates of formal intelligence training where SNA is not currently included within the Training and Readiness (T&R) Manual, and hence not formally taught. Above the rank of lance corporal, a typical intelligence Marine is more likely to have received additional training and/or have deployment experience, and thus is more likely to have been exposed to SNA. As such, the target population of the survey represents those ranks that are most likely to have been exposed to SNA through deployment, additional intelligence training, formal education, or all three.

The survey was created using the Naval Postgraduate School (NPS) approved LimeSurvey tool and consisted of 24 questions broken into three categories, consisting of multiple choice, Yes/No, and open response questions. The first category consisted of three questions, and elicited basic demographic information regarding the subject's rank, number of years in the intelligence community, and additional intelligence training received beyond initial entry-level intelligence training. The second category consisted of eight questions and elicited the subject to evaluate their perceived knowledge of SNA, and, if applicable, their use of it. The third category consisted of 12 questions that evaluated the subject's knowledge of SNA by asking a number of specific SNA related questions. These questions were based on material culled from NPS course work and other published material. The final question on the survey asked the subject to indicate if they were open to be contacted by the researcher.

The survey questions are available in Appendix A; a summary of survey results is available in Appendix B.

### 2. Qualitative Approach

The qualitative approach consisted of a series of semi-structured interviews with a wide range of personnel, with either specific knowledge in Marine Corps Training and Education, Intelligence, SNA, or some combination. Participants ranged from professors at academic institutions, to Marines currently serving in intelligence billets, to doctrine advocates and writers, and many more. Overall, the participants represented a range of subject matter expertise in their field and their perspectives were unique.

These interviews helped augment the survey by allowing the researcher to gather first-hand information regarding the knowledge level and capabilities of Marines in SNA. It also allowed for the development of issues, ideas, discussion, and recommendations for improving SNA within the MCISRE. In all, over three dozen personnel were interviewed. The interviews provided the researcher a wealth of ideas, perspectives, and knowledge that have influenced the writing of this research. Indeed, while the researcher is the one actually writing the recommendations, many are the collective input gleaned through hours of interviews.

An interview question guide and discussion of how interview subjects were chosen is available in Appendix C.

## C. CHAPTER REVIEW

To accomplish the purpose of this research, this document is as follows:

- Chapter II introduces what SNA is and the core assumptions and mathematical and social theory concepts integrated into it. Though not meant to be an in-depth examination of SNA, it should provide the reader with a framework of what SNA is, and such knowledge will prove useful in subsequent chapters.

- Chapter III argues why SNA is important to the intelligence field and discusses its representation in current and emerging (draft) doctrine. In wake of this discussion, the chapter also summarizes the results from the aforementioned survey, which serves to highlight current SNA knowledge in the MCISRE.

- Chapter IV examines causal factors and offer explanations for the survey's results using the Doctrine, Organization, Training, materiel, Leadership/Education, and Facilities (DOTmLPF) framework and offers recommendations for how to fix those deficiencies and build an SNA capability.

- Chapter V discusses those recommendations from Chapter IV that require additional research, and finally, a summary of the study is offered.

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# II. WHAT IS SNA?

This chapter introduces SNA by broadly covering some of the basic components that make up modern SNA. The review supplies a firm understanding of the breadth and depth of SNA, which can be applied to later chapters. As such, the chapter will briefly discuss the origins of SNA and offer a working definition before diving into key concepts and ideas, such as node-and network-level measures, and social theory. The chapter will also briefly cover future developments in SNA and offer a warning to those who seek to use SNA without fully understanding the results it provides.

## A. DEFINITION AND CRITICAL SNA ASSUMPTIONS

SNA is a collection of theories and methods with empirical underpinnings that has been refined over decades and continues to develop. Its origins are found in Gestalt theory, Field theory, Graph theory, and structural-functional anthropology, as well as statistical and probability theory, and algebraic models (Scott, 2000; Wasserman & Faust, 1994). Indeed, the field of SNA is interdisciplinary, with many new fields finding practical uses for its methods.

Perhaps the simplest way to explain the concept is to describe a *network*, and a *social network*. While the term "network" can be rather nebulous depending on context, within the framework of SNA, "networks are a way of thinking about social systems that focus our attention on the relationships among the entities that make up the system, which we will call actors or nodes" (Borgatti, Everett, & Johnson, 2013, pp. 1–2). It follows that a "social network" is "a finite set or sets of actors and the relation or relations defined on them" (Wasserman & Faust, 1994, p. 20), with the presence of relational information being the defining feature. What makes something a social network is that there is a relationship between actors or nodes; the word "social" implies relationship, not necessarily just people. In fact, the nodes or actors could be just about anything, such as organizations, countries, computers, and much more. In general, within SNA, all nodes are similar objects, and thus people are compared to people, organizations to organizations, etc., and not a combination of different objects.

The focus in SNA is on a node's location in a network and the relationships that node has with other nodes around it. In other words, "a generic hypothesis of network theory is that an actor's position in a network determines in part the constraints and opportunities that he or she will encounter, and therefore identifying position is important for predicting actor outcomes such as performance, behavior or beliefs" (Borgatti et al., 2013, p. 1). Additionally, since the behavior of a node or actor is related to position in a network, and their ties to others in a network, SNA can be defined as "detecting and interpreting patterns of social ties among actors" (Everton, 2012, p. 9).

In order to detect and interpret these social ties, SNA operates under a number of assumptions. Some common ones are:

- Actors and their related actions are interdependent, rather than independent, with other actors.
- Ties between actors are conduits for the transfer or flow of various types of material and/or nonmaterial goods or resources.
- Social structures are seen in terms of enduring patterns of ties between actors.
- Repeated interactions between actors give rise to social formations that take on a life of their own, follow their own logic, and cannot be reduced to their constituent parts even though they remain dependent on those parts.
- An actor's position in the social structure impacts its beliefs, norms, and observed behavior.
- Social networks are dynamic entities that change as actors, subgroups, and ties between actors enter, form, leave, or are removed from the network (Everton, 2012, p. 14).

SNA is an interdisciplinary endeavor, and Figure 1 highlights two critical components of SNA, mathematics and social theory. The two together form a synergistic whole. That is, math provides terminology to denote and label network structural properties, it provides a means to quantify and measure these properties, and it allows one to deduce testable statements (Wasserman & Faust, 1994). Therefore, when combined

with various social theories, it offers a hypothesis to explain behavior and potentially make informed predictions.

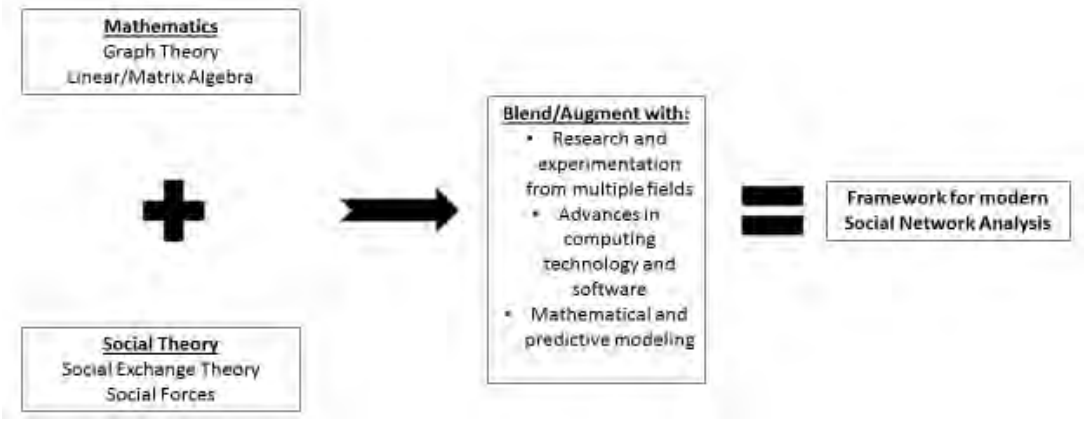


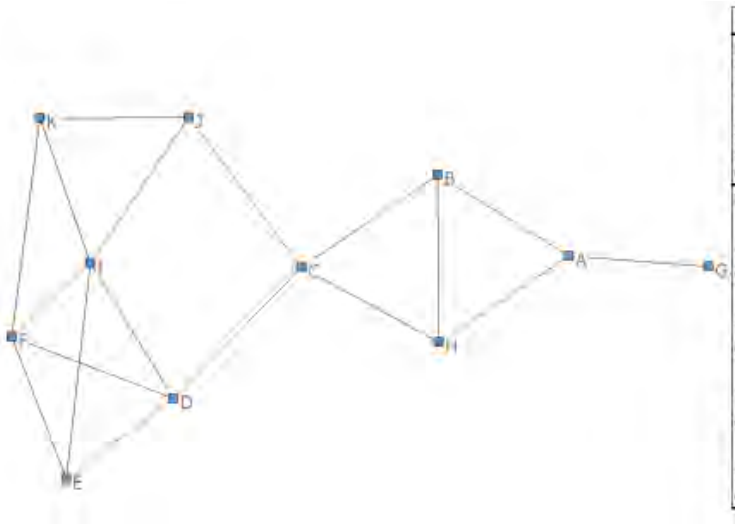

Figure 1. Components of modern SNA.

## B. CRITICAL COMPONENTS OF SNA

What follows is an outline of some of the key mathematical and social components that are integral to modern SNA. As different texts and authors use slightly different terms, multiple terms will be listed initially. As new terms are introduced, they will be in bold print to help distinguish them.

Before going into the mathematical basis of SNA, it should be mentioned that the outputs from SNA calculations can be numeric metrics and/or visualizations of a network. Visualization of a network relies on mathematical techniques that give meaning to the distances between actors in a social network. In other words, a visualization of a network represents social space between actors, not geographic space, thus providing meaning when an actor or actors are close to or far away from another actor or actors (Everton, 2012). The obvious advantages to visualizations are that they allow one to quickly see network structure and deduce characterizations about a network. However, with larger networks, visualizations may be more difficult to interpret. Typically, a combination of a visualization and numeric metrics is best.

Figure 2 demonstrates a few different ways to display a social network visually and through metrics.




| Common SNA Measurements | | |
|---|---|---|
| **Network Level** | | **Score** |
| Density | | 0.327 |
| Diameter | | 5 |
| Degree Centralization | | 0.211 |
| Betweeness Centralization | | 0.439 |
| Closeness Centralization | | 0.323 |
| **Node Level** | **Node** | **Score** |
| Highest Degree Centrality | I | 5 |
| Highest Closeness Centrality | C | 58.83 |
| Highest Betweeness Centrality | C | 54.44 |
| Highest Eigenvector Centrality | I | 68.9 |

Figure 2. Display of a network graphically and through common measurements.

## 1. Mathematical Basis of SNA

What is represented within an SNA visualization is called a **graph**, which represents a network. The component parts of a graph are a set of **vertices**, also called **nodes**, **points**, or **actors**, and a set of **edges**, also known as **links**, **lines**, or **ties**. Within SNA, the point of emphasis is the type of relationship, expressed by links between sets of vertices. That relationship is called a **dyadic** attribute and could represent a number of relations, such as kinship (father of, brother of), distance (number of kilometers between), affective (likes, respects), etc. (McCulloh, Armstrong, & Johnson, 2013). The types of ties between nodes can be directed or undirected. Within an **undirected** graph, the ties between nodes are reciprocated. Within a **directed** graph, the ties point from one node to another node. The sequence by which one gets from one node on a graph to another, without revisiting, is known as a **path**. The shortest path between two nodes is called a **geodesic**. The ties between nodes can have a value associated with them—for instance, ties can be weighted to express strength, frequency, or some other relationship between two nodes.

As noted in Figure 1, the basis of SNA is mathematics. As such, a social network can be represented by **matrices,** which can be **symmetrical**, meaning the network is undirected. A matrix may also be **asymmetric**, meaning that a network is directed. Often, what will determine the symmetry of a network or matrix is the type of data collected and the question being asked. For example, a kinship network that captures the links between family members is reciprocal, whereas an employment network may be directed, as it may ask, "Who works for whom?"

As discussed so far, a matrix has the same number of rows as columns, which means that the actors that make up the rows are the same actors that make up the columns—commonly called an **adjacency matrix**. However, this does not always have to be the case. The **mode** of a matrix defines the number of actors or entities present. Thus, the previous examples were **single-mode** networks as there was only one type of actor or entity present. However, in basic SNA, **two-mode** networks are also common. In this case, the rows of a matrix represent one entity and the columns represent another entity. For example, a matrix could be constructed where a group of people represents the rows, and a list of events they attended represents the columns.

Networks that are larger than single-mode are also known as **multimode** or **meta-networks**. In SNA, most meaningful calculations require single-mode matrices, that is, the comparison of like entities. Fortunately, some SNA software allows for the extraction of social networks, that is, like entities, from broader meta-networks, which then allows meaningful calculations to occur. For example, a meta-network may contain a series of actors, events, and other entities, such as vehicles. Through matrix algebra, it is possible to relate actors to each other through connection to events and/or vehicles. Thus, a multimode matrix can be reduced to a single-mode matrix, allowing for further calculation of meaningful metrics. Figure 3 displays an adjacency matrix and the network it produces.

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| B | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 |
| C | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| D | 0 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| E | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 0 |
| F | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 |
| G | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| H | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| I | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| J | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| K | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 |

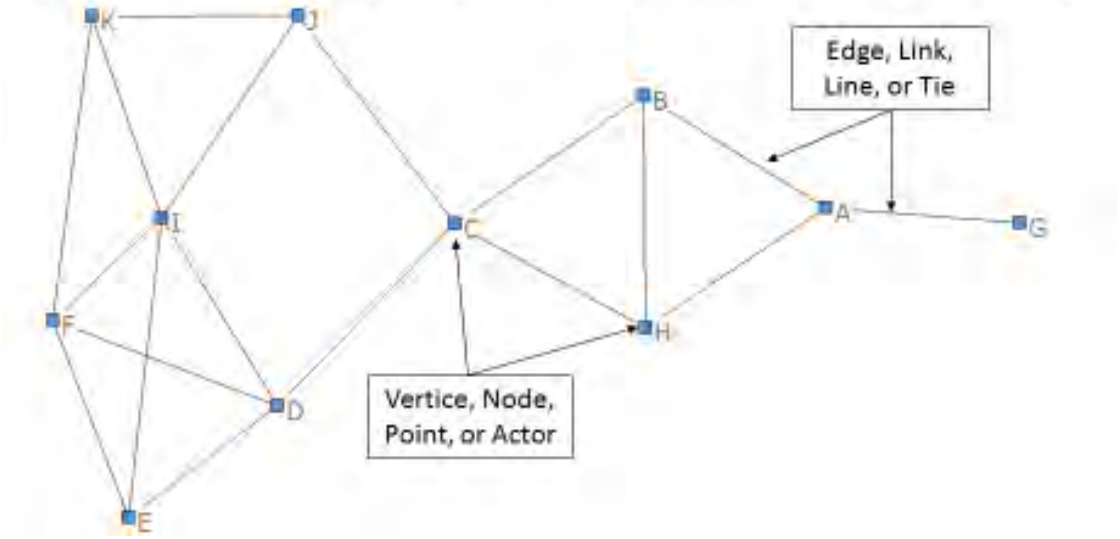



Figure 3. An adjacency matrix and its equivalent network.

## 2. Node-Level Measures

SNA primarily deals with two levels of analysis, node-level and network-or graph-level. **Node-level** analysis examines nodes within the structure of a network to determine a particular node's importance relative to other nodes. A key concept in node-level analysis is the idea of centrality, which is affected by a node's location in a network. Broadly, **centrality** is a measure of node's structural importance or contribution to a network (Borgatti et al., 2013). There are hundreds of different types of centrality that measure a node's importance in a variety of ways, however, there are four commonly used measures: degree centrality, closeness centrality, betweeness centrality, and eigenvector centrality.

**Degree centrality** is simply a measure of how many ties a node has—in other words, a count or sum of the number of links into a particular node. **Closeness centrality**

is a measure of how close a node is to all other nodes within a network in terms of geodesic distance. A node with high closeness centrality is usually in a position to hasten the flow of information through a network because it is close to a high number of other nodes. Conversely, an actor with low closeness centrality may be either disconnected or on the periphery of a network. **Betweeness centrality** is a measure of how much a node lies on the shortest path between all other nodes. Betweeness can be interpreted to mean a node's potential for controlling flow through a network—that is, it denotes a gatekeeping or brokerage role, which means such a node could control or distort information flow (Borgatti et al., 2013). **Eigenvector centrality** is a measure of how well a node is connected to other well-connected nodes. An interpretation of eigenvector centrality is that nodes with high scores are connected to influential nodes with lots of connections—expressing the idea of, "It's not what you know but who you know."

The various measures of centrality may indicate different things in different contexts. For example, while an actor with high degree centrality may appear to be very popular and well-connected, that actor may also experience a high level of constraint (to be discussed later) because of the obligation to reciprocate, and thus may be less productive than another actor with a lower degree centrality score. Therefore, it is imperative to have an idea of not only the meaning of a centrality score, but also what it may mean in a given context.

As noted, SNA emphasizes a node's placement in the overall network structure, but it also recognizes that individual nodes may have unique nonrelational characteristics. These nonrelational characteristics of individual nodes are called **attributes**, and can represent things such as gender, race, ethnicity, age, or years of education (Everton, 2012). Noting the attributes of nodes can be useful in development and identification of subgroups.

A final node-level concept worth mentioning is equivalence, which implies some type of interchangeability, sameness, or equal value between entities. Perhaps the simplest form of equivalence is **structural equivalence**, which exists when two nodes are connected to exactly the same nodes. Put another way, structurally equivalent actors have exactly the same relationships to all other actors—i.e., "identical ties to and from

identical other actors" (Everton, 2012; Wasserman & Faust, 1995, p. 468). This definition of equivalence is its most basic and strict form, and nodes that follow this strict definition will have the same centrality and other node-level measurement scores.

Other measures of equivalence exist as well, such as automorphic equivalence and regular equivalence, that are not as strict in definition, but potentially just as useful. Broadly, **automorphic equivalence** means that two actors are structurally similar if they occupy indistinguishable positions in a network. For example, squad leaders in a military unit would be considered automorphically equivalent if they were in charge of the same number of Marines (although not necessarily the same Marines) and were supervised by the same number of people (although not necessarily the same people) in identical structural positions (Everton, 2012). With **regular equivalence**, "actors do not need to have identical ties to identical other actors nor do they occupy indistinguishable positions in a network" (Everton, 2012, p. 292). In other words, actors must have identical ties to and from regularly equivalent actors, where regularly equivalent actors do not have to be connected to the same actors, but must be connected to actors in the same classes (Everton, 2012). This concept should be familiar to those in the Marine Corps, considering that different MOSs have similarly placed Marines in different units, who do similar functions, and are evaluated by similar people. Indeed, much of the Marine Corps' personnel evaluation system is based on the concept of equivalence.

Equivalence is relatively straightforward in a hierarchical organization such as the military, where redundancies are expected and necessary. In non-hierarchical and dispersed organizations, equivalence may be rarer and identifying it has implications that affect how to confront such a network. For example, if two actors are structurally equivalent, the removal of one actor does not completely sever a connection between disparate groups of actors, because another actor exists with the same contacts and relationships. The key point is that while various forms of equivalence have different meaning, all of them may be useful in identifying larger network structure and subgroups or subnetworks (to be discussed later).

## 3. Network-Level Measures

Moving beyond node-level measures, the level known as **graph**-or **network-level measures** examines the network as a whole. Network-level measures are important because they characterize the entire network, as opposed to just the individual nodes within it. In other words, while node-level analysis may determine the relative importance of a node compared to other nodes within a network, network-level measures can inform a strategy for affecting the entire network.

A method to measure how well all the nodes of a network are connected is called density. **Density** is a measure of the number of ties present in a network compared to the maximum possible number of ties, which is found via n-1, where n represents the number of nodes in a network. The densities of larger networks, however, are typically less than those of smaller networks. As a result, the **average degree** of a network is calculated instead, which allows for a normalized comparison between different networks. Density by itself may uninformative, however, unless it is compared to other networks, and its meaning is often dependent on the type of network under observation and the context.

**Diameter** is a measure of how much time or effort is required for information to flow from one end of a network to another (McCulloh et al., 2013). Specifically, the diameter of a network is the longest geodesic—i.e., the longest shortest path from one end of a network to the other. Much like density, diameter itself may lack meaning without context or comparison to another network. In general, given two networks, the network with a longer diameter indicates that it is more dispersed, implying that information would take longer to flow through it.

The relative dominance of a single node over other nodes in a network is known as **centralization**. It asks the question, “Does there exist a node in the network that is significantly more central than other nodes?” The values will fall between “0” and “1,” with “0” indicating no nodes dominate, to “1,” meaning that a single node exceeds all others. The concept of centralization is applied to the previously mentioned measures of centrality—degree, closeness, betweeness, and eigenvector. For example, a **degree centralization** score of “1” means that one node is connected to all other nodes and a

score of “0” means that all nodes have the same degree centrality score. Degree centralization relates to the concept of fragmentation, that is, higher degree centralization networks are more prone to fragmenting, because the removal of just a single node or nodes can severely disconnect the entire network. **Betweeness centralization** indicates the presence or absence of a gatekeeper node—a score of “1” means that a single node controls access to all other nodes. **Closeness centralization** indicates the similarity of closeness and indicates whether a single node is closer than others. **Eigenvector Centralization** indicates if a single node is connected to highly connected nodes, or if all nodes are more or less connected to equally connected nodes. In general, but not always, networks with high degree centralization scores often have high betweeness, closeness, and eigenvector centralization scores as well (Everton, 2012). The averages of these centralities can also be calculated, which may provide useful information when comparing different networks (McCulloh et al., 2013).

Another important concept when looking at network-level measures is the idea of network topology or topography. The **topology** of a network is the structure of the network as a whole that can help in identifying characteristics of a network (McCulloh et al., 2013). Different texts go into differing levels of detail, for example, McCulloh, notes six different types of pure network topologies: Lattice, Small world, Random, Core-periphery, Scale free, and Cellular to include common characteristics of each (2013, p. 78). By contrast, Everton, uses the term **topography** to refer to network-level measures and examines overall network structure through a combination of density and centralization. That is, the provincial-cosmopolitan dimension looks at a sliding scale of network densities, with very sparse networks (cosmopolitan) on one end, and very dense networks (provincial) on the other. The hierarchical-heterarchical dimension denotes a sliding scale of centralization, with highly centralized networks (hierarchical) on one end, and highly decentralized networks (heterarchical) on another. The two dimensions of a network are meant to be analyzed together, meaning that network structure can be any combination of the two dimensions (Everton, 2012).

## 4. Social Theory

The vocabulary offered by mathematics is augmented by social theory, which can construe meaning and interpretation of the values calculated. It is beyond the scope of this thesis to go into the decades of research on individuals and groups. That being said, some of the key social theory concepts that underlie basic SNA are concepts of self, self-worth, need for acceptance/social group, individual cognitive load in maintenance of relationships, utility of relationships, social capital, and social exchange theory (McCulloh et al., 2013). Of particular interest to SNA are social forces that forge a link between actors: homophily, reciprocity, proximity, prestige, transitivity, and balance. **Homophily** is the idea that individuals form relationships with those like themselves—"Birds of a feather flock together" (McCulloh et al., 2013). **Reciprocity** is the concept that individuals form relationships with people who initiate relationships with them (McCulloh et al., 2013). **Proximity** is simply the organizational or physical distance between nodes—the key idea being that close proximate individuals form groups and social norms become established (McCulloh et al., 2013). **Prestige**, broadly, is the influence an actor holds over other actors or how valuable an actor is perceived to be by other actors. Typically, individuals with high prestige have access to resources, and may have a significant number of ties (McCulloh et al., 2013; Everton, 2012). **Transitivity** means that if A has a tie to B, and B has a tie to C, then there is a tendency for A to form a tie with C as well. Transitivity is based on homophily, proximity, and brokered social relations from a common acquaintance (McCulloh et al., 2013). **Balance** is related to the idea of positive and negative affinity and cognitive dissonance. In other words, if two nodes have the same affinity for another node, there is balance; if the two nodes have differing affinity to another node, there is cognitive dissonance. Another way to think of balance is the idea that "The enemy of my enemy is my friend" (McCulloh et al., 2013).

## 5. Additional Areas of Interest

As "SNA provides context to the social dynamics of how people form relationships" (McCulloh et al., 2013, p. 109), there are a few additional topics that are both important and insightful. One such topic is the idea of structural holes, a concept

forwarded by Ronald Burt in his 1992 paper, *The Social Structure of Competition*. The idea is that nonredundant contacts are connected by a **structural hole**—that is, a relationship between two nodes with no other path available. An important concept in ensuring structural holes exist is cohesion. **Cohesion** exists if a strong relationship between the two nodes exists, as it likely implies a high level of familiarity, and thus a likelihood, but not a certainty, that there are redundant ties with others in the same network. The concept of **constraint** is closely aligned with structural holes because redundant ties to a network require maintenance, whereas nonredundant ties may offer better brokerage opportunities to multiple different networks (Everton, 2012).

The key concept from structural holes is that in a competitive environment, one should seek to be a structural hole. That is, one should seek to be in a position connecting two or more disparate networks because of the benefits of being connected to diverse networks, and the information that can be gleaned from them. Related to structural holes is the idea of **social capital**, or "the ability of an actor to connect to others in a network and provide access to knowledge and resources through their social connections" (McCulloh et al., 2013, p. 121). However, if an actor leverages him or herself between two networks and actively seeks to be the sole broker, members of the group may view this negatively, and actively seek to form redundant links to reduce dependence on the single broker (McCulloh et al., 2013).

Another important concept is **subgroups** or **subnetworks**, which are "portions of the network in which actors interact more with each other than they do with actors who are not in a group" (Borgatti et al., 2013, p. 205). There are a number of classes of subgroups, such as components, factions, cores, and Newman groups, as well as methods for teasing them out of a network (Everton, 2012). Subgroup analysis is important because while network structure may not predict behavior directly, it does predict similarity in behavior and attitude (Burt, 1992), which means that attitudes and behavior of a particular subgroup may be different from that of other subgroups, and the network as a whole. Therefore, if one wants to understand a network, one must identify subgroups as well.

The concept of structure, where a node sits in overall network structure, and subgroups, segues neatly into the idea of bridges and cutpoints. **Bridges** are simply ties that connect different subgroups of a network. Since ties represent flow through a network, their maintenance or elimination is important. Different SNA software programs and texts use different terms, but the nodes that sit on either end of a bridge are known as **cutpoints**—removing that node disconnects the network or disconnects a subgroup from a network (Everton, 2012).

As noted by Everton, many networks are simply too well connected to be severed by a single cutpoint (2012). Fortunately, algorithms exist that can identify optimal sets of nodes that either completely disconnect a network, or fragment a network such that it makes flow through it more difficult (Everton, 2012). Different texts and SNA software programs use different terminology to denote this algorithm, and some are more capable than others. One such set of algorithms is the Key Player algorithm, developed by Borgatti, which can identify the set of nodes whose removal most fragments a network, but also which actors are most optimally positioned to optimize flow through a network (Borgatti, 2006).

Figure 4 demonstrates some of the previously discussed concepts. Note that the two large circles encapsulate two potential subgroups of the larger network. Notice that node C acts as a cutpoint between the two subgroups, its elimination would sever the network into two parts. Finally, notice that nodes B and H are structurally equivalent because they are connected to the same exact nodes, which means if either B or H were eliminated, there would still a path to nodes A, C, and G.

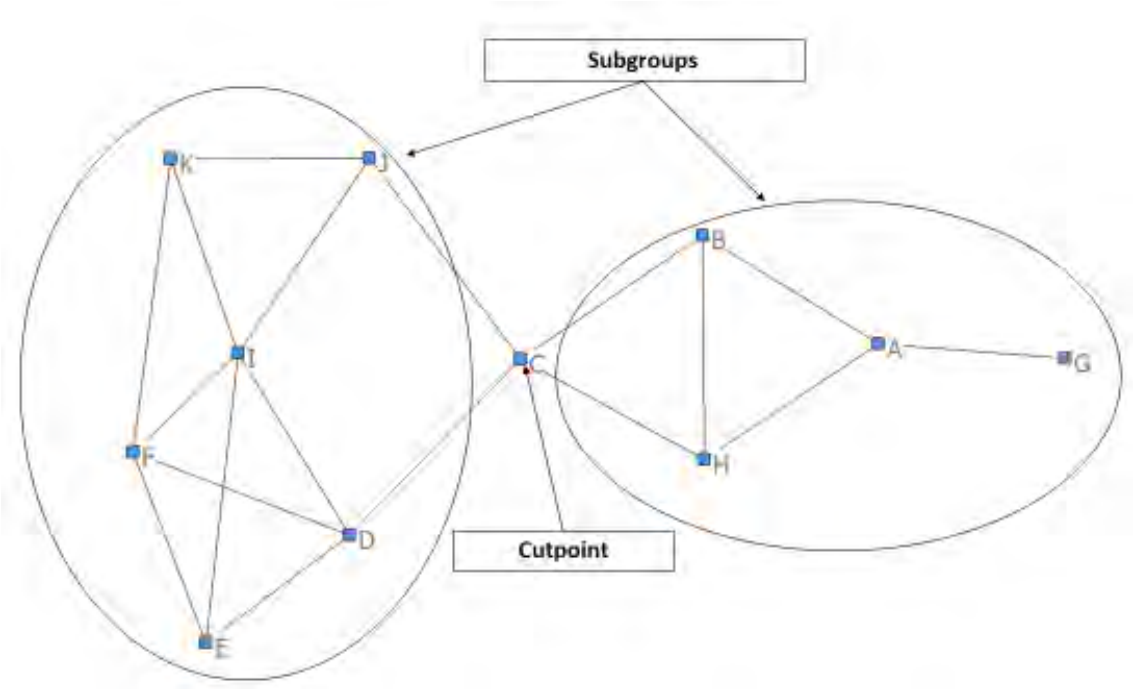



Figure 4. Notice the potential subgroups and cutpoint. Also note that nodes B and H are structurally equivalent.

## C. FUTURE ADVANCES AND A WARNING

To date, much of SNA has been done forensically, or after the fact. This makes sense, given that the domain of SNA has typically been formal research that requires careful data collection, and takes significant time to ferret out hypotheses. Thus, while these studies have helped advance the field, it makes its suitability for use in a dynamic environment more difficult to discern. That is, a network is always changing as new ties form and old ones dissolve as actors enter and leave a network—this longitudinal data can be difficult to collect and analyze (Everton, 2012). That is not to say that the SNA measures listed previously cannot be used; in fact, they are just as important, but rather traditional SNA has few developed measures for modeling changes over time. Fortunately, advances in computing technology allow for more robust modeling techniques and algorithms that can more accurately predict such things as future network structure and geographic location, to name a couple (Everton, 2012). Encouragingly, most of this new software is readily available and continues to be improved upon.

Regardless of advances in SNA, and the promise of methods previously developed, it must be understood that what results is not panacea. Rather, it is subject to multiple sources of error, to include: poor data collection, inappropriate algorithms or metrics for a given situation or question, and misinterpretation of results. This is not to imply that SNA software itself cannot be in error, but rather that it is the human user who is most prone. SNA software tools calculate the measure that is asked, the output is simply that—it is on the human to be able to interpret what it may mean in a given circumstance. To that end, it is critical not to confuse the inherent benefits that the empirical methods of SNA enable with fool proof results—educated users are the key.

## D. CONCLUSION

This chapter has covered the basics of what SNA is by offering a definition, the inherent assumptions behind SNA, and some of the important mathematical and social theory elements. This chapter also briefly covered future developments in SNA and the importance of understanding what the results from SNA mean. At this point, it is now possible to argue why SNA is important to military intelligence, discuss its representation in current and emerging military doctrine, and review survey data revealing the current SNA knowledge level within the MCISRE.

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# III. THE IMPORTANCE OF SNA, ITS PRESENCE IN DOCTRINE, AND SNA KNOWLEDGE WITHIN THE MCISRE

With a framework in place describing SNA, the next step is to evaluate its importance to the MCISRE, its standing in current and draft doctrine, and SNA knowledge within the MCISRE. The chapter argues why competence in SNA is important for the MCISRE. Second, it reviews current doctrine and briefly examines the role of SNA within emerging doctrine, and finally, it offers a summary of results from an SNA survey sent to the Marine Corps intelligence community. By examining these three areas, causal factors and potential reasons for the results—recommended corrective actions are identified.

## A. THE IMPORTANCE OF SNA TO MILITARY INTELLIGENCE

As noted in the first chapter, there are at least three reasons why SNA should be adopted and implemented within the MCISRE. First, it is a necessary step in the *MCISRE Roadmap* because it helps forward the concept of predictive analysis (U.S. Marine Corps, 2010). In addition to the concepts discussed in the previous chapter, SNA also provides a different way of thinking about problems because of its focus on interactions and relationships, as opposed to individual attributes. Second, SNA both raises and potentially answers questions that current doctrine on intelligence cannot, because current intelligence doctrine is subjective and lacks empirical rigor. The third reason is its applicability to a range of problem sets, to include planning, targeting, and information operations, to name a few.

### 1. SNA is a Different Way of Thinking

For the intelligence Marine, SNA provides a different way of thinking about problems that typical intelligence methods do not address. Perhaps the primary reason for this is that traditional techniques tend to focus on an individual actor's attributes. Conversely, SNA focuses on the relationship between actors and an actor's place within a network's structure (Everton, 2012; McCulloh et al., 2013). In other words, most analytic techniques assume the statistical independence of an actor amongst peers, focusing on

attributes such as age, race, and sex—conversely, SNA, assumes dependence on these patterns as important for predicting and understanding behavior (Everton, 2012; McCulloh et al., 2013). The trouble with traditional methods is that they focus information gathering toward a particular person or group of people, which elevates the importance of the group collected on, at the cost of other individuals and groups (Reed, 2006). One consequence is failure to account for the influence and importance of other actors who may play critical roles in how an organization operates.

For the complex and adaptive adversaries warned about in the *MCISRE Roadmap*, such attribute-based approaches could be troublesome. Indeed, hybrid and complex threats are by their very nature adaptive and resilient because they are well connected to resources necessary for sustenance (Reed, 2007). SNA, offers a way to empirically model and describe an organization and its behavior beyond much of the guesswork associated with traditional techniques.

### 2. SNA is not Traditional Intelligence Analysis

SNA provides a different way of thinking in that it places value in the structure and relationships between actors, as opposed to individual attributes. Furthermore, the differences between SNA and more common analytic approaches, such as link analysis, are often confused (Everton, 2012). As noted by Everton, the primary difference is that the mathematical foundations of SNA require a different level of rigor than simple link analysis. That is, while link analysis can be useful for visually displaying a large amount of information, the method itself is highly subjective. A link analysis chart simply communicates results; it is up to the analyst preparing the chart to perform analysis based on what is known and understood at the time—the intelligence function takes place in the mind of the analyst with the chart as a pictorial aid (Sparrow, 1991). Indeed, a link analysis chart is an individual's concept of an organization and subject to an individual analyst's bias; it follows no empirical methods or assumptions. As noted by Richard Heuer in his well-known work, the *Psychology of Intelligence Analysis*, "intelligence analysts do not approach their tasks with empty minds. They start with a set of assumptions about how events normally transpire in the area for which they are

responsible" (1999, p. 5). In other words, link analysis is subject to bias in a way that SNA is not. SNA's results are empirically based and repeatable and not subject to an individual's preconceived notions. The importance is that given the same set of data, the SNA measurements calculated should be the same across all analysts, which provide a means to verify quickly if something is amiss, and a result that can be compared to the output of other forms of analysis as well.

Other intelligence products lack empirical rigor as well. Consider, MCRP 2-3A, *Intelligence Preparation of the Battlespace*, (IPB), the primary doctrinal publication in guiding intelligence support to planning and operations. As noted in the manual:

> Through IPB, the staff aids the commander's understanding of how the enemy, terrain, weather, and civil considerations influence the operational environment and affect operations. IPB also helps the commander understand how to influence, use, or employ these variables to achieve desired conditions and end state. IPB is essential in helping the commander to understand, visualize, and describe the operational environment, make and articulate decisions, and assess military operations. (2014, p. 2–1)

The trouble with the IPB publication is that while it mentions civil and sociological considerations, it does so on broad terms, and does not provide a method or tools for analyzing those considerations. Ultimately, this leaves the intelligence analyst up to his or her own devices on how to approach them. Consider Figure 5 from *MAGTF Network Engagement*, which is an ASCOPE (Areas, Structures, Capabilities, Organizations, People, Events) and PMESII (Political, Military, Economic, Social, Infrastructure, Information) matrix. The figure has various adaptations and is in use in numerous publications, to include MCRP 2-3A. Arguably, while the figure provides a snapshot of major civil and social considerations, it is simply a list. There is no inherent analysis in constructing the matrix and ultimately the consumer of this product is left to form his or her own conclusions regarding its meaning.

| | P Political | M Military/ Security | E Economic | S Social | I Infrastructure | I Information |
|---|---|---|---|---|---|---|
| A Areas | District/ Provincial Boundary | IED/ Ambush sites, Military/ Insurgent bases | Bazaars, Farms, Repair Shops | Picnic Areas, Bazaars, Meeting areas | Irrigation Networks, Medical Services | Radio, Gathering points, Graffiti, Posters |
| S Structures | Shura Halls, Court House | Police Headquarters, Military Bases | Bazaars, Banks, Industrial Areas | Mosques, Wedding Halls | Roads, Bridges, Electrical Lines, Dams | Cell/ Radio/ TV Towers, Print Shops |
| C Capabilities | Dispute Resolution, Judges, Local Leadership | Military Police, Enemy Recruiting Potential | Access to Banks, Development, Black Markets | Traditional Structures, Means of Justice | Ability to build/ Maintain roads, bridges, dams | Literacy Rate, Phone coverage |
| O Organizations | Government Organizations, NGOs | Coalition, HN, and Enemy Forces, NGOs, OGAs | Banks, Land Holders, Economic NGOs | Tribes, Clans, Families | Governmental Ministries, Construction Companies | News Organizations, Mosques |
| P People | Governors, Council Elders, Judges | Coalition, HN, military/ Police Leaders | Bankers, Land Holders, Merchants, Criminals | Civic/ Religious Leaders, Elders, Families | Builders, Contractors, Development Councils | Civic/ Religious Leaders, Family Heads |
| E Events | Elections, meetings, Speeches, trials | Kinetic Events, Military Police Operations | Drought, Harvest, Businesses opening | Weddings, Funerals, Births, Bazaar Days | Road/ Bridges/ School Construction, Well Digging | Festivals, Project Openings |

Figure 5. An example ASCOPE and PMESII matrix (from USMC, 2015, p. 33).

Another publication, the Marine Corps' MCWP 2-3, *MAGTF Intelligence Production and Analysis*, offers its take on sociological issues. The publication, dated from July 2004, offers "Sociological Analysis" (U.S. Marine Corps, 2004, p. 6–29). The publication considers seven sociological factors: population, characteristics of the people, public opinion, education, religion, public welfare, and narcotics and terrorism tolerance. While these are important things to consider, there is no method to analyze and evaluate them—nothing beyond an individual's judgment.

The sociological factors may serve the purpose of helping one gain an understanding and a reference point of the operational environment. While this is important, in many instances, the products mentioned previously are the end and not the beginning of deeper analysis. Consider the following:

> Many who write about terrorists, criminals, and activists observe that one grouping or another is organized as a network. However, the analyst should be able to specify more than simply that. Among other things, assessment at this level should include showing exactly what type of

> network design is being used, whether and how members may act autonomously, where leadership resides and/or is distributed, and whether and how hierarchical dynamics may be mixed in with the network dynamics. (Reed, 2006, p. 256)

Hence, a key motivation for conducting SNA is that it gives the intelligence analyst more to offer the consumer.

Finally, a relatively new form of analysis that SNA may be confused with is social media analysis (SMA). A key consideration for the difference between SNA and SMA is that SMA, for the most part, is the application of traditional analytic techniques on a particular medium. That is, social media is a type of medium that is facilitated by social networking websites. SNA is broader than a singular medium; it can span relationships from the internet and the real world. Phrased differently, SNA can be performed on social media data, or incorporated into SMA, but SMA is not SNA. There is in fact a lot of usefulness for performing SNA on social media, however, for clarity, the term SMA refers to analysis done on a particular medium.

From the standpoint of the MCISRE, current intelligence doctrine provides little in the form of predictive intelligence analysis. Certainly, doctrine brings up important points and considerations, however, it is very much dependent on the individual analyst and does not have the repeatable and empirical background of SNA.

### 3. Other Potential SNA Applications

A final consideration for why SNA is important is its potential usefulness to other applications for which intelligence provides support. The evolution of SNA is decades old and has touched on many different fields and disciplines. It would be unfortunate to simply look at SNA singularly as a tool for intelligence analysis—and further, only as a tool for tactical operations. As noted, SNA is relatively new to the military; however, its potential uses are numerous. Consider Table 1, which is a small sampling of SNA-related research conducted by NPS students on uses of SNA to military problems. The table provides a brief look at SNA's potential usefulness to military problems, highlighting its broad applicability. Indeed, as posited earlier, SNA provides a different way to think about problems that could be greatly beneficial to a wide variety of military consumers.

Table 1. SNA's application to potential military problems.

| Author(s) | Title | Premise |
|---|---|---|
| Brown, Jason C. | Improving nonlethal targeting: a social network analysis method for military planners | Explores how a deception plan against a terrorist network can be informed and prepared using social network analysis methods |
| Erlacher, Matthew D. | Fighting Dark Networks: Using Social Network Analysis to Implement the Special Operations Targeting Process for Direct and Indirect Approaches | Provide a framework to understand and measure changes in social networks to help design an intervention strategy. |
| Giles-Summers, Brandon & Morganthaler, Jeffrey | Targeting Social Network Analysis in Counter IED Operations | Introduce SNA to attack-the-network methodology in order to provide commanders a means to gain perspective on social interactions of networked members |
| Gregory, Leo S. | A social network analysis of the Chinese Communist Party's Politburo | Use SNA to test academic models describing the Politburo's behavior in order to determine which model most closely resembles observed behavior |
| Moore, Dale L. | A Social Network Analysis of the National Materials Competency at Naval Air Systems Command | Using SNA to make recommendations for improved organizational performance |
| Ruth, Lars | Battle Narratives | Uses SNA to analyze narratives from 2008 Presidential Election campaigns. |
| Schuhart, Russell G. | Hacking Social Networks: Examining the viability of using computer network attack against social networks | Presents a possible way to improve SNA performance against covert networks using CNA model |
| Tangeman, Darrin K. | Intelligence collection, targeting and interdiction of dark networks | Uses SNA, among other methods to formulate modes of effectively targeting terrorist threats |

## B. CURRENT AND EMERGING DOCTRINE AND OTHER METHODS

In terms of its entrance into military doctrine, SNA's introduction has been lethargic. Despite its near 100-year existence, SNA did not receive formal introduction until FM 3-24/MCWP 3-33.5, *Counterinsurgency*, in December 2006. Rather, prior and current doctrine, particularly at the Joint-level, emphasized the idea of the "systems perspective." Broadly, the "systems perspective" is a way of viewing the operational environment that seeks to understand the relationships within interrelated PMESII and other systems (Joint Chiefs of Staff (JCS), 2009). A "system" is defined as "a functionally, physically, and/or behaviorally related group of regularly interacting or interdependent elements; that group of elements forming a unified whole" (JCS, 2014, p. 246). Figure 6, taken from JP 2-01.3, is an example of how one may view these interrelated systems. Within this construct, the idea of networks refers specifically to telecommunications, computers, and other command and control systems. In fact, the term network itself is not even defined within the *Depart of Defense Dictionary of Military and Associated Terms*, (JP 1-02).

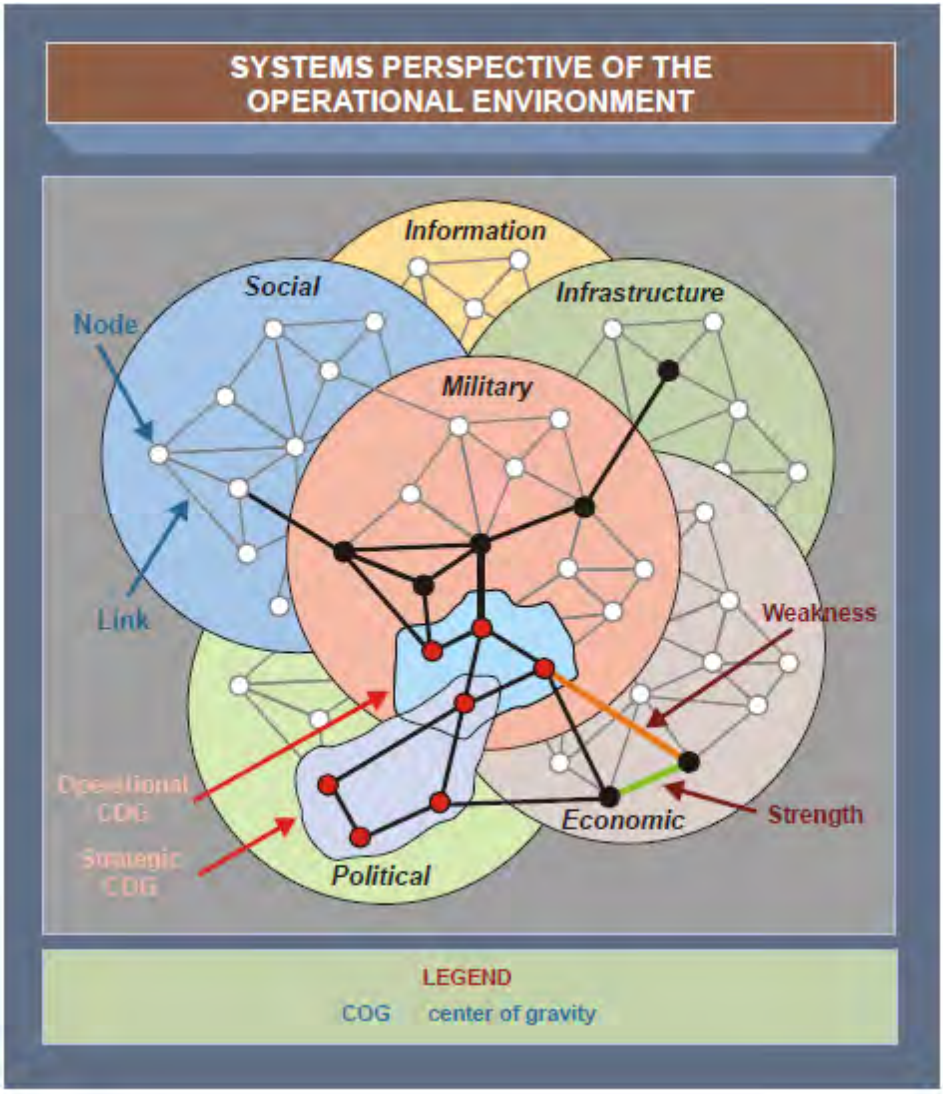


Figure 6. The interrelated systems of the operating environment (from JCS, 2009, p. II–45).

Although there are many similarities between the "systems perspective" and SNA, they are different. The systems approach is a derivative of General Systems Theory, an idea forwarded by Ludwig von Bertalanffy in 1969 (Joint Staff, J-7, 2011, p. II–4). Broadly, the approach is applied within Operational Design and Planning and is qualitative in nature. It deals very broadly with a number of interacting systems in order to help understand what the problem is. SNA is an applied quantitative and qualitative approach with a set of rules and assumptions that is applied when the problem is known.

With this in mind, it is possible to examine SNA within current doctrine. Table 2 lists several prominent and well-known doctrinal publications that, given the applicability of SNA, one would expect to find it mentioned. On closer examination, what is interesting is not the scarcity of SNA references within doctrine, but the lack of a consistent description and definition across it.

Table 2. SNA in prominent doctrine.

| Criteria / Publication | Joint Intelligence Preparation of the Opertional Environment (JP 2-01.3) | Joint Targeting (JP 3-60) | Intelligence Preparation of the Battlespace (MCWP 2-3A) | MAGTF Intelligence Production and Analysis (MCWP 2-3) | Insurgencies and Countering Insurgencies (MCWP 3-33.5) |
|---|---|---|---|---|---|
| Mentions SNA? | | | X | | X |
| Defines SNA? | | | | | X |
| Defines/Describes Terminology? | X | | | | |

First, consider MCRP 2-3A, *Intelligence Preparation of the Battlespace*, which while mentioning SNA, does so without consideration of its meaning. In chapter seven, under the title "Understanding the Population," SNA is mentioned in parentheses, once, as a way to determine how a society functions; however, there is no definition or description about what SNA is, or what is involved. Furthermore, while SNA may provide insight into how a society functions, it is erroneous to equate SNA with such a broad topic.

Next, consider MCWP 3-33.5, *Insurgencies and Countering Insurgencies*, which both defines and discusses SNA. Note, that when the manual was first published in 2006, it included an appendix that discussed SNA, to include some common centrality measures. The publication was revised and updated in May 2014, however, and the subsequent layout was changed considerably. As such, there is no longer an appendix with an SNA subsection. The publication describes SNA in terms of the broader concept of Attack the Network (AtN) operations:

> Attack the network operations require that commanders and staffs understand social networks. A social network analysis is a tool for understanding the organizational dynamics of an insurgency and how best to attack or exploit them. A social network analysis allows analysts to

> identify and portray the details of a network structure. It shows how an insurgency's networked organization behaves and how that connectivity affects its behavior. A social network analysis allows analysts to assess the network's design, how its members may or may not act autonomously, where the leadership resides, how leadership is distributed among members, and how hierarchical dynamics may mix or not mix with network dynamics. (U.S. Marine Corps & U.S. Army, p. 7–13)

This defines SNA as a powerful method for discovering and analyzing the human networks within an area. However, the new version of the publication uses some of the same graphics from the previous edition, but disassociates it entirely from the discussion of SNA. There is also discussion about the network characteristics of insurgencies in chapter four, to include concepts of centrality and topography, as well as other basic SNA terms, but no mention of SNA until chapter seven. Arguably then, the new MCWP 3-33.5 is a step backward from the 2006 edition as far as SNA is concerned. In this case, SNA is obfuscated at the altar of Attack the Network terminology and methodology, leaving the reader with an idea of what SNA is, but ultimately failing to link it to its terminology. Furthermore, like the previous edition and the other publications mentioned, there is no discussion of how one actually does SNA or the processes involved.

Finally, consider JP 2-01.3, *Intelligence Preparation of the Operational Environment*, which interestingly, appears to rename social network analysis as "systems network analysis," to fit its preferred "system" terminology. Indeed, it notes systems network analysis as "facilitating the identification of significant information about a group of entities that may otherwise go unnoticed" (JCS, 2009, p. II–53). In addition, node-level measurements such as degree, closeness, and betweeness centrality, as well as network-level measures such as density and distance (path length) are defined and described. Unfortunately, the publication does not identify a methodology for how one conducts systems network analysis and what is described is absent the mathematical foundations that make up SNA. Rather, systems network analysis is basically a judgment call on the part of the analyst—with the publication noting, "although largely influenced by subjective judgment, the identification of a potential key node may be facilitated through an analysis of node centrality" (2009, p. II–52). This leaves the analyst with a

definition and description of the various centrality measures, but no methodological basis to find it; in other words, the analyst will give it his or her best guess.

## C. OTHER PUBLICATIONS AND METHODS

In addition to the aforementioned publications, there are two additional publications, and one method worth examining. The first is an Army publication, ATP 2-33.4, *Intelligence Analysis*, which outlines and describes a number of analytic techniques for intelligence personnel to use. The publication is classified as "For Official Use Only" (FOUO), so only a very basic aspect of it can be discussed here. The fundamental flaw of its description of SNA is that it disassociates and compartmentalizes critical aspects of SNA and renames them. That is, what could easily be summarized as component parts of SNA are now fragmented and organized into a separate lexicon. This confuses what SNA is, because now two terms, in this case "network analysis" and SNA, describe what a single term and methodology adequately did. Thus, while credit should be given for taking a network approach to intelligence analysis, the tautology potentially creates confusion.

The next publication is MSTP Pamphlet 2-0.1, *Red Cell-Green Cell*, which is produced by the Marine Corps' MAGTF Staff Training Program (MSTP). Broadly, the purpose of the publication is to offer a detailed description of what a Red Cell and Green Cell are and how to implement them within the Marine Corps Planning Process (MCPP). SNA receives discussion in Appendix B as an example of Green Cell Products. Interestingly, the Green Cell's purpose is "to consider the population in order to promote a better understanding of the environment and the problem" (2011, p. Green–2). As such, SNA is then described as "a tool for understanding the organizational dynamics of a given population" (2011, p. Green–29), allowing analysts to show how key influencers are interconnected. While it is certainly laudable that SNA garners mention, simply listing it as a Green Cell product and not also as a Red Cell product is unfortunate. Furthermore, as with the previously noted publications, a methodology for how to conduct SNA and the processes involved are absent.

A final resource worth mentioning is not a publication, but a method, the SMAT. SMAT, or Structured Models, Approaches, and Techniques, is a concept that broadly offers a structured approach to addressing specific intelligence questions. It provides both a theoretical basis and direction for how to create intelligence products. An "SNA SMAT" does not exist; however, it is worth noting that SNA is described as a theoretical basis for some of them. For example, within the "Human Systems Analysis" SMAT, SNA is mentioned prominently. However, mentioning SNA without defining, describing, or discussing its methodology and terminology does not help advocate for its use, but rather ensures its disuse in favor of more familiar, though potentially less useful, approaches.

## D. EMERGING DOCTRINE

As noted, several doctrinal and non-doctrinal publications mention and describe SNA with varying levels of detail. Simply mentioning and describing SNA, however, will do little for a user who does not appreciate what it is. In addition, inconsistencies in its description across doctrine would only seem to confuse the issue further and make its adoption and use far more tenuous. Fortunately, emerging, or draft doctrine, takes a more aggressive stance on network approaches, with SNA advocated as something that needs to be done.

It is important to recognize that emerging doctrine is just that, unapproved and not official at the time of this writing. There are three new publications that greatly advance and make note of network approaches: MCIP 3-40.01, *Marine Air-Ground Task Force Network Engagement*, ATP 5-0.6, *Network Engagement*, and JP 3-25, *Countering Threat Networks*. A critical concept is the idea of 'Network Engagement,' (NE), which consists of

> lethal and non-lethal means to support friendly networks; influence neutral networks; and neutralize threat networks. NE is conducted simultaneously and continuously at multiple levels and requires a broader approach that leverages the capabilities of unified action partners. (Munch & Worret, 2014, p. 3)

The critical objective of which is, “friendly force ability to neutralize enemy/threat network capabilities” (Munch & Worret, 2014, p. 3). Network Engagement is an evolution of the Attack the Network methodology, which according to several interviewees involved in writing these publications, was overly focused on countering improvised explosive device (IED) networks. Indeed, in an interview with members of the Marine Corps’ Small Wars Center, Irregular Warfare Integration Division, there is an effort underway to adopt Network Engagement, as opposed to Attack the Network, because it supports a broader range of operations than Counter-IED. In fact, there is a Doctrine, Organization, Training, materiel, Leadership/Education, Personnel, and Facilities (DOTmLPF) Change Recommendation (DCR) in place to do this.

The major implication of emerging doctrine is that SNA is recognized as a necessary form of analysis if the operational environment is to be understood. Furthermore, military forces will always interact with the populace, regardless of operation, and network approaches are applicable across the range of military operations (ROMO). In addition, MCIP 3-40.01 notes, “there is no doctrinal template that facilitates understanding of human networks or the certainty of their actions” (U.S. Marine Corps, 2014, p. 9), meaning that techniques and methods such as SNA are essential.

In other words, SNA is becoming a requirement, something that commanders will expect from their intelligence personnel. With that in mind, it is worthwhile to assess the current SNA knowledge level within the MCISRE.

## E. SNA KNOWLEDGE OF MARINE CORPS INTELLIGENCE PERSONNEL

One of the purposes of this research was to determine the current level of SNA knowledge within the MCISRE. Table 3 and the remainder of this chapter provide a summary of the results from a survey meant to determine this knowledge. A detailed list of survey questions and results and responses can be found in Appendix A and Appendix B, respectively.

Table 3. Aggregated and abbreviated summary of SNA survey results.

| **Demographics:** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Grade** | E4 & E5 | E6 & E7 | E8 & E9 | O1-O3 | O4-O6 | WO-CWO5 | Other | |
| | 25.00% | 28.85% | 5.77% | 22.75% | 8.98% | 5.44% | 3.21% | |
| **Years in Intelligence** | 1-3 years | 4-6 years | 7-9 years | 10-12 years | 13-15 years | 16-18 years | 19+ years | Other |
| | 22.12% | 20.83% | 19.23% | 12.82% | 7.05% | 8.65% | 8.01% | 1.28% |
| | | | | | | | | |
| **Self-Diagnosed SNA Knowledge:** | | | | | | | | |
| **Not Proficient** | 67.31% | | | | | | | |
| **Some Proficiency** | 22.44% | | | | | | | |
| **Proficient** | 7.69% | | | | | | | |
| **Very Proficient** | 2.56% | | | | | | | |
| | | | | | | | | |
| **SNA Knowledge Assessment:** | | | | | | | | |
| **Response:** | | "I don't know" | Judged Adequate | | Judged Inadequate | | | |
| **Link Analysis vs. SNA (mean values)** | | 66.66% | 4.17% | | 29.17% | | | |
| **SMA vs SNA free response question (mean values)** | | 59.94% | 7.05% | | 33.01% | | | |
| | | | | | | | | |
| | | "I don't know" | Correct | Incorrect | | | | |
| **SMA vs SNA multiple choice question** | | 56.09% | 36.86% | 7.05% | | | | |
| **SNA Terminology (mean values)** | | 67.60% | 17.86% | 14.54% | | | | |
| **Graph Interpretation (mean values)** | | 52.24% | 30.29% | 17.47% | | | | |
| **Matrix Interpretation (mean values)** | | 71.26% | 21.36% | 7.38% | | | | |
| | | | | | | | | |
| **Total Respondents:** | **312** | | | | | | | |

## 1. Demographics

The survey had 312 full-responses, from which Table 3 was constructed, and an additional 156 incomplete responses. All grades that the survey targeted had at least one response, with some groups providing far more responses than others. For example, non-commissioned officers (NCOs) and staff non-commissioned officers (SNCOs) together, accounted for more than 50% of responses, and an additional 22% were company grade officers (O1-O3). Unsurprisingly, more than 60% of respondents had less than 10 years of intelligence experience.

Respondents were asked to list additional intelligence training received outside their entry-level MOS producing course, resulting in a wide range of responses. Responses included: formal Marine Corps intelligence training and education courses, to those offered outside the Marine Corps, to include Geographic and Functional Combatant Command courses and schools, as well as courses from other DOD and non-DOD entities. The wide variety of courses and schools represented is encouraging because it would seem to indicate a well-trained and educated pool of respondents.

### 2. SNA Self-Assessment

After the demographics section, the survey then asked respondents about their perceived knowledge level of SNA. In all, the eight questions spanned from whether respondents had heard the term SNA before, (to which nearly 81% said "Yes"), to its use on deployment, awareness of SNA software programs, and a question asking their rated self-proficiency, as noted in Table 3. In terms of software, while more than 77% answered they did not know particular SNA programs, the written responses ranged from well-known SNA programs such as ORA and UCINET, to more ubiquitous programs with minimal SNA capabilities such as Analyst's Notebook and Palantir. A number of respondents also listed social media exploitation tools, which would appear to indicate confusion between SNA and SMA.

Interestingly, slightly more than 25% of respondents indicated they had received training on SNA, but only about 10% indicated they considered themselves proficient or very proficient in SNA. As noted in Table 3, the vast majority of respondents, nearly 90%, rate their proficiency as non-existent or minimal—indicating a general wariness and self-admitted lack of comfort with the topic of SNA.

### 3. SNA Knowledge Assessment

The final part of the survey asked 12 questions meant to assess a respondent's SNA knowledge. The questions ranged from free response questions, to matching, and multiple-choice options. The questions tested a respondent's ability to differentiate SNA from other forms of analysis, such as link analysis and social media analysis—to matching social theory and SNA measurement terms to their correct definitions, and to interpreting graphs and matrices. Respondents were asked to mark "I don't know" if they did not know the answer, thus, in Table 3, the "Correct" and "Incorrect" categories indicate that a respondent attempted to answer the question and was marked accordingly.

The first question asked respondents "How does social network analysis differ from link analysis?" If a respondent did not know, they were asked to answer, "I don't know" in the response window. In this case, more than 66%, or two-thirds of respondents, admitted to not knowing, with the remainder offering an answer, which

would be judge for adequacy. Due to the subjective nature of the question, three judges evaluated the remaining answers. The judges were, an instructor from NPS's SNA course, the U.S. Army's Training Brain Operations Center's (TBOC) Advanced Network Analysis and Targeting (ANAT) Course, and the author. The mean value of the three judges for the remaining responses resulted in 12.50% of respondents offering an adequate response. This means that for all 312 respondents, only 4.17% could adequately differentiate SNA from link analysis. Appendix B has more detailed information on the judging process, such as criteria, trends, and a breakdown of how judges scored responses.

The next two questions asked about the differences between SMA and SNA. The first one asked respondents, "Is social media analysis the same thing as social network analysis?" with approximately 56% responding, "I don't know", and more than 36% correctly responding that SMA and SNA are different. The second question related to the previous question in that it asked respondents who answered either "Yes" or "No" to explain their rationale. As before, the responses that were not marked "I don't know," were judged for adequacy. Here, the mean value of the three judges, for those attempting to differentiate the two, resulted in 17.60% of respondents adequately differentiating SNA from SMA. This means that for all 312 respondents, 7.05% could adequately differentiate SNA from SMA. Furthermore, what the two questions illustrate is that while more than 36% of respondents correctly knew there was a difference between the two, only about 7% of the total respondents could adequately explain the difference. Judging criteria, trends, and how judges scored responses is available in Appendix B.

The next two questions consisted of matching terms with definitions. In the first question, respondents were asked to match definitions of betweeness, closeness, degree, and eigenvector centrality, and centralization, with its corresponding term. The second question asked respondents to match definitions of balance, homophily, prestige, proximity, reciprocity, and transitivity, with its corresponding term. In both questions, respondents were offered the opportunity to answer, "I don't know" to each question.

The results in Table 3 represent the mean of the responses for the total of 11-sub questions. The two questions have a total of 13 sub-answers, however, two of them are "I

don't know," and are subtracted from 13, bringing the total to 11. Thus, the responses for each sub-question were, "I don't know," the correct answer, or an incorrect response. Then, for Table 3, the percentages of the three possible responses were summed and divided by 11 to reach a mean value. Therefore, the values represented in the table indicate that on average, 67.60% of respondents admitted they did not know the term and definition, 17.86% could match them, and 14.54% could not.

A closer examination of the breakdown of responses by question is available in Appendix B, but it is worth noting a few items here. In general, respondents did worse matching SNA measurements than they did matching terms and definitions with social theory terms. Within the SNA measurements question, the mean percentage of correct answers was only 13.20%, whereas in the social theory questions, the mean percentage of correct answers was 21.74%. There are also indications of guessing as well. On the SNA measurements question, more than 23% identified correctly the definition and term "closeness centrality," whereas the mean correct response for other measurements was 10.58%. A possible explanation is that the word "close," is used in the definition describing closeness centrality. Furthermore, the number of respondents answering "I don't know" was fairly steady throughout the sub-questions, which would indicate that absent the ability to guess an answer, there would be more incorrect responses.

Following the matching questions, the next four questions asked respondents to answer questions based on their interpretation of a graph (network). For the first three questions, respondents used Figure 7 to answer questions. The first question asked respondents to use the figure to find the geodesic length between vertex G and K. Respondents were given a single-answer multiple choice question with answers ranging from 4 to 8, with "I don't know" as an answer choice. The second question asked respondents to use the figure to find which node had the highest degree centrality, with single-answer multiple choice answers listing all the nodes, to include an "I don't know" option. The third question asked respondents to use the graph to determine which node probably had the highest betweeness centrality. As before, the question was a single-answer multiple choice question with each node listed and included an "I don't know" response.

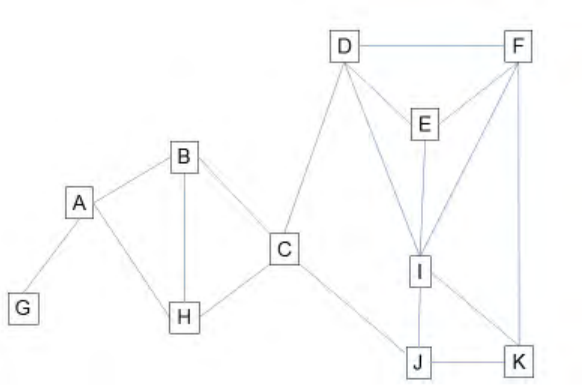


Figure 7. Sample Network 1 from Survey

The fourth question used a slightly different graph, displayed as Figure 8, which asked respondents to select which two nodes exhibited structural equivalence. Here, respondents had the opportunity to select multiple nodes, and also, the opportunity to select "I don't know."

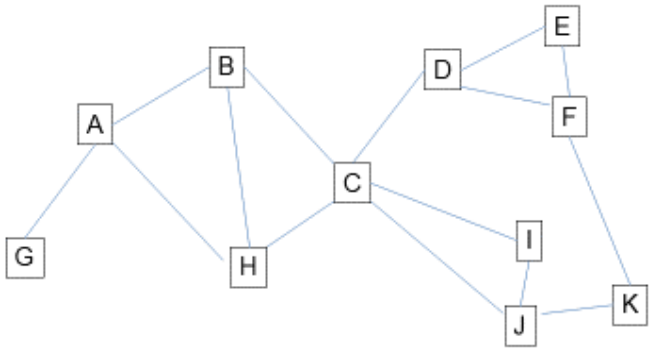


Figure 8. Sample Network 2 from Survey

Table 3 presents the mean value of answers from the four questions. Between the four questions, "I don't know" was selected 52.24% of the time, the correct response was given 30.29% of the time, and the incorrect response was given 17.47% of the time. However, there was variation amongst the questions, that is, respondents generally fared better on the first two questions—finding the length of the geodesic and determining the node with the highest degree centrality. In fact, more than 43% correctly noted the

geodesic length was “5”, and almost 33% answered that node “I” had the highest degree centrality. By the third question, however, regarding betweeness centrality, approximately 25% of respondents answered correctly, and by the fourth question, identifying which nodes exhibited structural equivalence, only 19% answered correctly. The sequential drop in correct answers as the graph questions progressed may indicated guessing, and it is likely the number of incorrect answers and “I don’t know” responses should be higher.

The final three questions asked respondents to interpret two, single-mode matrices. The first was an actor-by-actor matrix; the second was an event-by-event matrix. The questions required respondents to use the appropriate matrix to answer a question—no mathematics or manipulation was required. Respondents were asked to select among single-answer multiple choice answers with an “I don’t know” option available for each question.

Table 3 presents the mean value of answers from the three questions. On average, 71.26% of responses were “I don’t know,” 21.36% were correct, and 7.38% were incorrect. There was variation in the answers among the questions, and the percentage of correct answers dropped from a high of 26.28% on the first question, to 16.67% by the third question. Of note, respondents answered with a higher “I don’t know” rate than previous questions. A possible explanation is that the matrix questions, which may appear significantly harder than they actually are, and they are also the last set of questions of a lengthy survey. Respondents may have simply been fatigued and opted to select “I don’t know.”

### 4. Survey Conclusions

The survey results suggest that the majority of Marine Corps intelligence personnel are not knowledgeable in SNA. Specifically, more than 60% of respondents answered, “I don’t know” to the SNA knowledge assessment questions. Furthermore, the results on Table 3 represent mean values, and the results do not account for guessing either. Thus, it is likely that “I don’t know” and “Incorrect” responses are higher than what is displayed on the table. The results also indicate that some Marines do possess

SNA knowledge, and more importantly however, as will be covered in the next chapter, there are ways to improve SNA knowledge across the MCISRE.

## F. CONCLUSION

This chapter covered a number of important topics, to include why SNA is important to intelligence personnel, as well as SNA's place in current and emerging doctrine. It noted that there are deficiencies in current doctrine with regard to SNA, but that emerging doctrine is emphasizing it to a much greater extent. Finally, the chapter displayed and discussed the results of a survey meant to determine the level of SNA knowledge in the MCISRE. The results show that Marines are not proficient in SNA; however, there are ways to improve.

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# IV. TOWARD A BETTER SNA CAPABILITY WITHIN THE MCISRE

With a review of SNA knowledge within the MCISRE complete, causal factors can be examined and recommendations made to bridge the gap between current SNA knowledge with that proposed for in the *EF 21* and *MCISRE Roadmap*. This chapter examines these factors through the lens of the DOTmLPF pillars and offers recommendations. Using the DOTmLPF pillars ensures that SNA is analyzed systematically and thoroughly, and provides easier incorporation of recommendations.

Before beginning, however, there are two considerations worth mentioning. First, the following discussion and recommendations are independent from the current Network Engagement DOTmLPF Change Recommendation (NE DCR), though there may be some overlap. Thus, while SNA is discussed in Network Engagement doctrine, a more in depth look at SNA, separate from the greater Network Engagement framework, is in order, to ensure that all of its component areas and considerations are adequately covered. This does not suggest that the current NE DCR is inadequate, but rather that the goal of this study is to explore ways to build an SNA capability within the MCISRE and a more detailed look at SNA is required to achieve this goal.

Major section headers are the DOTmLPF pillars. Next, key findings are listed. Finally, recommendations to address the key findings are discussed. A chart at the end of the chapter summarizes key findings, recommendations, and related DOTmLPF areas.

## A. DISCUSSION AND FINDINGS OF DEFICIENCIES

### 1. Doctrine

*"Fundamental principles that guide the employment of U.S. military forces in coordinated action toward a common objective." (JCS, 2012, p. A-4)*

Doctrine is fundamental to the military—it describes how the military fights, and the concepts, principles, policies, and tactics, techniques, and procedures it follows. Doctrine forms the basis of how a military organizes itself, how it trains, and how it equips itself. The deficiencies of current doctrine are described in detail in Chapter III,

with the primary issue being the lack of a consistent description and definition of SNA across it. Indeed, in interviews with personnel from the Marine Corps Special Operations Command (MARSOC) G-2 and the Marine Corps Intelligence Activity (MCIA), it was evident that current lexicon and terminology is a significant cause of confusion. That is, the proliferation of terms such as "networks" and "networking," "social networks" and "social networking" and others, have rendered the term SNA meaningless. The interviewees suggest that many Marines believe that they do SNA, because they think about social relationships and consider what they could mean, but are actually doing link analysis. This is also reflected in a number of survey responses in which respondents could not adequately differentiate the difference between SNA and link analysis. Furthermore, this may explain why nearly 81% of survey respondents said they heard of SNA, but so few could demonstrate knowledge of it.

Emerging doctrine's ability to define and describe SNA is questionable as well. As noted in Chapter III, while emerging doctrine does argue for the importance of networks and the need to use SNA techniques, it is arguable that they adequately define and describe SNA in sufficient detail. That is, the audience of MCIP 3-40.01, *MAGTF Network Engagement* and JP 3-25, *Countering Threat Networks*, is commanders and staffs, not the personnel likely to conduct SNA. Thus, while doctrine calls for SNA's use, there is little currently available to guide its employment.

### 2. Organization

*"A unit or element with varied functions enabled by a structure through which individuals cooperate systematically to accomplish a common mission and directly provide or support warfighting capabilities." (JCS, 2012, p. A-5)*

The existing organizational construct for intelligence appears to be adequate for enacting recommendations.

### 3. Training

*"Training, including mission rehearsals, of individuals, units, and staffs using doctrine or tactics, techniques, and procedures to prepare forces or staffs to respond to strategic, operational, or tactical requirements considered necessary by the commands to execute their assigned or anticipated missions." (JCS, 2012, p. A-5)*

Training describes how the military fights and covers basic training to advanced training, to include individual, unit, and joint training and exercises. Training, however, is driven by doctrine—meaning that given current doctrinal deficiencies, SNA is not taught within formal military training. The results of the survey indicate that, but they also indicate that some respondents are knowledgeable in SNA, and received training on it. Indeed, it is not that SNA training does not exist, it does, but rather that there is no requirement for it. SNA is not found within the Intelligence MOS Training and Readiness (T&R) Manual, to include MARSOC's 8071 All Source Analysis Specialists' T&R Manual. In T&R Manual terminology, an event "is an individual or collective training standard" (U.S. Marine Corps, 2013, p. 1–4). A T&R standard, then, "identifies the minimum standards that Marines must be able to perform in combat" (U.S. Marine Corps, 2013, p. 1–2).

Of the 14 listed intelligence MOSs within the Intelligence T&R manual, only the 0202, MAGTF Intelligence Officer, has an event related specifically to networks (outside computer or communication networks), listed as "0202-GCE-2001 Attack the Network." The event is taught during formal intelligence training at the MAGTF Intelligence Officer Course (MIOC) as part of the Attack the Network framework, which is likely to be replaced by the Network Engagement framework, pending DCR approval. Discussions with MIOC instructors reveal that SNA is not formally instructed during the course, though it is mentioned.

This brings up an important question; given the depth and breadth of SNA, what aspects and where within military training should it be instructed? That is, does SNA belong within the T&R Manual, and if so, what parts—or does it belong as a certification, or another type of MOS, such as a Necessary MOS (NMOS)? Elements of SNA can be quite basic, but some require advanced training and education—particularly its predictive modeling capabilities. In addition, while elements of SNA can be instructed without SNA software, most practical uses for it require the use of software.

Consider two currently available SNA courses, the Training Brain Operation Center's (TBOC) Advanced Network Analysis and Targeting (ANAT) course, and the Naval Postgraduate School's (NPS), Common Operational Research Environment

(CORE) Lab's Level 1 and Level 2 SNA courses. Both courses instruct SNA, but do so differently. The ANAT Course is typically three days long, though tailorable, and focuses on one particular SNA software program and some of the mathematical aspects behind SNA, with little social theory concentration. By contrast, the NPS courses are usually five to ten days in length, do not focus on math, but focus instead on a number of SNA software programs, and do emphasize social theory. Interviews with instructors from both courses reveal that their instruction represents a basic level of SNA functionality and that much is left uncovered due to constraints, such as time, student proficiency, and technical issues. Instructors at both courses also recognize that SNA, particularly its software, requires refresher training and skill maintenance.

Therefore, given the depth and breadth of SNA, additional research is needed to find an appropriate pedagogy and progression for SNA skill development. Furthermore, this research must consider the Doctrine, materiel, Leadership/Education, and Personnel pillars as well.

### 4. Materiel

*"All items (including ships, tanks, self-propelled weapons, aircraft, etc., and related spares, repair parts, and support equipment, but excluding real property, installations, and utilities) necessary to equip, operate, maintain, and support military activities without distinction as to its application for administrative or combat purposes." (JCS, 2012, p. A-5)*

Materiel refers to individual equipment necessary to equip Marines so that they can operate effectively. The typical intelligence Marine uses equipment that is part of the Intelligence Analysis System (IAS) Family of Systems (FOS)—to include a suite of software programs that facilitates collection, processing, analysis, and dissemination of intelligence. As of the publication of this thesis, there are no SNA-centric software programs available on Marine Corps networks, although some are on other networks within the DOD. The implication is that even if there was a training and doctrinal obligation to do SNA, there is no software solution currently available on Marine Corps networks.

Outside of SNA specific software, some currently available software programs do have limited SNA capabilities. Of note, it is the limited SNA functionality of these programs that may also factor into confusion regarding what SNA is. Indeed, the first introduction to SNA for many Marines will come in the form of the SNA Helper application in the Palantir program. Broadly, Palantir is a data analysis tool that allows users to do a host of functions to include link analysis, temporal analysis, social network analysis, and geospatial analysis, among others. While Palantir is not a Marine Corps Program of Record, it provides capabilities that current analytic packages cannot, and its use is widespread. Perhaps one of Palantir's best attributes is that the user can derive their own ontology, collaborate with other users, and graphically and visually manipulate their data to look for links and patterns. SNA is not one of the primary functions of Palantir; it is a limited functionality.

Currently, the SNA Helper can only do measures of centrality: degree, betweeness, closeness, and eigenvector, (i.e., only node-level measurements). The trouble with the SNA Helper is that while it will produce, say, rankings that are equivalent to other SNA-centric programs, the scores usually do not match. In addition, the helper will also allow the user to apply SNA algorithms on two-mode and multi-mode data, which allows users to compare unlike entities, such as, people and places, rather than just people and people. As noted in Chapter II, this violates the underlying mathematical foundations of SNA and may lead to erroneous conclusions.

Therefore, the issue for the analyst using the SNA Helper is that it will allow them to do things that should not be done. That is, an analyst with no training or background in SNA, can use the tools available and produce results, scores, and rankings that may be meaningless in reality, but otherwise look acceptable. Furthermore, by only offering four centrality scores, the helper does not provide a lot of SNA functionality. Rather, it allows an analyst to base their analysis on four scores without considering the larger network, creating a couple of problems. First, with just four basic centrality scores, a well-researched analyst may find the results unenlightening. Specifically, node-level measures, such as centrality, are important, but absent network-level measures, visualization algorithms, and other concepts such as subgroups, the results offered are rather limited

and may not offer new insight. Second, the helper's lack of robust functionality creates a false sense of what the true capabilities of SNA are. That is, because one does not need much training to use the helper, and because the tool offers so few options, one is ultimately left with a false impression of what SNA is. Indeed, the basic workspace functions on Palantir look like link analysis, hence SNA algorithms done on it tend to look like link analysis as well. Given the number of survey responses that listed Palantir as SNA software, and the number of responses that said link analysis and SNA are the same, it seems likely that Palantir has negatively affected understanding of what SNA is.

Finally, one may use Palantir's SNA tools and believe they did SNA without ever knowing what they did, why they did it, and what other information they should be looking for. The SNA Helper offers untrained users just enough functionality to feel as though they did SNA, without any measures in place to ensure they did it correctly. The danger is that such results will find their way into analytical products and result in negative consequences.

Aside from SNA-centric software, other materiel considerations include both hardware and software packages that can perform data collection and aggregation that allows SNA to be performed. While a major deficiency is lack of SNA-centric software, there are other elements that are required to make an SNA capability functional within the MCISRE. Specifically, there are a number of commercial off-the-shelf (COTS) programs and hardware available, to include programs that have undergone development and testing at the NPS CORE Lab, that are worth examination—these will be discussed more in Chapter V.

### 5. Leadership/Education

*"Professional development of the joint leader is the product of a learning continuum that comprises training, experience, education, and self-improvement." (JCS, 2012, p. A-5)*

This pillar describes how military leaders prepare to fight at all levels and includes professional development, to include professional military education (PME). Leadership/Education is closely intertwined with the Training pillar, though broader in scope. Furthermore, as the purpose of this thesis is to help build an SNA capability within

the MCISRE, a discussion of Leadership/Education is necessary, and there are a number of deficiencies that fall within its realm. First, as noted within the Network Engagement DCR, there is inadequate continuity with regards to Network Engagement activities throughout the PME pipeline. This means that SNA likely receives minimal, if any, attention within both Officer and Enlisted PME. This is probably expected given that SNA may be considered more of an intelligence function rather than a holistic command and staff one. However, leaders who do not understand what something is, or do not know that something exists, are unlikely to advocate for its use. Given that SNA can be applied to threat, friendly, and neutral networks, as well as facilitate planning, targeting, and other applications, its inclusion in PME is warranted.

Beyond formal PME, however, are additional educational opportunities, such as those offered by the Commandant's Career Level Education Board (CCLEB) and the Commandant's Professional Intermediate Level Education Board (CPIB). Selection into either of these programs offers officers the opportunity to attend the Naval Postgraduate School, the Air Force Institute of Technology (AFIT), the Junior Officer Strategic Intelligence Program (JOSIP), or the Junior Officer Cryptologic Career Program (JOCCP), among others. At this point in time, leveraging officers in these programs to do research on behalf of Intelligence Department remains an unexploited opportunity.

### 6. Personnel

*"The personnel component primarily ensures that qualified personnel exist to support joint capability requirements." (JCS, 2012, p. A-5)*

The Personnel pillar refers to the availability of qualified personnel in peace, war, and for other contingency operations. Specific to the topic of SNA, this pillar is intertwined with the discussion on Training and Leadership/Education—there are no major issues to discuss.

### 7. Facilities

*"Real property consisting of one or more of the following: buildings, structures, utility systems, associated roads and other pavements, and underlying land." (JCS, 2012, p. A-5)*

The Facilities pillar refers to real property such as installations and industrial facilities that support Marine Corps forces. There are no significant issues to discuss.

## B. KEY FINDINGS

Given the previous discussion, the following are key findings:

- Key Finding 1: The term SNA is inadequately defined and described in current doctrine.
- Key Finding 2: SNA is often confused with traditional forms of analysis.
- Key Finding 3: Emerging doctrine does not adequately define and describe SNA in a manner that makes it accessible.
- Key Finding 4: Contingent upon improved doctrine, elements of SNA need to be introduced into the Intelligence T&R Manual.
- Key Finding 5: In concert with other DOTmLPF pillars, research is required to develop an appropriate pedagogy and progression to develop advanced SNA capabilities and practitioners.
- Key Finding 6: Current software programs in use are not sufficient for SNA.
- Key Finding 7: Additional hardware and software research and investment is required to build and maintain an SNA capability.
- Key Finding 8: Increased Intelligence Department involvement within graduate education programs is necessary.

## C. RECOMMENDATIONS BASED ON KEY FINDINGS

The DOTmLPF pillars are interrelated, as such; many of the key findings can be grouped together. It is logical then to discuss recommendations within these groupings as well.

### 1. Recommendations for Key Findings 1, 2, and 3

Key findings 1, 2, and 3 relate almost exclusively to doctrine, and there are a number of ways to address them. First, given the inadequacies of current and emerging doctrine with respect to SNA, one possibility is creating a standalone SNA publication or handbook. This would ensure thoroughness and standardization of key SNA terms and concepts and become the de facto guide to SNA. Furthermore, references to SNA in other publications could simply reference the SNA one. The document would require periodic updating and would also have to align itself with specific software, particularly if it is to be used as a step-by-step guide.

While such a document would present a simple fix, a publication or handbook alone would not necessarily lead to proficient SNA users, or better intelligence Marines. Specifically, a standalone document may present SNA as a separate analytic tool altogether, instead of one that is used in conjunction with other tools and techniques. That is, SNA should be viewed as a tool within an analyst's toolbox, used when necessary, but not the end state of analysis. Therefore, while SNA can be an involved process, segregating it from well-known intelligence publications and other analytic tools and techniques may further inhibit its employment.

An alternative is to place an SNA appendix in prominent intelligence publications, such as MCRP 2-3A, *Intelligence Preparation of the Battlespace,* MCWP 2-3, *Intelligence Production and Analysis*, and others. This would provide an opportunity to more fully develop, define, and explain what SNA is and what it does, in the context of other intelligence tools and techniques. It could also identify SNA's key assumptions, its terminology, to include social theory underpinnings, and the software and training necessary to do it, without the detail of a standalone publication. That being said, the two options do not have to be mutually exclusive.

### 2. Recommendations for Key Findings 4, 5, and 8

The DOTmLPF pillars are interrelated, as such, Doctrine, Training, and Leadership/Education are often dependent on each other. To that end, Key Finding 4 is

very much contingent upon doctrine, Key Findings 5 and 8, however, are tied to not only Doctrine, but also Training, and Leadership/Education as well.

SNA's inclusion within doctrine allows for its instruction in formal learning centers. Specifically, there are basic components of SNA, such as its underlying assumptions, the terminology for its measurements, and other concepts that can be defined and described without a significant time investment. Such items can be instructed as basic core "1000", or if necessary, core plus "2000" level-events in formal MOS training and would provide every Marine with a very basic and consistent idea of what SNA is. Additionally, not only would this provide a baseline knowledge of SNA, but also setup Marines for future follow-on SNA training and education.

Following a basic introduction to SNA within formal MOS training, is determining a progression for advancing those skills. It is beyond the scope of this study to research the best approach, however, there are a few ideas to consider. First, Marines could be sent in greater numbers to attend currently available SNA training provided by both NPS and the TBOC's ANAT course. This would increase the number of Marines familiar with and proficient in using SNA and its software. However, a higher throughput of students may be unsustainable for the courses themselves, and therefore, developing a USMC specific course may be necessary. The skills attained in these courses must also be sustained; fortunately, the issue of skill credentialing and sustainment is part of the greater *MCISRE Roadmap*. It would be prudent to attach SNA specific sustainment training as part of a larger analytic sustainment package.

A step beyond training Marines to be proficient in SNA, is developing Marines to find innovative uses for it. Intelligence Department must take note of intelligence officers going to the educational opportunities provided by both the CCLEB and CPIB and leverage them to do research on their behalf. While Intelligence Department may not currently sponsor a curriculum, the intelligence officers going through the numerous programs of study at AFIT and NPS will eventually return to the intelligence community after their payback tours and/or could be closely working with intelligence functions during them. Moreover, such research does not even have to be SNA related, but would no doubt benefit the MCISRE.

Returning specifically to SNA, however, are the number of studies conducted by students at NPS exploring the use of SNA's application to military problems, as noted in Table 1, in Chapter III. Presently, there is no formal custodian of social network research to aggregate and disseminate this research and knowledge. The sponsorship or development of a formal center of excellence within an existing facility and/or command would provide a number of benefits. Such a center could act as the custodian of past research on topics, such as SNA, and would be cognizant of current methods, research, and shortfalls, as well as promote and advocate for future research. Furthermore, the custodian could also serve as a conduit for Intelligence Department research as well. A logical place for such a custodian would be within the NPS CORE Lab; however, additional investment and sponsorship of CORE Lab research is likely required. The MCIA or MAGTF Intelligence Centers (MICs) may also be able to act as custodians for research as well.

A final, and more involved concept, involves Intelligence Department sponsorship of a new program of study in Network Science. Network Science extends beyond SNA and encompasses a number of different fields and areas of study. Indeed, in 2006 the US Army commissioned the National Research Council (NRC) to conduct a study on Network Science and its future applications for the Army. The NRC study found that despite high interest in networks (of all kinds, social, telecommunications, biological, etc.) and their importance to Army operations, research and understanding of networks was fragmented and limited (2006, p. 3). While the Marine Corps may not have the resources, funding, or scope of the Army, such a program may prove beneficial and could receive support from other Services. Future research is necessary to develop an academic curriculum for the potential stakeholders; however, such a program could prove extraordinarily innovating and groundbreaking.

### 3. Recommendations for Findings 6 and 7

Findings 6 and 7 primarily relate to the materiel pillar because they involve hardware and software; but they also relate to the Leadership/Education pillar as well. In terms of difficulty, these findings are perhaps the simplest to address as DOD network-

worthy SNA software already exists, and programs and hardware to facilitate SNA exist as well.

That said, just because a single SNA program is in use on numerous DOD networks, does not mean the USMC should validate it. It is worthwhile to examine the MCISRE's needs and SNA's potential uses before deciding which SNA software package fits best. That being said, the Organizational Risk Analyzer (ORA) program began as a DOD-sponsored program and is currently authorized on numerous networks. Additionally, it is the program that is taught at the TBOC's ANAT course and is also one of the SNA programs taught within the NPS SNA course as well. Therefore, the simple solution is to adopt it, as it is used by the Army and other entities within the DOD, and is one of the more capable SNA software packages. However, its integration and capability with Marine Corps specific programs is unknown, and more advanced users of SNA may prefer to have a host of other SNA programs available, not just a single one.

Finally, in order to make SNA functional, data must be collected. Data collection can be manual, such as a Marine with a notepad and pen, or automated, via numerous data collection mechanisms. The Marine Corps and Intelligence Department are involved in a number of different initiatives, such as Identity Intelligence (I2), and numerous tools to collect data exist. If SNA is to play a significant role in the MCISRE's future, however, such tools must collect the type of data that SNA can be conducted on. This is a critical area of research, and given NPS' research with SNA-related capabilities, it may prove worthwhile to invest and/or research programs and hardware developed by students and faculty at the CORE Lab as well. This topic is discussed more in Chapter V.

## D. CONCLUSION

This chapter examined possible causal factors for the survey results discussed in Chapter III, using the DOTmLPF pillars as a guide. Table 4 summarizes these findings. Some of these recommendations are no doubt easier than others to implement, and not all of these recommendations are as essential as others. However, the recommendations should serve to demonstrate, broadly, what is involved in building an SNA capability

within the MCISRE. Further discussion of some of the more involved recommendations and the future research required to make them a reality are covered in Chapter V.

Table 4. Summary of Findings and Recommendations to Enhance SNA within the MCISRE.

| Key Findings | Recommendations | DOTmLPF Pillar |
|---|---|---|
| 1. SNA is inadequately defined and described in current doctrine<br>2. SNA is confused with traditional forms of analysis<br>3. Emerging doctrine does not adequately define and describe SNA | - Insert SNA appendix into prominent intelligence publications, such as IPB, and Intel P&A | Doctrine |
| 4. SNA needs to be introduced to the Intel T&R Manual<br>5. Research is required to identify SNA pedagogy and progression in order to develop advanced skills<br>6. Intel Dept needs to increase involvement in Graduate Education | - SNA inclusion in Intel T&R as "1000" or "2000" level-event for MOS school<br>- Research appropriate progression from basic SNA skills to advanced skills<br>- Send Marines to available SNA Training courses<br>- Sponsor/Support NPS/AFIT student research<br>- Sponsor/Support Network Center of Excellence/Custodian<br>- Sponsor/Support development of Network Science Curriculum | Doctrine, Training, Leadership/Education Facilities |
| 7. Current software is not sufficient for SNA<br>8. Additional hardware and software research/investment is requird to build and maintain SNA proficiency | - Research and select SNA program(s) to put onto Marine Corps Networks<br>- Research/Invest in software & hardware that facilitate conduct of SNA | Materiel |

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# V. FUTURE RESEARCH AND RESEARCH SUMMARY

The recommendations provided in Chapter IV offer both short- and long-term solutions to building a sustainable SNA capability within the MCISRE. Greater inclusion of SNA within doctrine, its addition to the T&R Manual, and Marine attendance in current SNA training opportunities will help to build such a capability; however, more involved and significant efforts are also required. These efforts require additional research, and are beyond the scope of this study. However, this chapter discusses some of these research areas in order to further develop the recommendations offered in Chapter IV, but also provides Intelligence Department future research topics. The chapter concludes with a brief summary of the research presented in this document.

## A. FUTURE RESEARCH TOPICS

The topics that follow link to each other and are listed in logical order of precedence. First, is developing an SNA concept of employment within the MCISRE to support Marine Corps operations. Second, is investigating software and hardware requirements to support SNA employment. Finally, is developing a pedagogy and progression of SNA training and education to build and sustain an SNA capability within the MCISRE.

### 1. Develop an SNA Concept of Employment within the MCISRE

SNA, as argued throughout this study, may provide significant benefits to the MCISRE. Given what SNA is, what it does, and what is necessary to perform it, a concept of operations (CONOPS) for its employment must be developed. Such a CONOPS needs to address the use of SNA across the range of military operations (ROMO). SNA has proven its utility in counterinsurgency (COIN) operations, but its efficacy beyond that remains very much in the realm of research, such as that listed in Table 1.

Furthermore, SNA must also be integrated with other initiatives, such as Identity Intelligence (I2), and regular operating concepts, such as Marine Expeditionary Units

(MEUs) and Theater Security Cooperation exercises. The Marine Corps deploys to locations that allow it unique opportunities to collect information—how that information is collected, aggregated, and managed needs to be more closely examined. Specifically, does this data lend itself to further and deeper analysis, such as what SNA can provide? Similarly, does a MEU require a reach back capability to the MCIA or MAGTF Intelligence Center (MIC)? If so, what must be in place to make this union work, and where is advanced analysis, such as SNA, conducted—in stateside facilities such as the MCIA or MIC, or on a MEU—or both?

SNA must also fit within the greater analytic framework of the intelligence function. SNA is a powerful tool that can be used to support a commander's intelligence requirements; however, to make SNA useful, it needs to be more than just additional training—it must be integrated into the analytic processes intelligence Marines regularly do. Thus, while Marines will discover unique applications for SNA, it remains worthwhile to further study where, in the types of problem sets intelligence Marines face, that SNA can be used and how it can be leveraged.

### 2. Investigate Software and Hardware Requirements to Support SNA within the MCISRE

In conjunction with determining an SNA concept of employment, software and hardware needs to make such a concept work must also be investigated. Intelligence Marines rely on a bevy of different components and programs within the IAS Family of Systems, and any additional piece of hardware or software must be compatible with not only current systems, but also the greater knowledge management framework so that data can be used throughout the MCISRE.

There is a plethora of COTS software that can do an array of SNA functions. However, most, if not all, SNA software is standalone, and thus not integrated into a larger analysis program. This is an advantage of the Palantir program because it combines the functionality of many standalone programs into a single one. That being said, Palantir's limited SNA functionality makes it worthwhile to examine standalone SNA software. Furthermore, much like Palantir, most standalone SNA software can also

import and export in various file types, which should help make it compatible with current IAS platforms and systems.

Therefore, finding suitable SNA software should be a simple task. This task is made simpler because one particular software package, Organizational Risk Analyzer (ORA), is already approved and in use on a number of DOD-networks. As noted in Chapter II, however, SNA software packages occasionally use unique terminology; for example, a "boundary spanner" in one program may refer to a "cutpoint" in another. Furthermore, some packages may yield different calculations for the same measurements. Therefore, the choice of software potentially affects doctrine and training development because the terms and measures a software package uses should be aligned with doctrine and training materials. In addition, advanced SNA users may prefer to use multiple versions of SNA software because of inherent strengths and weaknesses within them. That is, different pieces of software may do certain functions better than others. For example, some SNA software is excellent at creating visualizations, while others may be better at computing extremely large data sets.

Therefore, any evaluation of SNA software must, at a minimum, consider four areas. First, it must be compatible, or made to be compatible, within the IAS Family of Systems, to include being network worthy. Second, it must provide, at the very least, node-level and network-level calculations, and a visualization function. This is covered by most, if not all, commercially available products. Third, it must be able to import and export various file types. Fourth, software specific terminology must be noted for follow-on doctrinal and training purposes.

Other significant considerations related to SNA are hardware and software packages that facilitate data aggregation. Specifically, SNA requires relational data—which is simply data that links different entities to each other. Relational data can be structured—such as the association matrices discussed in Chapter II, or it can be unstructured, which requires additional manipulation, such as reading a report and manually specifying the relationship between entities. An ontology, usually requiring the development of a "code book" is necessary to ensure data is structured and standardized. For example, some forms of data, such as Twitter data, are already relational as they can

relate a particular account to a "tweet", to another account, and potentially to a geographic location as well. However, middleware may be necessary to ingest Twitter data and format it so that it can be analyzed with SNA tools.

Some data must be collected manually, however, and requires the interface between human and electronic means. For example, a Marine with a notepad who notes the relationships between villagers in a village will eventually have to input that data into a database. The process is labor intensive and error-prone, as in many cases the data collector is not the same person entering it. Fortunately, hardware solutions exist that can automatically collect relational data at point of collection and immediately update databases. One such example is the Lighthouse project, developed at the NPS CORE Lab. Lighthouse is a mix of COTS hardware and software that allows for socio-cultural data collection. The Lighthouse concept significantly simplifies data collection because data collected is immediately available for analysis. While Lighthouse may or may not suite the needs of the greater MCISRE, it is an important concept, and software and hardware solutions like it should be researched.

### 3. Develop a Pedagogy and Progression of SNA Training and Education within the MCISRE

Adding SNA to doctrine, the T&R manual, and sending Marines to currently available SNA training will increase the number of Marines with SNA knowledge, but it will not build a capability. Instead, a more holistic approach, is required that takes into account not only the doctrinal and training aspects, but also considers the materiel, personnel, and leadership/education aspects as well. Indeed, while the following discussion may be applicable to the intelligence MOS as a whole, it is specifically focused on SNA.

Depending on the problem and question asked, the element of SNA used may be simple or complex. That is, it is simple to take a formatted data set and run various measurements on it with available SNA software. Interpreting the results of the measurements given the situation and assessing what they mean adds a bit more complexity. Structuring data to a usable form, manipulating it, and using SNA algorithms

that will offer answers to yet to be asked questions, is even more complex, but is part of what predictive analysis is—and it requires more than basic skill.

Mastery of SNA requires a progression of skills. Marines can be trained to become proficient with SNA software and the use of basic measurements. Furthermore, some Marines will likely become very proficient and advanced users. However, there is a limit to those skills unless Marines receive further education. SNA, particularly advanced methods, are math intensive. While Marines can become proficient in the software without going into mathematics, as algorithms become more robust, it becomes more important to understand what is happening so that results can be understood. That is, SNA software performs the functions it is asked to do, but interpreting and understanding the results is the responsibility of the user. Concepts such as regression and stochastic modeling methods could ostensibly be done by anyone with data and software, but the results are of no value without the knowledge to interpret them.

Therefore, progression into more advanced SNA use requires additional education. Chapter IV had two recommendations: first, to become more involved in the officer education process, and second, to sponsor a new program of study. Another option is to screen current Marines with the necessary mathematical background and skillsets. In this case, Marines could receive specific SNA and other skill training, without a larger educational investment. Another possibility is to examine the creation of a Necessary MOS (NMOS), Free MOS (FMOS), or Exception MOS—a "social network analyst." Additionally, the adoption of one of these particular MOSs may allow Marines outside of the Intelligence MOS to become "social network analysts" as well. For instance, Marines with Master's in Operations Research often have requisite computer programming and mathematical skills, making them excellent candidates.

Beyond skill progression, is also the question of instructional methods and curriculum content. Mathematics is the basis for SNA, but its instruction in current courses is mixed. In the two primary courses mentioned in this study, ANAT and NPS, both have reported success using different methods. An interview with Dr. Ian McCulloh (LTC, USA, Retired), who created the ANAT course, noted that providing mathematical foundations significantly aided in skill retention post-training. However, Dr. Sean

Everton, a professor at the Naval Postgraduate School, who instructs the Disrupting Dark Networks course, a 12-week course, from which the aforementioned five to ten training day course is modeled, noted success without a major mathematical focus. That being said, the two courses are different, not only in length and scope, but in audience as well—Dr. Everton's course is taught to graduate students whose curriculum includes mathematical requirements, while ANAT is available to all interested parties. Therefore, should the Marine Corps opt to create or sponsor its own SNA course, a deeper look into mathematical emphasis is warranted. Aside from whether or not to include mathematics into an SNA course is also the question of what subjects to instruct. In part, this will be defined by course length, SNA software used, and target audience. Certainly, the NPS and ANAT courses offer a template, but a deeper review is warranted.

Finally, instructional methods should also be explored. That is, an ideal SNA course would be multi-week and Marines would be fully exposed and immersed in SNA. However, such a course is unlikely outside of academia, and other options should exist. Online or computer-based training and refresher modules may offer a method for both training and skill sustainment, and may also be cost effective and efficient as well. The MCIA and MICs may also provide a venue from which to instruct and sustain skills as well.

## B. SUMMARY OF RESEARCH

This research investigated the current knowledge level of SNA within the MCISRE and recommended ways to improve it. A survey quantitatively determined the level of SNA knowledge within the MCISRE, and interviews with academics, military intelligence professionals, doctrine advocates and writers, Marines and civilians with intelligence and SNA training backgrounds, and many more, helped augment it. The thesis argued that SNA provides a different form of analysis from traditional methods and it may be an effective tool for intelligence personnel. Survey results, however, indicate much work remains if an SNA capability is to be built. Furthermore, discrepancies in doctrine, training, materiel, and leadership/education provided a means to make recommendations to help improve current SNA knowledge and build an SNA capability.

The thesis concluded by addressing additional research topics necessary to help build upon the offered recommendations. This thesis provides a pathway forward to bringing SNA to the Marine Corps and is a springboard for further research. A final consideration—social networks are out there and they influence the world we live in, whether we choose to analyze and understand them, or remain blind to their influence, is up to us.

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# APPENDIX A. SURVEY QUESTIONS AND SURVEY DISTRIBUTION

## A. SURVEY DISTRIBUTION

The survey was available to all intelligence MOS Marines of rank corporal and above. In order to facilitate widest dissemination, Intelligence Department, Headquarters Marine Corps, released MARADMIN 014/15 on January 9, 2015, titled SOCIAL NETWORK ANALYSIS SURVEY FOR INTELLIGENCE MOS MARINES on the researcher's behalf. The MARADMIN can be found at the following link:

http://www.marines.mil/News/Messages/MessagesDisplay/tabid/13286/Article/172778/social-network-analysis-survey-for-intelligence-mos-marines.aspx .

Although the survey was directed to intelligence MOS Marines of the specified rank, the posting of the MARADMIN meant that additional personnel could take the survey as well, and the survey accounted for this.

## B. SURVEY QUESTIONS

### 1. Demographic Information (questions 1–3)

1. Please select your current rank:

E4
E5
E6
E7
E8
E9
O1
O1E
O2E
O3E
O2
O3
O4
O5
O6
WO
CWO2

CWO3
CWO4
CWO5
Other

2. How many years have you been in the Marine Corps Intelligence Community?

1-3
4-6
7-9
10-12
13-15
16-18
19+
Other

3. Aside from your initial entry level intelligence training (e.g. MAGTF Intelligence Specialist Entry Course, Ground Intelligence Officer Course, etc.) please list both formal and informal intelligence training and education courses you have attended (e.g. MAGTF Intelligence Specialist Career Course, MAGTF Intelligence Officer Course, Advanced Network Analysis & Targeting Course, etc.).

## 2. Diagnostic SNA Questions (questions 4–11)

4. Are you aware of or heard the term — Social Network Analysis?

Yes
No

5. Have you received any training on Social Network Analysis?
Yes
No

6. If yes, where and when did you receive this training?

7. Are you aware of any Social Network Analysis software packages?

Yes
No

8. If yes, please list which ones

9. Have you used Social Network Analysis on deployments?

Yes
No

10. If yes, please describe how it was used, time frame of deployment, and software (if any used).

11. How would you rate your proficiency in conducting SNA?

Not proficient, received no training
A little proficient, received some training
Proficient, received training
Very proficient, received training and conduct often

### 3. SNA Assessment Questions (questions 12–23)

12. How does social network analysis differ from link analysis?

I don't know
Please describe

13. Is social media analysis the same thing as social network analysis?

Yes
No
I don't know

14. If you answered yes or no above, please explain your answer.

15. Match the term (A-E) with the correct definition or description (1-5):

A. Eigenvector Centrality
B. Closeness Centrality
C. Degree Centrality
D. Betweeness Centrality
E. Centralization
F. I don't know

1. The extent to which each actor lies on the shortest path between all other actors in network.
2. A measure of network topography that provides a network-level measure of potentially exceptional nodes in the network.
3. Assumes ties to central actors are more important than ties to peripheral actors and score is dependent upon centrality of adjacent nodes to which it connects.
4. Captures how close each actor is to all other actors in a network.

5. The count of the number of an actor's ties.

16. Match the term (A-F) with the correct definition or description (1-6):

A. Homophily
B. Reciprocity
C. Proximity
D. Prestige
E. Transitivity
F. Balance
G. I don't know

1. Those actors in a network perceived by others to be valuable. It can also be achieved in terms of an actor's access to resources, knowledge, and other social circles.
2. An aggregate level measure in which agents tend to form relationships such that a friend of a friend is a friend, a friend of an enemy is an enemy, and an enemy of an enemy is a friend.
3. Is whether agents tend to form directed relationships with alters who initiate relationships with them.
4. Deals with the tendency of individuals to form relations with those like themselves.
5. Is the organizational or physical distance between two nodes
6. Means that if there is a link between two actors (A and B) and another link between actor A and actor C (A and C) then there is a tendency for actor B and actor C to form a link with each other (B and C).

Use the sample network pictured below to answer questions (17–19):

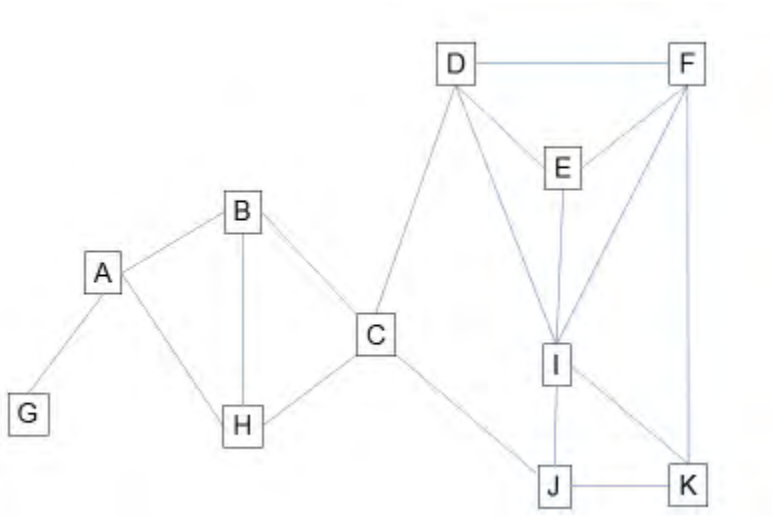



Figure 1

17. What is the length of the geodesic between vertex G and K pictured in Figure 1?

4
5
6
7
8
I don’t know

18. Using the network depicted in Figure 1, which node has the highest degree centrality?
A
B
C
D
E
F
G
H
I
J
K
I don’t know

19. Using the network depicted in Figure 1, which node probably has the highest betweeness centrality?
A
B
C
D
E
F
G
H
I
J
K
I don’t know

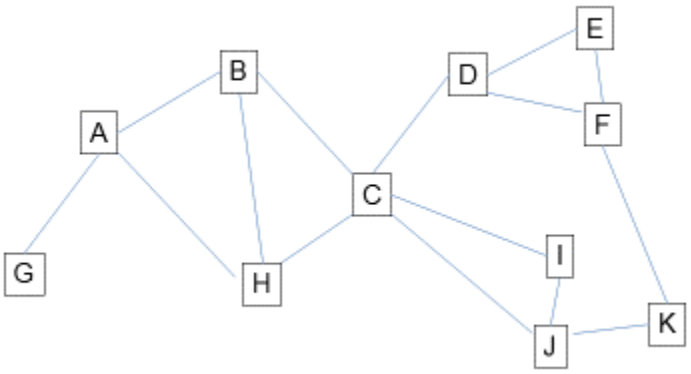



Figure 2

20. Using the sample network pictured in Figure 2, select which two nodes exhibit structural equivalence

A
B
C
D
E
F
G
H
I
J
K
I don’t know

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 4 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | 2 | 2 |
| 5 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 1 |
| 6 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 2 | 3 | 2 | 0 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| 7 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 |
| 8 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 0 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 0 | 2 | 0 |
| 10 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 0 | 0 | 2 | 3 | 0 | 2 | 2 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| 12 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 0 |
| 13 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 4 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| 14 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 7 | 4 | 2 | 5 | 4 | 2 | 5 | 2 | 2 | 3 | 3 | 3 | 3 |
| 15 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 4 | 5 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | 4 | 3 | 3 | 2 |
| 16 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 0 | 1 | 1 | 2 | 0 | 1 | 2 | 3 | 5 | 2 | 0 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 17 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 0 | 0 | 1 | 2 | 0 | 2 | 5 | 3 | 2 | 6 | 2 | 1 | 4 | 1 | 2 | 3 | 2 | 2 | 3 |
| 18 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 2 | 0 | 2 | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 |
| 19 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 5 | 2 | 2 | 1 | 1 | 3 | 1 | 1 |
| 20 | 2 | 1 | 1 | 3 | 1 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 5 | 3 | 2 | 4 | 2 | 2 | 5 | 2 | 2 | 3 | 3 | 2 | 2 |
| 21 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 1 |
| 22 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 1 |
| 23 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 4 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 4 | 3 | 2 | 2 |
| 24 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 5 | 1 | 1 |
| 25 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 |
| 26 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 0 | 2 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 11 | 11 | 2 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 2 | 6 |
| 3 | 2 | 11 | 22 | 8 | 3 | 4 | 2 | 3 | 5 | 1 | 4 | 4 | 4 | 3 | 8 |
| 4 | 3 | 2 | 8 | 12 | 1 | 1 | 3 | 2 | 4 | 3 | 3 | 2 | 2 | 0 | 4 |
| 5 | 0 | 1 | 3 | 1 | 3 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 6 | 1 | 3 | 4 | 1 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| 7 | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 8 | 1 | 1 | 3 | 2 | 0 | 1 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 9 | 1 | 1 | 5 | 4 | 1 | 0 | 1 | 0 | 6 | 0 | 0 | 1 | 1 | 0 | 1 |
| 10 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 0 |
| 11 | 0 | 3 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 1 | 0 | 3 |
| 12 | 0 | 3 | 4 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 5 | 2 | 0 | 3 |
| 13 | 0 | 3 | 4 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 2 | 5 | 1 | 3 |
| 14 | 0 | 2 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 0 |
| 15 | 1 | 6 | 8 | 4 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 0 | 9 |

21. Consider the two matrices to the right and below. They are derived from an affiliation matrix that recorded the 15 clubs to which 26 CEOs belonged. The top matrix is the actor-by-actor (co-membership) matrix. The bottom one is the event-by-event (event overlap) matrix. How many club memberships do CEOs #1 and #13 share?

1.
2.
3.
4.
5.
I don't know

22. How many clubs does CEO #7 belong to?

1.
2.
3.
4.
5.
I don't know

23. How many CEOs were members of club #4?

2.
3.
8.
12.
15.
I don't know

24. Would you like to be contacted by the researcher of this study to discuss the study in more detail? If you would, please provide your email address and/or phone number in the

space provided. Please note that if you provide your contact information that your identity and survey results will be made available to the researcher. If you do not wish to be contacted, leave the space blank.

# APPENDIX B. SURVEY RESULTS AND GRADING CRITERIA

## A. SURVEY CONFIDENCE LEVELS AND INTERVALS

The survey received 312 respondents. The survey distribution method meant that other than intelligence MOS Marines could partake in the survey. Questions 1 and 2 accounted for this by asking those non-intelligence MOS Marines, or those falling outside the corporal and above target audience, to identify themselves. An estimated 15 respondents were outside the target population, leaving 297 respondents within it. This accounts for less than 5% of all respondents, and for sake of simplicity, they are not factored out of overall calculations.

As of September 2014, the target population of all intelligence MOS Marines, of rank corporal and above was 5924. This is important because it means that the sample size of 297, allows for a 95% confidence level with +/- 5.54% confidence interval. In other words, the results that follow imply with 95% confidence the knowledge level of the entire target population, +/- 5.54%.

## B. SPECIAL GRADING CRITERIA

Questions 12 and 14 ask respondents to offer their explanations on the differences between SNA and link analysis and SNA and social media analysis, respectively. As there is no "doctrinal" answer, the researcher, and instructors from ANAT and NPS graded the responses. Graders were asked to mark if a response was "adequate" meaning it sufficiently explained the difference, or "inadequate" meaning that it did not. Graders were also asked to note their particular grading criteria and trends they noticed while grading.

## C. SURVEY RESULTS

The following provides a summary of results from the Social Network Analysis Survey for Intelligence MOS Marines. When appropriate, questions will appear as they did in the LimeSurvey. Some results are summarized for space constraints and some are redacted for privacy.

## 1. Demographic Information (questions 1-3)

1. Please select your current rank: If Other, please describe.

| Answer | Count | Percentage |
|---|---|---|
| E4 (A1) | 30 | 9.62% |
| E5 (A2) | 48 | 15.38% |
| E6 (A3) | 55 | 17.63% |
| E7 (A4) | 35 | 11.22% |
| E8 (A5) | 13 | 4.17% |
| E9 (A6) | 5 | 1.60% |
| O1 (A7) | 7 | 2.24% |
| O1E (A19) | 2 | 0.64% |
| O2 (A8) | 19 | 6.09% |
| O2E (A18) | 2 | 0.64% |
| O3 (A9) | 32 | 10.26% |
| O3E (A20) | 9 | 2.88% |
| O4 (A10) | 14 | 4.49% |
| O5 (A11) | 11 | 3.53% |
| O6 (A12) | 3 | 0.96% |
| WO (A13) | 1 | 0.32% |
| CWO2 (A14) | 3 | 0.96% |
| CWO3 (A15) | 8 | 2.56% |
| CWO4 (A16) | 3 | 0.96% |
| CWO5 (A17) | 2 | 0.64% |
| Other (A21) | 10 | 3.21% |
| Comments | 18 | 5.77% |

2. How many years have you been in the Marine Corps Intelligence Community? If you are not associated with the Marine Corps Intelligence Community, please describe your relevant experience.

| Answer | Count | Percentage |
|---|---|---|
| 1-3 years (A1) | 69 | 22.12% |
| 4-6 years (A2) | 65 | 20.83% |
| 7-9 years (A3) | 60 | 19.23% |
| 10-12 years (A4) | 40 | 12.82% |
| 13-15 years (A5) | 22 | 7.05% |
| 16-18 years (A6) | 27 | 8.65% |
| 19+ years (A7) | 25 | 8.01% |
| N/A (A8) | 4 | 1.28% |
| Comments | 9 | 2.88% |

3. Aside from your initial entry level intelligence training (e.g. MAGTF Intelligence Specialist Entry Course, Ground Intelligence Officer Course, etc.) please list both formal and informal intelligence training and education courses you have attended (e.g. MAGTF Intelligence Specialist Career Course, MAGTF Intelligence Officer Course, Advanced Network Analysis & Targeting Course, etc.).

The responses will be omitted because respondents listed well over 500 responses. In summary, the courses ranged from an assortment of counterintelligence/human intelligence courses, both at the Marine Corps and national level, to numerous Geographic and Functional Combatant Command courses, to Defense Intelligence Agency, Central Intelligence Agency, Federal Bureau of Investigation, and National Security Agency intelligence courses and Marine Corps and other service level courses and various bachelor's and master's programs. Those interested in a full-listing of courses may contact the author.

### 2. Diagnostic SNA Questions (questions 4-11)

4. Are you aware of or heard the term — Social Network Analysis?

| Answer | Count | Percentage |
|---|---|---|
| Yes (Y) | 252 | 80.77% |
| No (N) | 60 | 19.23% |

5. Have you received any training on Social Network Analysis?

| Answer | Count | Percentage |
|---|---|---|
| Yes (Y) | 81 | 25.96% |
| No (N) | 231 | 74.04% |

6. If you answered 'Yes' to Question 5, where and when did you receive this training? If you answered 'No' to Question 5, please put 'None' in the response field.

It appears that many respondents did not list SNA training, but rather cyber/SMA/ link analysis training instead. It is possible that some of the courses listed may have SNA within them, but the apparent trend is that SNA instruction in such courses is limited. Some respondents did mention courses at NPS, which instructs SNA, however, others mentioned the MAGTF Intelligence Officer Course (MIOC) and MCIA Open Source Seminar, which may mention SNA and discuss it, but do not actually instruct it. Those interested in a full-listing may contact the author.

7. Are you aware of any Social Network Analysis software packages?

| Answer | Count | Percentage |
|---|---|---|
| Yes (Y) | 69 | 22.12% |
| No (N) | 243 | 77.88% |

8. If you answered 'Yes' to Question 7, please list which ones. If you answered 'No' to Question 7, please put 'None' in the response field.

The “None” response constituted the vast majority of responses, however, Palantir and Analyst’s Notebook (i.e., ANB) were the next most common response.

A variety of computer network and cyber-centric software tools and SMA tools were listed, such as: Maltego, Renoir, AllegroGraph (does have some SNA functionality), NodeXL (some SNA functionality), EgoNet, amongst others. Some specific SNA software was mentioned such as: UCINET, ORA, Gephi, and Pajek.

Numerous respondents would not reveal software because of classification concerns. Those interested in a full-listing may contact the author.

9. Have you used Social Network Analysis on deployments?

| Answer | Count | Percentage |
|---|---|---|
| Yes (Y) | 61 | 19.55% |
| No (N) | 251 | 80.45% |

10. If you answered 'Yes' to Question 9, please describe how it was used, time frame of deployment, and software (if any used). If you answered 'No' to Question 9, please put 'None' in the response field.

Responses were very similar to Question 6 in that it appeared respondents considered link analysis and SNA to be the same. Arguably, much of what was described would be considered link analysis with some additional considerations given to social relationships. Those interested in a full-listing may contact the author.

11. How would you rate your proficiency in conducting SNA?

| Answer | Count | Percentage |
|---|---|---|
| Not proficient, received no training (A1) | 210 | 67.31% |
| A little proficient, received some training (A2) | 70 | 22.44% |
| Proficient, received training (A3) | 24 | 7.69% |
| Very proficient, received training and conduct often (A4) | 8 | 2.56% |

### 3. SNA Assessment Questions (questions 12-23)

12. How does social network analysis differ from link analysis? If you don't know, put "I don't know" in the response field.

| **Question 12: SNA vs Link Analysis Summary** | | | | |
|---|---|---|---|---|
| | | Percentage | | |
| Total Responses: | 312 | 100% | | |
| "I don't know" Responses: | 208 | 66.66% | | |
| Reseponses Judged for Adequacy: | 104 | 33.33% | | |
| | | | | |
| | Adequate Responses | Percentage of Judged | Percentage of Total | |
| Judge 1 | 5 | 4.81% | 1.60% | |
| Judge 2 | 24 | 23.08% | 7.69% | |
| Judge 3 | 10 | 9.62% | 3.21% | |
| Mean | 13 | 12.50% | 4.17% | |

The range in “adequate” responses from the three judges resulted from varying criteria among the three. For example, one judge looked for one key element between SNA and link analysis, while another looked for specific mention of the mathematical underpinnings of SNA compared to link analysis.

For trends, one judge noted that respondents were very confident in their incorrect responses, and that many respondents had the wrong idea of not only SNA, but link analysis as well. Another noted that no respondents mentioned that in SNA, distance, or social space between nodes, is meaningful. Further, no respondents noted that SNA compares like-entities, while link analysis simply notes the existence of a link between two entities.

13. Is social media analysis the same thing as social network analysis?

| Answer | Count | Percentage |
|---|---|---|
| Yes (A1) | 22 | 7.05% |
| No (A2) | 115 | 36.86% |
| I don't know (A3) | 175 | 56.09% |

14. If you answered yes or no to Question 13, please explain your answer. If you answered 'I don't know' to question 13, please put 'I don't know' in the response field.

| **Question 14: SNA vs Social Media Analysis Summary** | | | | |
|---|---|---|---|---|
| | | Percentage | | |
| Total Responses: | 312 | 100% | | |
| "I don't know" Responses: | 187 | 59.94% | | |
| Responses Judged for Adequacy: | 125 | 40.06% | | |
| | | | | |
| | Adequate Responses | Percentage of Judged | Percentage of Total | |
| Judge 1 | 18 | 14.40% | 5.77% | |
| Judge 2 | 13 | 10.40% | 4.17% | |
| Judge 3 | 34 | 27.20% | 10.90% | |
| Mean | ~22 | 17.60% | 7.05% | |

As with Question 12, the range in the judge's scores is due to differing criteria among the three. For example, one judge wanted responses that noted that SMA is medium specific, and holistic. Another judge wanted respondents to state that SNA is about analyzing networks, and that social media is online, and consists of user-generated content on which SNA can be applied.

For trends, one judge noted difficulty in grading because even within their criteria, respondents could give adequate responses while still being confused about the differences between SNA and link analysis. For example, a respondent could give a strong, accurate response regarding the difference between SNA and SMA, however, the respondent's version of SNA could be incorrect. Another judge noted that many respondents simply didn't answer the question, and those that did often focused on the "online" or "cyber" aspects of social media.

15. Match the listed terms with the correct definition or description (1-5): Answers filled in chart and noted with answer distribution below.

| |
|---|
| 1. The extent to which each actor lies on the shortest path between all other actors in network. |
| 2. A measure of network topography that provides a network level measure of potentially exceptional nodes in the network. |
| 3. Assumes ties to central actors are more important than ties to peripheral actors and score is dependent upon centrality of adjacent nodes to which it connects |
| 4. Captures how close each actor is to all other actors in a network |
| 5. The count of the number of an actor's ties |

If you don't know, please select 'I don't know' for all answers.

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| **Eigenvector Centrality** | | | **X** | | |
| **Closeness Centrality** | | | | **X** | |
| **Degree Centrality** | | | | | **X** |
| **Betweeness Centrality** | **X** | | | | |
| **Centralization** | | **X** | | | |
| **I don't know** | | | | | |

Term 1: The extent to which each actor lies on the shortest path between all other actors in network. Correct Answer: **Betweeness Centrality**

| Answer | Count | Percentage |
|---|---|---|
| Eigenvector Centrality (A1) | 14 | 4.49% |
| Closeness Centrality (A2) | 24 | 7.69% |
| Degree Centrality (A3) | 8 | 2.56% |
| Betweeness Centrality (A4) | 39 | 12.50% |
| Centralization (A5) | 19 | 6.09% |
| I don't know (A6) | 208 | 66.67% |

Term 2: A measure of network topography that provides a network-level measure of potentially exceptional nodes in the network. Correct Answer: **Centralization**

| Answer | Count | Percentage |
|---|---|---|
| Eigenvector Centrality (A1) | 39 | 12.50% |
| Closeness Centrality (A2) | 4 | 1.28% |
| Degree Centrality (A3) | 18 | 5.77% |
| Betweeness Centrality (A4) | 11 | 3.53% |
| Centralization (A5) | 24 | 7.69% |
| I don't know (A6) | 216 | 69.23% |

Term 3: Assumes ties to central actors are more important than ties to peripheral actors and score is dependent upon centrality of adjacent nodes to which it connects. Correct Answer: **Eigenvector Centrality**

| Answer | Count | Percentage |
|---|---|---|
| Eigenvector Centrality (A1) | 25 | 8.01% |
| Closeness Centrality (A2) | 6 | 1.92% |
| Degree Centrality (A3) | 24 | 7.69% |
| Betweeness Centrality (A4) | 23 | 7.37% |
| Centralization (A5) | 29 | 9.29% |
| I don't know (A6) | 205 | 65.71% |

Term 4: Captures how close each actor is to all other actors in a network. Correct Answer: **Closeness Centrality**

| Answer | Count | Percentage |
|---|---|---|
| Eigenvector Centrality (A1) | 2 | 0.64% |
| Closeness Centrality (A2) | 74 | 23.72% |
| Degree Centrality (A3) | 12 | 3.85% |
| Betweeness Centrality (A4) | 13 | 4.17% |
| Centralization (A5) | 8 | 2.56% |
| I don't know (A6) | 203 | 65.06% |

Term 5: The count of the number of an actor's ties. Correct Answer: **Degree Centrality**

| Answer | Count | Percentage |
|---|---|---|
| Eigenvector Centrality (A1) | 20 | 6.41% |
| Closeness Centrality (A2) | 1 | 0.32% |
| Degree Centrality (A3) | 44 | 14.10% |
| Betweeness Centrality (A4) | 12 | 3.85% |
| Centralization (A5) | 25 | 8.01% |
| I don't know (A6) | 210 | 67.31% |

16. Match the listed terms with the correct definition or description (1-6): Answers filled in chart and noted with answer distribution below.

| |
|---|
| 1. Those actors in a network perceived by others to be valuable. It can also be achieved in terms of an actor's access to resources, knowledge, and other social circles. |
| 2. An aggregate level measure in which agents tend to form relationships such that a friend of a friend is a friend, a friend of an enemy is an enemy, and an enemy of an enemy is a friend. |
| 3. Is whether agents tend to form directed relationships with alters who initiate relationships with them. |
| 4. Deals with the tendency of individuals to form relations with those like themselves. |
| 5. Is the organizational or physical distance between two nodes |
| 6. Means that if there is a link between two actors (A and B) and another link between actor A and actor C (A and C) then there is a tendency for actor B and actor C to form a link with each other (B and C). |
| If you don't know, please select only the 'I don't know' response for all answers. |

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| **Homophily** | | | | X | | |
| **Reciprocity** | | | X | | | |
| **Proximity** | | | | | X | |
| **Prestige** | X | | | | | |
| **Transitivity** | | | | | | X |
| **Balance** | | X | | | | |
| **I don't know** | | | | | | |

Term 1: Those actors in a network perceived by others to be valuable. It can also be achieved in terms of an actor's access to resources, knowledge, and other social circles. Correct Answer: **Prestige**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 2 | 0.64% |
| Reciprocity (A2) | 2 | 0.64% |
| Proximity (A3) | 2 | 0.64% |
| Prestige (A4) | 97 | 31.09% |
| Transitivity (A5) | 1 | 0.32% |
| Balance (A6) | 1 | 0.32% |
| I don't know (A7) | 207 | 66.35% |

Term 2: An aggregate level measure in which agents tend to form relationships such that a friend of a friend is a friend, a friend of an enemy is an enemy, and an enemy of an enemy is a friend. Correct Answer: **Balance**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 6 | 1.92% |
| Reciprocity (A2) | 26 | 8.33% |
| Proximity (A3) | 8 | 2.56% |
| Prestige (A4) | 2 | 0.64% |
| Transitivity (A5) | 25 | 8.01% |
| Balance (A6) | 26 | 8.33% |
| I don't know (A7) | 219 | 70.19% |

Term 3: Is whether agents tend to form directed relationships with alters who initiate relationships with them. Correct Answer: **Reciprocity**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 7 | 2.24% |
| Reciprocity (A2) | 54 | 17.31% |
| Proximity (A3) | 2 | 0.64% |
| Prestige (A4) | 2 | 0.64% |
| Transitivity (A5) | 9 | 2.88% |
| Balance (A6) | 19 | 6.09% |
| I don't know (A7) | 219 | 70.19% |

Term 4: Deals with the tendency of individuals to form relations with those like themselves. Correct Answer: **Homophily**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 80 | 25.64% |
| Reciprocity (A2) | 7 | 2.24% |
| Proximity (A3) | 2 | 0.64% |
| Prestige (A4) | 1 | 0.32% |
| Transitivity (A5) | 5 | 1.60% |
| Balance (A6) | 5 | 1.60% |
| I don't know (A7) | 212 | 67.95% |

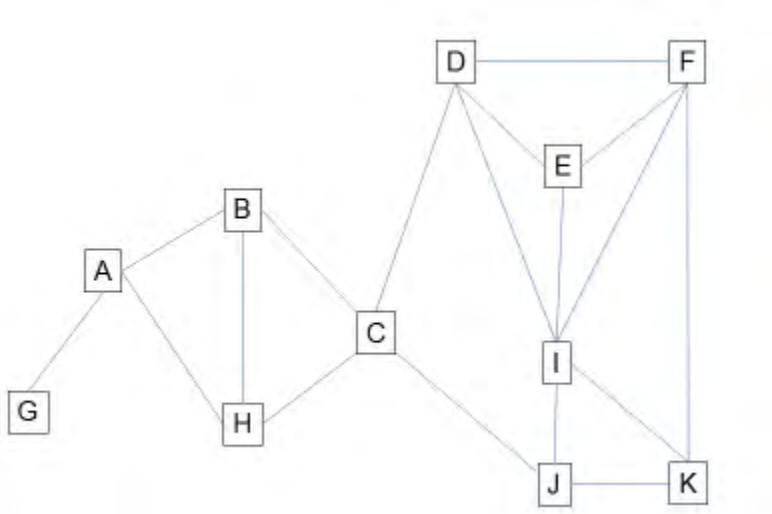
Term 5: Is the organizational or physical distance between two nodes. Correct Answer: **Proximity**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 2 | 0.64% |
| Reciprocity (A2) | 1 | 0.32% |
| Proximity (A3) | 92 | 29.49% |
| Prestige (A4) | 0 | 0.00% |
| Transitivity (A5) | 2 | 0.64% |
| Balance (A6) | 10 | 3.21% |
| I don't know (A7) | 205 | 65.71% |

Term 6: Means that if there is a link between two actors (A and B) and another link between actor A and actor C (A and C) then there is a tendency for actor B and actor C to form a link with each other (B and C). Correct Answer: **Transitivity**

| Answer | Count | Percentage |
|---|---|---|
| Homophily (A1) | 1 | 0.32% |
| Reciprocity (A2) | 8 | 2.56% |
| Proximity (A3) | 3 | 0.96% |
| Prestige (A4) | 1 | 0.32% |
| Transitivity (A5) | 58 | 18.59% |
| Balance (A6) | 25 | 8.01% |
| I don't know (A7) | 216 | 69.23% |

Use the sample network pictured below to answer questions (17-19):




17. Using the figure above: What is the length of the geodesic between vertex G and K? If you don't know, please select the 'Other' option.
Correct Answer: 5

| Answer | Count | Percentage |
|---|---|---|
| 4 (A1) | 13 | 4.17% |
| 5 (A2) | 135 | 43.27% |
| 6 (A3) | 5 | 1.60% |
| 7 (A4) | 5 | 1.60% |
| 8 (A5) | 5 | 1.60% |
| Other | 149 | 47.76% |

18. Using the figure above: which node has the highest degree centrality? If you don't know, please select 'Other'.
Correct Answer: I

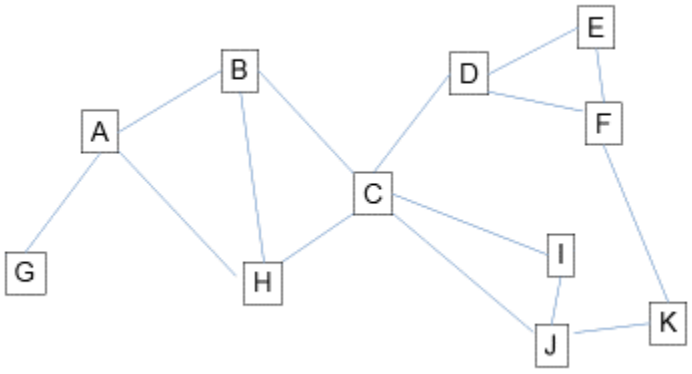
| Answer | Count | Percentage |
|---|---|---|
| A (A1) | 0 | 0.00% |
| B (A2) | 1 | 0.32% |
| C (A3) | 39 | 12.50% |
| D (A4) | 0 | 0.00% |
| E (A5) | 22 | 7.05% |
| F (A6) | 4 | 1.28% |
| G (A7) | 1 | 0.32% |
| H (A8) | 0 | 0.00% |
| I (A9) | 102 | 32.69% |
| J (A10) | 0 | 0.00% |
| K (A11) | 0 | 0.00% |
| Other | 143 | 45.83% |

19. Using the figure below: which node probably has the highest betweeness centrality? If you don't know, please select 'Other’.

Correct Answer: C

| Answer | Count | Percentage |
|---|---|---|
| A (A1) | 0 | 0.00% |
| B (A2) | 1 | 0.32% |
| C (A3) | 80 | 25.64% |
| D (A4) | 3 | 0.96% |
| E (A5) | 28 | 8.97% |
| F (A6) | 1 | 0.32% |
| G (A7) | 2 | 0.64% |
| H (A8) | 0 | 0.00% |
| I (A9) | 18 | 5.77% |
| J (A10) | 1 | 0.32% |
| K (A11) | 0 | 0.00% |
| Other | 178 | 57.05% |

Use the sample network pictured below to answer question (20):




20. Using the figure above: select which two nodes exhibit structural equivalence. If you don't know, please select 'Other' and put an alphanumeric character in the space provided.

Correct Answer: B and H

| Answer | Count | Percentage |
|---|---|---|
| A (SQ001) | 18 | 5.77% |
| B (SQ002) | 60 | 19.23% |
| C (SQ003) | 37 | 11.86% |
| D (SQ004) | 30 | 9.62% |
| E (SQ005) | 15 | 4.81% |
| F (SQ006) | 17 | 5.45% |
| G (SQ007) | 5 | 1.60% |
| H (SQ008) | 62 | 19.87% |
| I (SQ009) | 17 | 5.45% |
| J (SQ010) | 14 | 4.49% |
| K (SQ011) | 11 | 3.53% |
| Other | 182 | 58.33% |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 0 | 2 | 3 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 |
| 2 | 0 | 11 | 11 | 2 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 2 | 6 |
| 3 | 2 | 11 | 22 | 8 | 3 | 4 | 2 | 3 | 5 | 1 | 4 | 4 | 4 | 3 | 8 |
| 4 | 3 | 2 | 8 | 12 | 1 | 1 | 3 | 2 | 4 | 3 | 3 | 2 | 2 | 0 | 4 |
| 5 | 0 | 1 | 3 | 1 | 3 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 0 | 1 |
| 6 | 1 | 3 | 4 | 1 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 3 |
| 7 | 1 | 0 | 2 | 3 | 1 | 0 | 4 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | 0 |
| 8 | 1 | 1 | 3 | 2 | 0 | 1 | 0 | 4 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 9 | 1 | 1 | 5 | 4 | 1 | 0 | 1 | 0 | 6 | 0 | 0 | 1 | 1 | 0 | 1 |
| 10 | 1 | 0 | 1 | 3 | 0 | 0 | 1 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 0 |
| 11 | 0 | 3 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 1 | 4 | 2 | 1 | 0 | 3 |
| 12 | 0 | 3 | 4 | 2 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 5 | 2 | 0 | 3 |
| 13 | 0 | 3 | 4 | 2 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 2 | 5 | 1 | 3 |
| 14 | 0 | 2 | 3 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 3 | 0 |
| 15 | 1 | 6 | 8 | 4 | 1 | 3 | 0 | 1 | 1 | 0 | 3 | 3 | 3 | 0 | 9 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 3 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| 2 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 3 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 |
| 4 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 3 | 2 | 3 | 1 | 1 | 3 | 1 | 2 | 3 | 2 | 2 | 2 |
| 5 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 0 | 0 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 6 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 2 | 2 | 3 | 2 | 0 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| 7 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 3 | 2 | 1 | 1 | 2 | 1 | 1 |
| 8 | 1 | 1 | 0 | 0 | 0 | 0 | 2 | 3 | 2 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 2 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 9 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 2 | 4 | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 2 | 1 | 2 | 1 | 0 | 2 | 0 | 0 |
| 10 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 11 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 0 | 0 | 2 | 3 | 0 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 |
| 12 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 | 0 | 2 | 1 | 1 | 0 | 0 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 |
| 13 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 4 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 |
| 14 | 2 | 1 | 2 | 3 | 2 | 2 | 3 | 1 | 1 | 1 | 2 | 1 | 2 | 7 | 4 | 2 | 5 | 4 | 2 | 5 | 2 | 2 | 3 | 3 | 3 | 3 |
| 15 | 1 | 1 | 1 | 3 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 4 | 5 | 3 | 3 | 2 | 1 | 3 | 1 | 2 | 4 | 3 | 3 | 2 |
| 16 | 1 | 1 | 1 | 2 | 2 | 3 | 1 | 0 | 1 | 1 | 2 | 0 | 1 | 2 | 3 | 5 | 2 | 0 | 1 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| 17 | 1 | 2 | 2 | 3 | 1 | 2 | 2 | 0 | 0 | 1 | 2 | 0 | 2 | 5 | 3 | 2 | 6 | 2 | 1 | 4 | 1 | 2 | 3 | 2 | 2 | 3 |
| 18 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 4 | 2 | 0 | 2 | 5 | 2 | 2 | 1 | 1 | 1 | 2 | 1 | 1 |
| 19 | 3 | 2 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | 5 | 2 | 2 | 1 | 1 | 3 | 1 | 1 |
| 20 | 2 | 1 | 1 | 3 | 1 | 2 | 3 | 1 | 1 | 2 | 1 | 2 | 5 | 3 | 2 | 4 | 2 | 2 | 2 | 5 | 2 | 2 | 3 | 3 | 2 | 2 |
| 21 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 1 |
| 22 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 2 | 1 |
| 23 | 1 | 1 | 1 | 3 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 4 | 3 | 3 | 1 | 1 | 3 | 1 | 2 | 4 | 3 | 2 | 2 |
| 24 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 3 | 3 | 2 | 2 | 3 | 5 | 1 | 1 |
| 25 | 1 | 1 | 1 | 2 | 2 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 3 | 2 |
| 26 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 0 | 0 | 1 | 2 | 0 | 1 | 3 | 2 | 2 | 3 | 1 | 1 | 2 | 1 | 1 | 2 | 1 | 2 | 3 |

21. Consider the two matrices above. They are derived from an affiliation matrix that recorded the 15 clubs to which 26 CEOs belonged. The top matrix is the actor-by-actor (co-membership) matrix. The bottom one is the event-by-event (event overlap) matrix. How many club memberships do CEOs #1 and #13 share? If you don't know, please select 'Other'.
Correct Answer: 3

| Answer | Count | Percentage |
|---|---|---|
| 1 (A1) | 2 | 0.64% |
| 2 (A2) | 3 | 0.96% |
| 3 (A3) | 82 | 26.28% |
| 4 (A4) | 6 | 1.92% |
| 5 (A5) | 9 | 2.88% |
| Other | 210 | 67.31% |

22. Consider the two matrices above. They are derived from an affiliation matrix that recorded the 15 clubs to which 26 CEOs belonged. The top matrix is the actor-by-actor (co-membership) matrix. The bottom one is the event-by-event (event overlap) matrix. How many clubs does CEO #7 belong to? If you don't know, please select 'Other'.
Correct Answer: 4

| Answer | Count | Percentage |
|---|---|---|
| 1 (A1) | 3 | 0.96% |
| 2 (A2) | 7 | 2.24% |
| 3 (A3) | 7 | 2.24% |
| 4 (A4) | 66 | 21.15% |
| 5 (A5) | 4 | 1.28% |
| Other | 225 | 72.12% |

23. Consider the two matrices above. They are derived from an affiliation matrix that recorded the 15 clubs to which 26 CEOs belonged. The top matrix is the actor-by-actor

(co-membership) matrix. The bottom one is the event-by-event (event overlap) matrix. How many CEOs were members of club #4? If you don't know, please select 'Other'.
Correct Answer: 12

| Answer | Count | Percentage |
|---|---|---|
| 2 (A1) | 2 | 0.64% |
| 3 (A2) | 6 | 1.92% |
| 8 (A3) | 11 | 3.53% |
| 12 (A4) | 52 | 16.67% |
| 15 (A5) | 9 | 2.88% |
| Other | 232 | 74.36% |

24. Would you like to be contacted by the researcher of this study to discuss the study in more detail? If you would, please provide your email address and/or phone number in the space provided. Please note that if you provide your contact information that your identity and survey results will be made available to the researcher. If you do not wish to be contacted, leave the space blank.

Redacted for privacy

# APPENDIX C. INTERVIEW METHODOLOGY AND QUESTION POOL

## A. INTERVIEW METHODOLOGY

Candidates for interview were chosen using a snowball technique. That is, outside of initial candidates with whom the researcher knew, or his advisors could immediately recommend, each subsequent interview candidate was recommended by a previous candidate. As additional information was learned, subsequent interviews were adjusted. The grounded theory approach best describes the overall methodology used. For this study, the research purpose, which was to improve SNA capability in the MCISRE, was the starting point, and interviews and independent study provided an azimuth for the development of recommendations.

Interviews were conducted in a private setting, where distractions could be minimized—most often an interviewee's office. On multiple occasions, group interviews were conducted for both the sake of time, but also to allow for the development of discussion. When possible, interviews were recorded using an electronic voice recorder so that the researcher could focus on maintaining discussion, and not writing notes. When a voice recorder was not used, the interviewer would write down responses, and follow up an interview with an email to clarify remarks or ask additional questions.

Interviews themselves were semi-structured in approach and tailored to a given interviewee's background. For example, an interviewee with experience in training and education, would be asked questions about those topics, as opposed to questions related to SNA software. In most cases, interviewees had broad backgrounds and experiences in multiple fields and could provide a number of different insights. The typical interview lasted between 45 minutes and one hour.

## B. INTERVIEW QUESTION GUIDE

In order to begin research, the researcher was required to submit interview material to the Institutional Review Board (IRB) as part of its Human Subject Research review protocol. Due to the grounded theory approach, setting a specific set of interview

questions prior to beginning actual research was not feasible. As such, the following bulleted-points represent the general pool of questions the researcher submitted as part of IRB protocol and was used as a reference during interviews, but not necessarily as a guide.

**1. SNA Training and Application SMEs**

- What is your experience with social network analysis (SNA)?
- How did you get into it / find out about it?
- School?
- Deployment?
- Military training?
- Other?
- What issues and shortfalls have you identified with it either in trying to train it or apply it?
- SNA itself—limitations to what it is / does?
- External issues—unreceptive command, personnel shortfalls, etc.?
- How would you characterize the understanding amongst military or other agency professionals about what SNA is?
- Elaborate / explain
- What do they think it is?
- What are common perceptions or misconceptions?
- In your opinion, what needs to be in place to effectively train SNA or apply it in an operational environment?
- Systems?
- Personnel?
- Shop or section manning or layout?
- Who does it, why, when?

- Time requirements?
- Aside from software, computers, and personnel—what else do you need in place—what front end efforts must go into to successful employment?
- Does it affect intelligence collection requirements?
- What types of missions would it be most useful for—or most un-useful for?
- Other?
- What equipment / systems did you or do you use?
- Security / IA issues?
- Cost?
- Training time for software?
- Software shortfalls or issues encountered (i.e., crashes often, not good for large data sets)?
- Other issues?
- Training recommendations?
- What methods of instruction do you think work the best—what has worked best for you —why?
- What hasn't worked and why?
- Scenarios?
- Do you use them? If so, why? If not, why?
- With SNA, some classes get mathematics involved, others don't—what's your take in terms of instruction and ultimately retention?
- If you were to build an ideal training methodology—how would you do it?
- How long would it be (continuous or segmented)?
- Who would be the target audience?— why?
- What would you cover and what would you leave out—why?

- References, which ones and why?
- What instructional methods would you use—lecture, guided discussion, etc.—why?
- Within greater analytical framework—i.e., in how we understand the operating and informational environments, where do you place and see SNA?
- As a whole, do you think SNA receives proper attention or do you think it needs more? Why?
- Do you have thoughts or ideas for me as I continue my research?
- Any other lessons learned you would like to share?
- Do you think I missed anything in the interview that you would like to add?
- Any questions or comments?

**2. UMSC Training and Education SMEs**

- Fundamentally, how does the training and education process work?
- From entry level through higher ranks?
- What are the primary guiding documents that we use?
- Can you discuss how intelligence training works?
- Enlisted and Officer?
- Entry level through career level?
- Other training opportunities?
- How are they created?
- Who runs them?
- How are new ideas or methods or subjects introduced into formal training?
- Doctrine, MARADMIN, etc.?
- How are events introduced into the T&R?

- What about events not in the T&R how do they get trained—or do they?
- For example, a non-doctrinal activity?
- So, with SNA, if I wanted it to be introduced into intelligence training, how do I go about doing it?
- At entry level?
- At career level?
- How do we get it into fleet schools such as Regional Intelligence Training Centers (RITCs)?
- What goes into making that decision?
- Typically, how long does the process take?
- Instructors (Contractors, GS, or military) are there different considerations for each? If so, what are they?
- What equipment or cost factors are there?
- Who ultimately makes the decision—who makes decisions along the way?
- Other?
- Any other thoughts and considerations or anything to add?
- Any questions or comments about the interview?

**3. Marine Corps Intelligence SMEs**

- What is your experience, if any, with Social Network Analysis?
- If so, where did you acquire it?
- Broadly, what is your opinion on SNA?
- Do you see it as something congruent with the DIRINT's Marine Corps Intelligence, Surveillance, and Reconnaissance (MCISRE) Roadmap?
- Do you believe it is something the USMC IC should adopt or invest further training into? Why?
- What issues would you see standing in the way of implementing SNA?

- Training?
- Personnel?
- Systems?
- Other?
- Do you think we are currently doing SNA / using SNA as a community?
- If so, where, who, and for what?
- Where do you see SNA fitting into the greater analytic framework?
- Who does it?
- At what level—battalion, regiment, higher, MEU?
- Where do the results of it reside?
- Where does SNA expertise reside?
- What current missions sets do you suppose SNA would be most useful—what ones would it be least useful?
- How do you see it being implemented?
- What challenges does the USMC intelligence community face right now and into the future?
- Where do you see the USMC intelligence going?
- What will be our points of emphasis?
- Will training and education change?
- Certification and professionalization?
- How?
- How are we going to get there?
- Do you see SNA as part of the future of Marine Corps intelligence?
- Are you supportive of it?
- Any other thoughts or considerations or anything to add?

- Any questions or comments about the interview?
- Miscellaneous:
- Systems—how do we get SNA software onto our current intelligence systems?
- What are the considerations for security, cost, training, licensing, etc.?

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