Social Network Analysis Workshop for Water and Resource Management

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Several CSU faculty, graduate students, and professionals are appreciated for preparing specific briefs on their work and research that provided important practical applications of social network analysis for attendees. All attendees must also be thanked for devoting four hours of their weekday evening to participate substantively in the topics discussed and for their thoughtful workshop evaluations. Thanks in particular to all those who have chosen to continue expanding their learning and sharing through the online SNA Workshop collaborative companion website (http://sna.wateractionnetwork.org).

In 2014 spring follow-up, three additional SNA teaching opportunities presented themselves. Thanks to Danielle Ross-Winslow for organizing *Social Networks and Natural Resource Management* for the federal / CSU co-sponsored Interactions of Society and the Environment Seminar Series. Sincere thanks to Carla Schnitker, One World-One Water Center at Metropolitan State University of Denver, for permitting an introduction to SNA to be provided to her students. Special thanks to Tara Teel, Human Dimensions of Natural Resources Program at CSU, and her Conservation Leadership through Learning cohort for participating in a full-day follow-up SNA workshop, which included GEPHI SNA software training.

Many faculty and CSU staff also assisted in promoting the workshop in engineering, agriculture, forestry, natural resources, and other technical disciplines. Without this recruiting assistance, attendees would not have been as diverse, the discussions would have been less interesting, and we all would have learned less.

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ABSTRACT:

Social network analysis (SNA) is a system for studying relationships and transactions between people, organizations, countries, and other entities. The purpose of this CWI project was to research and apply SNA techniques, then develop materials to provide a Fall 2013 half-day introductory workshop in *Social Network Analysis for Water and Natural Resources Management* at Colorado State University (CSU). The SNA workshop introduced interested students and professionals in engineering, natural resources, agriculture, and other scientific disciplines to complimentary analysis for human dimensions of their work and research through SNA principles and techniques. Complex social-ecological systems cannot be well-studied by only relying on technical analysis of the natural systems. SNA can help analyze how humans interact with resources and their environment and how their ties affect management choices. Social network structure can then be improved to enhance cooperation and innovation.

CSU TILT instructional designers were involved in periodic workshop materials review with focus on implementing Research-Based Instructional (RBI) design. The workshop was marketed intensively for three weeks prior to delivery. The most effective means of participant recruitment were word of mouth and group emails, rather than posted flyers or campus-wide online calendars and newsletters. Instead of a traditional classroom, the SNA workshop was held in a conference room that permitted all attendees to sit facing one another around a large oval table, which enhanced participation and shared learning. Expert speakers with real world experience and warnings helped attendees better understand SNA application context and nuance. Providing two smaller sessions, rather than one larger offering, also allowed all attendees to participate more fully, and post-workshop evaluations from the first session were used to improve the second session by most evaluation measures.

Follow-up included posting an SNA software demo online using CSU Echo 360 software and expanding other resources and discussion at the SNA Workshop Collaborative website (http://sna.wateractionnetwork.org) to serve as an ongoing source for learning and sharing. Although not in the scope of the original project, in the Spring of 2014, a half-hour panel brief, a shortened seminar for undergraduates, and SNA software training for graduate students were also tested for SNA technical education merit. The SNA workshop will continue to be refined and tailored to specific CSU departments and programs, and it may be offered to more academic institutions and for other groups and agencies statewide and nationwide. Since attendees felt more time was needed to cover the many related topics and better learn SNA software tools for different applications, the SNA workshop will also be developed into a semester-long course and related textbook.

Keywords:

Social Network Analysis (SNA), Social-Ecological Systems, Adaptive Co-management (ACM), Researched-Based Instruction (RBI), Coalition Building, Core-Periphery, Hub-Spoke, Integrated Water Resources Management (IWRM), Network Weaver, Fragmentation, Centrality, Isolate, Bridging Tie, Triadic Closure, Bonding Tie, Homophily, Cohesion, Social Capital, Social Learning, Redundancy, Network Maturity Model, Resilience, Tacit Knowledge

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1.0 JUSTIFICATION OF WORK PERFORMED

1.1 Why SNA is an Important Tool for Water and Natural Resources Engineers and Managers

Each organization and institution shown in Figure 1 that can be found operating within a community has an organizational mission and hierarchical structure of positions with defined roles to carry out its business. However, none of them operate completely independently of others and collectively they impact water and the environment in a variety of ways.

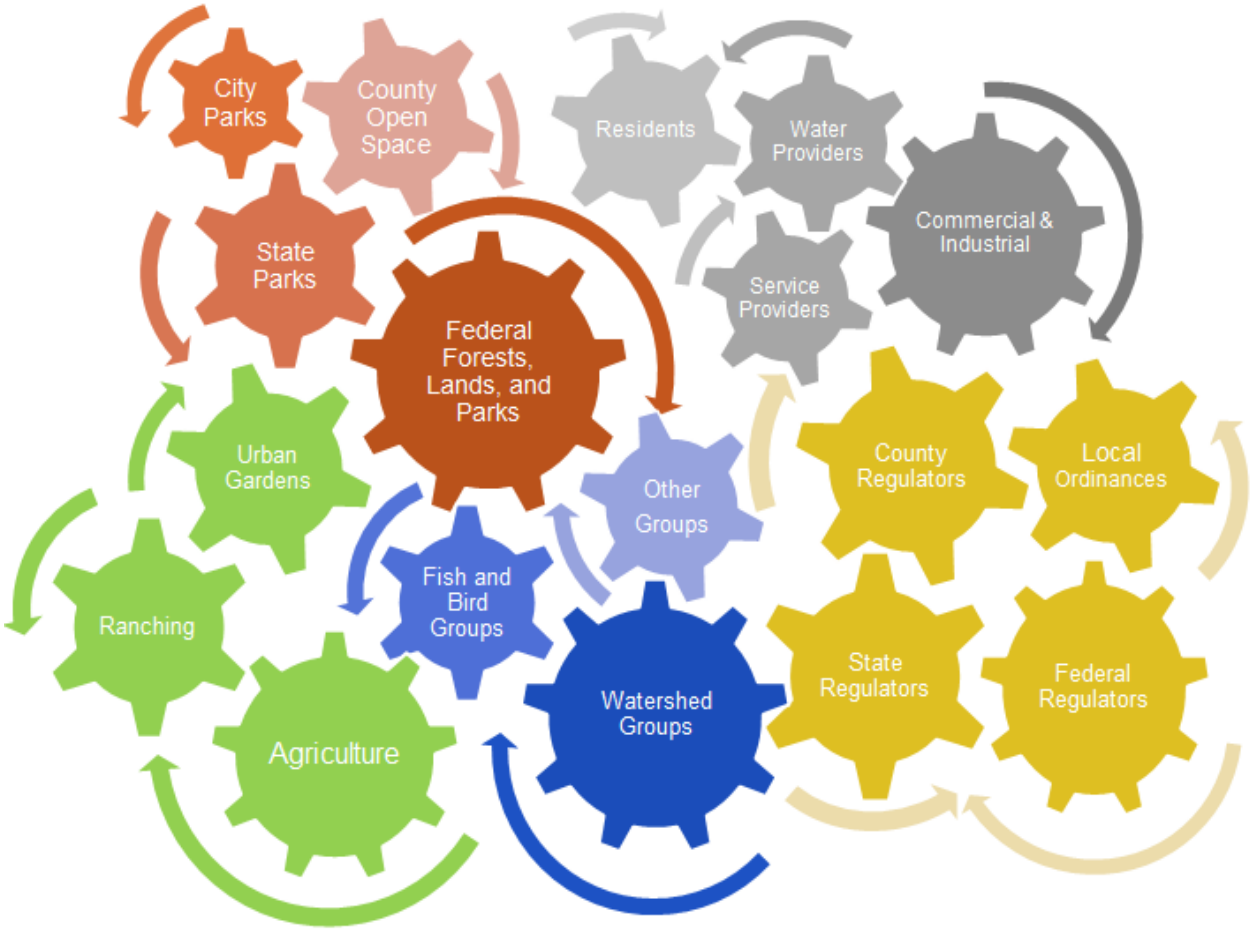


Figure 1. Different Community Stakeholders and Layers of Regulation must Align for Progress

This relational nature of water and natural resources problems increases management complexity in several critical ways. Interorganizational relationships and transactions are not often described in organizational by-laws or formal memorandum-of-understanding between organizations. Usually interorganizational ties are formed through a difficult-to-determine set of social practices held in common among members of each distinct group and coalition. These sociological constructs are in continual flux through interactions between groups and group members involved in each intergroup transaction and other environmental factors. Sometimes relationships between players outside of their formal roles – such as company managers sharing

a hunting friendship – might affect how organizations relate to one another, as well. Knowledge and resource exchange does not transpire evenly throughout social networks, but tends to clump within clusters of like-minded sectors and interests. For example, how rules are applied may be affected by stronger ties between certain regulators, regulated entities, and political forces, so the law may seem more just to these collaborators than others. Information, resource, regulatory, and communication fragmentation creates obstacles to exchange that requires conscious actions to circumvent or correct. Social network analysis provides theories and software tools to understand relational complexities and to work toward improving network structure to enhance cooperation.

Humans threaten watershed function by fragmenting habitat, infilling wetlands, altering flows, increasing erosion, overusing natural resources, concentrating nutrients, and contaminating the environment. Fragmented rule-making authority spans federal, state, county, and local jurisdictions. Public, private, and leased lands intermingle, making landscape-scale wildfire, flood, and drought mitigation planning more challenging. Uncertainty in pollutant sources and their fate and transport makes it difficult to determine the most appropriate technical measures to improve water quality. Even when pollution sources and pathways are generally known, competing science and contrasting results may lead to disagreement over which corrective measures to employ.

To attempt to apply engineering and technology solutions to water and natural resources problems independently of an understanding of these relationships, uncertainties, ambiguities, and the resulting social dimensions of the problem can lead to less optimal solutions. Engineers most often operate in an academic or consultant role, so their tasks may already be ill-defined and of too limited scope to address most underlying complexities. It is also common for communities simply not to think to call upon technical expertise in certain phases and circumstances, reducing the role technology and engineering play in crafting more comprehensive solutions.

For these reasons, business and relations do not necessarily adapt and transform in ways the community may consider most positive. By limiting applied science and engineering roles in watershed management, less innovation is applied to halt degradation in ecosystem services to ensure clean water and air, increasing concomitant health and economic losses over time. The UN ecosystem assessment worries that watersheds will continue to degrade, because currently applied political and technical solutions are not sufficient to halt or reverse current trends (MEA 2005).

Interdisciplinary distrust may exacerbate these issues because a watershed manager with biological, nonprofit, or natural resources training may see an engineer as an enemy, who supports wastewater dischargers and urban development over environmental protection. They may not consider that a different kind of engineer could offer assessment, modeling, best practices, and other critical technical support for more rapid reductions in stormwater, wastewater, and nonpoint pollution sources. In other cases, communities simply cannot afford engineering support or it is unavailable.

To continue to ignore these relational realities hurts engineers, whether in a water management, regulatory, academic, or consultant role. It prevents engineers from having a greater impact on their communities and playing a more important role in the civil discourse that would lead to improved civil engineering practices more aligned with specific community aims to promote sustainability and resilience. Of especial concern is that poor local choices have proven to have regional and, collectively, even global implications for planetary health and human advancement (MEA 2005).

Civil engineers no longer frequently have the opportunity to design historic, regional water structures. Instead, today's water resource engineers must recognize more extreme limitations, work with several different disciplines, and help to build *management coalitions*, rather than expect a single technical type to effectively lead a watershed program. They must learn community through extended, diverse engagement, and spend more time and social capital to build robust cooperative resource and funding networks. With this expanded mindset, a water resource engineer can then more effectively focus on their particular professional strengths: building collaborative knowledge networks for more effective decision support, planning and conducting studies, improving models, monitoring thresholds, assessing progress, and sharing engineering expertise to continually expand community technical capacity.

By helping to analyze stakeholders involved in water and landuse decisions, their competing interests, and underlying values, SNA may help resolve complex water issues. SNA can be used to plan stakeholder engagement processes to work towards shared understanding. Robust coalitions may then be built to address complex issues as a team. Knowledge, resources, and funds can be pooled towards creative, longer-term solutions than any one group could accomplish on its own. Regulatory effects may also be better aligned to reduce the economic cost of compliance.

SNA provides a point of initiation to train more water resources planning and management student in these skills. By providing theory and software that helps focus on creating the antecedent conditions for success: community capacity and institutional alignment, SNA helps to create an environment to more effectively target water resources engineering services.

1.2 Background

This project was based on the need expressed by CSU graduate students in several science and engineering departments. They wished to learn Social Network Analysis (SNA) for interdisciplinary research and practice to better understand the relational human dimensions of water resources, natural resources, and environmental management. However, there are only a few CSU semester long courses in sociology, communications, and anthropology that briefly mention SNA as part of the curriculum. Therefore, the *Social Networking Analysis for Water and Resource Management* Workshop (SNA Workshop) was designed to specifically fill a gap in natural systems-focused SNA for under-served seniors and graduate students, as well as, interested faculty in CSU science and engineering departments, and interested area professionals.

Not only can SNA help researchers describe social, organizational, political, legal, and regulatory issues better, but it may also be used to compare successful and unsuccessful applications of Integrated Water Resources Management (IWRM) and other resource management methods. SNA may also serve to more fully analyze how well alternative options improve relationships for long term sustainability and resilience, rather than focusing only on technical merits. SNA is an effective monitoring and assessment tool to gauge how well an implemented solution improves social network structure to enhance cooperation and resource and information exchange over time.

1.3 Anticipated Benefits

Increasing awareness of SNA among workshop attendees in agriculture, engineering, and natural resources disciplines met several objectives:

- encourage attendees to strive to build more resilient social-ecological systems,
- consider the human dimensions of apparently technical problems more analytically,
- increase interdisciplinary research and project activity,
- increase the flow of scientific research into practical applications, and
- better assess project outcomes to include improvements in social network structure.

Since the SNA Workshop could be repeated at different interested universities and other settings after initial development, training potential could be quite large, but as a minimum, a single workshop was planned to reach at least twenty students in engineering, natural resources, natural sciences, and agriculture colleges in a variety of disciplines at CSU through effective marketing.

1.4 SNA Basics

To better understand course content and utility, critical sociological principles that underlie SNA and the SNA concepts and methods that were taught will be briefly explained.

1.4.1 Sociology

Sociology is the study of interactions and relations among human beings and how the governing rules of society are founded and perpetuated. Understanding basic principles in sociology can assist in employing SNA to improve cooperation among groups involved in water and natural resources management. Since sociology studies the interactions between people, it mainly focuses on groups and institutions. A group can be an informal group of friends or a complex, multinational organization. Institutions are the formal systems a particular society develops to educate, feed, and regulate its citizens. For example, in the United States, we have a complex system of federal U.S. Environmental Protection Agency (EPA) regulations enforced by the Colorado Division of Public Health and Environment, Water Quality Control Division (CDPHE WQCD), city and county governments, and water and wastewater providers to ensure that our drinking water is clean and that wastewater is purified before it reenters our lakes and streams.

There are four main concepts used to study social practices that develop within and among groups in society, including: beliefs, values, norms, and sanctions. Beliefs are the collective views of a group about what is true, such as that *all men are created equal*. Values represent matters of preference, such as, what is the best way an environmental group thinks it should preserve habitat in the watershed. Norms are the group's expected patterns of behavior for each particular group role. Sanctions are positive and negative rewards conferred on a person for executing a role to conform appropriately with its *pre-defined* patterns of behavior. By *consciously* analyzing the underlying forces controlling the social practices of each group, an engineer can become more effective in interacting with the group and in fostering its cooperation with other groups.

At any moment throughout the day, each person may be *acting* in a particular role in the context of a particular organizational setting. While performing that role, they will have to reflect certain values, beliefs, norms, and sanctions associated with that role that could be very different than they would act in a different context in which they are performing a different role – such as meeting a boss or being a parent at a soccer game. For this reason, engineers should attempt to interact with community members in different settings, then apply SNA to better understand all the aspects of their lives and groups in terms of the different roles they perform. By using SNA to analyze a community technically, engineers may develop a deeper understanding of the groups and settings that control them. This can help limit quick (and typically simplified) judgments, while providing new problem-solving avenues that include a broader range of social, economic, political, and regulatory solutions. SNA helps reveal how individual and group characteristics may be exercised through network interactions as *unconscious sorters*. This occurs because links tend to form between groups and individuals with the most in common, known as *homophily* (McPherson et al. 2001). This knowledge may help further ties that bind and minimize differences to develop problem-solving coalitions. Returning to Figure 1, imagine all the organizations and institutions shown as cogs operating as an efficient machine built for collaboration and innovation to resolve community problems as a team.

1.4.2 Social Network Theory

For the purpose of SNA, relationships and interactions are represented as simple nodes (actor, vertex, site) and links (tie, edge, arc). A network boundary defines what nodes and links are included.

As an example, the SNA shown in Figure 2 represents an ego network, which depicts a single entity (the ego) and its relationships with others (its altars), in which the thickness of the ties could represent the strength of the relationships and the size of the nodes could depict the relative importance of each entity in the overall network. The dotted line represents the network boundary, showing which entities and relationships have been included – and which have not – and how these relationships and characteristics were determined. It is particularly important to describe likely errors, as false nodes or missing ties can greatly affect the analysis.

The kernel of SNA is the dyad, two nodes representing two people, organizations, countries, species, etc., which are connected by a link. The link may represent either a relationship (bond) or transaction (single point in time or continuous flow). The link may be uni-directional (one-way) or bi-directional (both ways), represented by single or double arrows. More than one type of link may also connect two nodes, which can be a particularly effective way to measure strength of relationships. Dyads are used in pairwise relationship studies, such as how different water resources engineering role associations affect specialization.

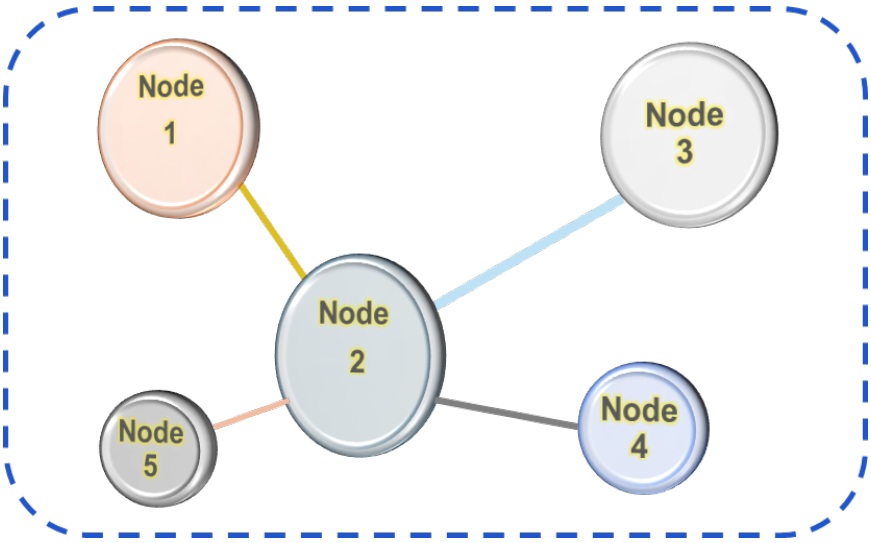


Figure 2. SNA Example of Ego Network with Altars

In addition to the dyad and ego network units of analysis, another focal point of SNA is triad analysis. A triad is particularly important to organizational research because it is the building block of a social network. An open triad consists of one node that connects to two other nodes that do not connect to each other. SNA demonstrates that networks generally expand by closing these open triads (Granovetter 1973). This tends to occur because if A is friends with both B and C (open triad in Figure 3), A will tend to introduce B and C, and they will begin to interact, as well (closed triad in Figure 3). If not, A may end up disassociating with B and / or C for not closing the triad, a form of sanctioning. Over time, systematically closing triads can achieve a denser core of principal associations and stronger outward links to access resources more effectively.

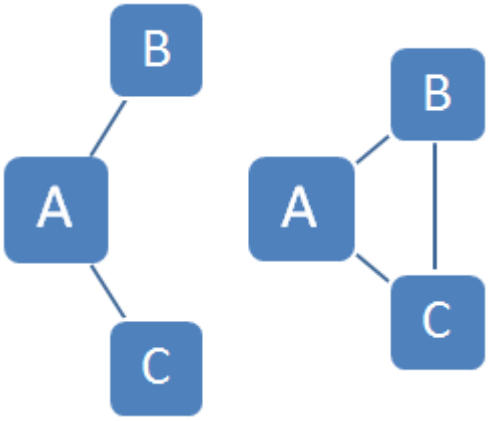


Figure 3. Triadic Closure

Closing triads helps create a tighter central core of mutually connected nodes. All nodes that are directly connected to each other through a cluster of closed triads are known as a clique, or more loosely as a subgroup. An n-clique represents a cluster that does not yet possess completely closed triads, but every node is connected to every other node by just a few *hops*. For example, a 3n-clique would connect all members within three links. SNA has led to the important realization that in many situations, there are really only a few choice hops separating one node from almost any other node in the network. This is possible because, even as the number of nodes increases exponentially in the typical population, the average shortest path distance measured in links between one node and any other node only increases *linearly*

(Figure 4). This is evident in most social networks due to inherent clustering, which greatly improves overall connectivity compared to random link generators that would produce a more evenly spaced network of nodes and links. You may know this as *small world theory* because when you meet someone at a professional event you quickly find you have a mutual acquaintance and note *what a small world we live in*! It is also know as *six degrees of separation* from studies indicating that on average you may be connected to almost anyone in the nation by just a few hops and the world by a few more (Easley & Kleinberg, 2010).

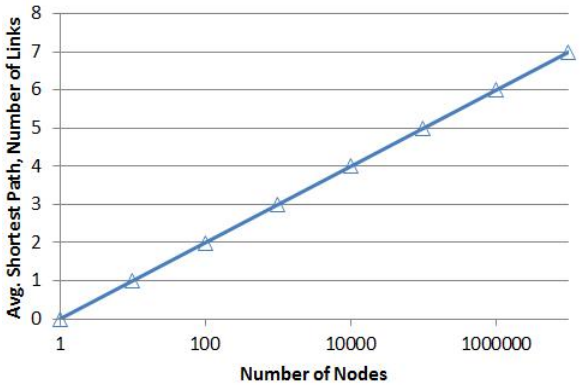


Figure 4. Shortest Path vs. Number of Nodes

This relationship has important implications for watershed management and multi-scale IWRM. It indicates that by systematically improving even a few key connections, flow throughout the entire network can be significantly improved. One way SNA can help accomplish this task is by comparing bonding and bridging ties. A bonding tie links members of a subgroup, which we already discussed as being well connected, allowing the free flow of information and resources. Bonding ties tend to develop particularly among those who share similar characteristics, which is know as homophily (McPherson et al. 2001). In contrast, a bridging tie links members of one subgroup with those of another, or an isolate (disconnected node) to the rest of the network, aiding in the transfer of information between otherwise unconnected network actors. SNA theory can help uncover *brokers*, nodes that play a bridging role, and reveal gaps, where adding a bridging tie between well-connected hubs could greatly increase the connectivity of network overall (Figure 5). It has been postulated that communities with more bridging ties have a greater capacity to organize to address shared concerns (Granovetter 1973 & 1983), though stronger bonding ties may be necessary among organizations to encourage information sharing (Carpenter et al. 2003). Consciously gaining awareness of SNA patterns can help foster such ties.

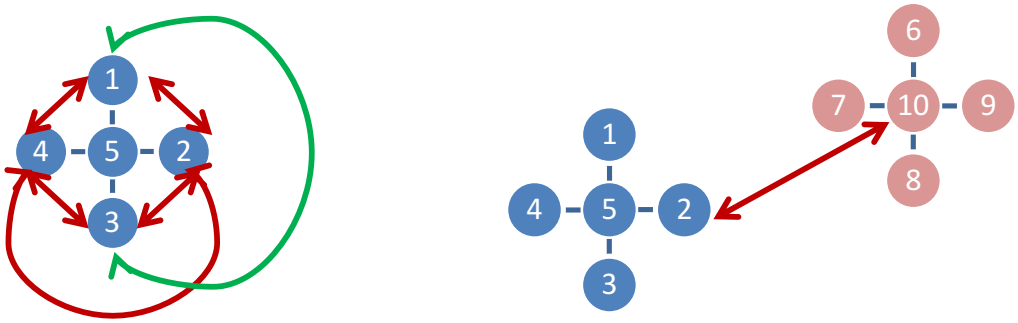


Figure 5. Bonding Tie (left) further connects already associated nodes, while a bridging tie (right) connects otherwise unconnected nodes or subgroups

Building bridging ties does not diminish the importance of bonding ties. One effective strategy is to first builds strong bonding ties between organizations in a coalition to enforce cohesiveness and shared knowledge and ongoing learning. A more well-connected core builds

adaptive capacity and collaboration skills to then further strengthen bridging ties with other community groups and government institutions. This hastens network maturity from the hub-spoke stage to the more resilient core-periphery structure by increasing the density of both bonding and bridging ties, which is further discussed in Section 1.4.7.

1.4.3 Levels of Analysis

Bodin and Prell (2011) suggest three levels of SNA: the binary metaphorical approach, the descriptive approach, and the structurally explicit approach. The *binary metaphorical approach* simply determines if network connections between different entities are present or absent.

The descriptive approach determines if the links are *bonding links* between relatively homogenous entities of the same group, *bridging links* between similar entities from different groups (horizontal linkages), or *linking ties* between two entities from different levels of power and authority (typically vertical linkages from local actors to higher scales in the political or institutional hierarchy). This approach may be employed in a watershed program development strategy to encourage targeted organizational bonding. Analyzing bonding may also help determine which organizations and institutions are already aligned or collaborating effectively and which may need to be more systematically brought into the management or governance context.

Finally, the *structurally explicit approach* treats the social network more analytically to determine quantitative measures of proximity, centrality, degree, and structure defined explicitly by SNA theory (Wasserman & Faust 1994; Prell 2012; Borgatti 2013). This approach more methodically enumerates and analyzes all nodes and ties within stated boundary conditions and data development method limitations. This approach is most likely to reduce error in analysis and improve the rate and effectiveness of structural change for network extension and densification over *ad-hoc* coalition building methods. SNA includes agent-based modeling techniques and other tools to further uncover patterns, explain outcomes, and help to develop theoretical frameworks to further its utility. Figure 6 demonstrates some of the network features that can be measured using SNA software for explicit structural analysis.

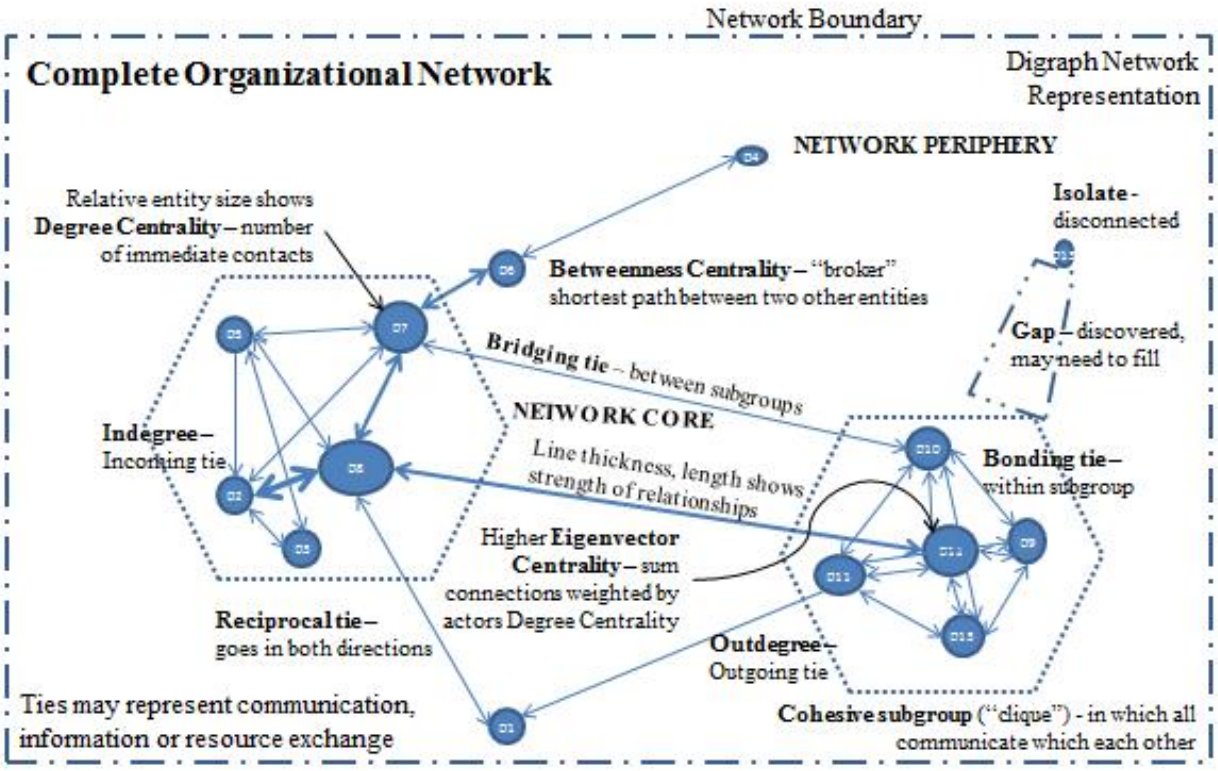


Figure 6. Social Network Analysis Schematic demonstrating Key Concepts

1.4.4 Affiliation Networks

In addition to direct member relationships or organization-to-organization network analysis, organizations can also be analyzed in *two modes* by analyzing associations, events, and projects in which they jointly participate to determine network measures. Such *affiliation network analysis* provides three types of structures in two modes of data to consider: organization by event, organizational relations via joint attendance, and relations of events by attraction of common organizations (Wasserman & Faust 1994; Knoke &Yang 2008). Affiliation networks are also known as *two-mode* data, since multiplying the actor-event matrix by its transpose produces one mode of co-occurrences (Borgatti et al. 2013). Ties are synthesized by extent that they share affiliations, which introduces errors by event size and importance. Affiliation network analysis can study project partners as a complimentary measure of relationship strength and cooperative capacity.

1.4.5 Knowledge and Resource Exchange Networks

In addition to relationships between organizations or individuals, it is also critical to analyze at the outset, how various organizational actors find, acquire, and internalize new information. Knowledge brokering through advanced knowledge bases for storage, search, and retrieval – including the importance of social networks in transferring knowledge – is gaining recognition as a critical research focus, especially at the interorganizational level (Holzmann 2013).

Explicit knowledge can be documented and systemized. *Tacit knowledge* is determined by context and specific actions learned through experience, making it difficult to describe. Cultural and local knowledge, as well as watershed program management skills, are all critical ingredients to better managing watersheds, but cannot be easily captured (Hordijk & Baud 2011). SNA can be employed to discover and then transform knowledge assumed tacit into explicit knowledge that can be codified or at least shared more broadly. By encouraging sense-making and networking, SNA can help develop core values and beliefs in common that may better guide watershed program decisions by reducing uncertainty and ambiguity (Thiry 2011).

1.4.6 Social Network Maturity Model

Rather than only serving as a descriptive tool, the purpose of SNA in some research and most natural resource management applications is to improve the overall network structure in time and space. This includes increasing both horizontal ties (between cross-sector and community groups) and vertical ties (aligning local, regional, state, and federal governance frameworks) through both bridging and bonding ties. Networks naturally follow a progressive clustering trend in development as they age; however, SNA can help indicate issues in the structure to further improve and speed network maturity. To assist in improving network structure, SNA is often classified into a four-stage maturity model (Zolli & Haly 2012):

1. Small clusters first form by self-organization based on similar roles, location, and homophily.

2. An intentional hub may be developed by a *network weaver* focused on network integration or develop naturally from a central cluster of power and influence.

3. Triadic closure then occurs through natural network extension processes or more systematically as the network weaver teaches others to link to form a denser core and expand bridging ties to peripheral actors.

4. Core / Periphery network structure develops as strongly affiliated hubs connect to a constellation of weaker ties to access resources from other scales and regions.

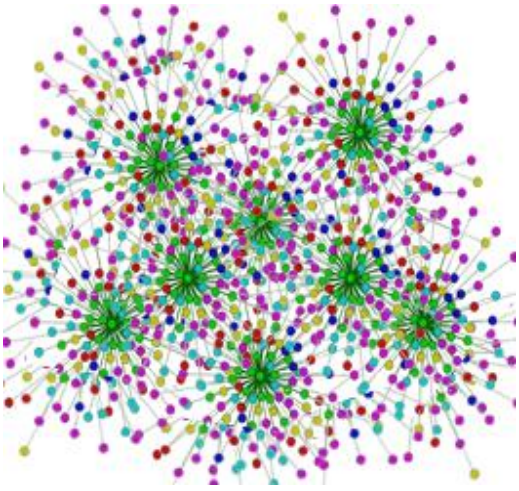


Figure 7. Core-Periphery Structure

The end result of an effective network maturity process is a core-periphery structure as depicted in Figure 7. The dense central core (giant component) includes many redundant connections for multiple paths to information and resources and stable, well-connected relationships. The periphery includes an additional array of resources that are needed less often, but are still connected adequately to remain readily available. There are no obvious gaps or sparse, central areas in the network that would present an obstacle to network flows. Most real-world networks will not look exactly this way, but the model serves as an ideal to emulate.

1.4.7 SNA Software

Although one could apply ad-hoc Social Network theory and research findings to improve social network structure, SNA software provides opportunities to more systematically map and manage more complex networks over time. It also can be more effective in quickly describing the relationships with node and link labeling, coloring, and sizing based on node and link characteristics as shown in Figure 8. Finally, SNA software includes sophisticated functions that can reveal information about the importance of various nodes and ties to the overall structure, including emergent properties. It helps distinguish cohesive subgroups from less dense areas of the network that may need more attention to improve information flows. There are tools in SNA software to study networks in space and time. In spite of these benefits, most SNA is inexpensive or freely downloadable open source software. As a supplement to the SNA Workshop, a companion website (http://sna.wateractionnetwork.org) has been created with references and links to software, courseware, manuals, applications, and related resources.

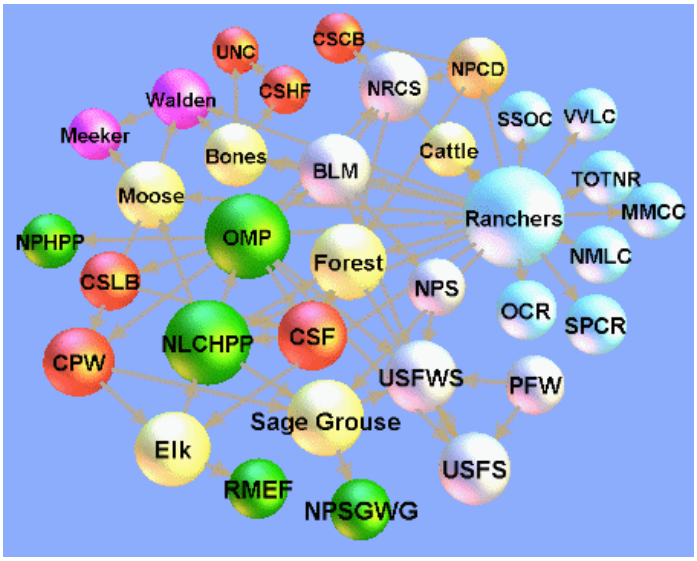


Figure 8. SNA Software Example Demonstrating Sizing, Labeling, and Clustering for Understanding

1.5 SNA Application to Water and Natural Resources Management

In addition to SNA itself, several important related concepts were stressed in workshop instruction for their applicability to improve water and natural resource management applications. SNA applications to Water and Natural Resources have been effectively detailed in several important research compilations (Bodin 2009 & 2011), as well as, periodically in Ecology and Society, an online journal devoted to understanding complex socio-ecological systems. Systems thinking (Checkland 1999) helped sensitize the water and natural resource community to focus on the complexity of social-ecological systems characterized by emergent properties at scale that cannot be easily defined by simple feedback system analysis. Social systems design (Banathy 1996) began a discourse on system improvement and transformation, which was later incorporated into a mature theory of Resilience Practice for monitoring complex systems to manage change thresholds and better respond to system shocks (Ostrom 2005, Walker & Salt 2012). Most effectively, these concepts have been developed into the framework of Adaptive Co-management (ACM), which combines the incremental, collaborative problem-solving approach of *adaptive management* with more cooperative institutional controls through *co-management* (Plummer 2012). ACM incorporates much of the lessons learned in Common Pool Resource (CPR) theory (Berkes 1989, Freeman 1992 & 2010, Ostrom 2005, Pratt 2010) as to common factors that permit shared governance to be most effective, many aspects for which SNA can serve as a monitoring and assessment tool. Rodela (2012) confirms the importance of this adaptive management approach focused on shared experimentation and reflection to promote *shared learning* through *boundary crossing*, a multi-disciplinary approach the SNA Workshop

was also particularly designed to foster among attendees. As shown in Figure 9, SNA should be considered one component of a larger effort to better couple natural, human, and knowledge systems for more comprehensive problem specification to enhance engineering practice.

1.5.1 Related Application

Social-ecological systems are complex, as are the human systems in their social networks upon which their future depends. Figure 9 depicts how this nested structure of knowledge, networks, and social-ecological systems must interconnect. Water resources management systems should evolve to serve as a foundation for better managing both human and natural systems by reflecting a similar level of complexity. In other words, the knowledge system must map to the relationships, transactions, and flows in the social network to modulate its structure and permit the participants to interact in ways that provide increasing benefits to the overall social-ecological system and its economic viability.

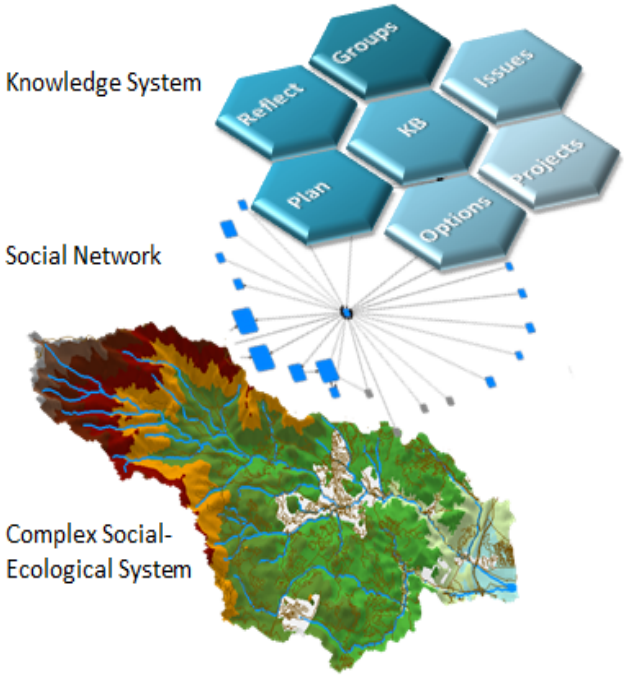


Figure 9. Integrated Systems of Knowledge, Humans, and Natural Processes for Better Management

In preparation for the SNA Workshop, the facilitator completed research on a dissertation entitled *Operationalizing Collaborative, Adaptive Watershed Management.* The study employed semi-structured interviewing techniques and social network analysis (SNA) routines to define organizational ties, information and resource flows, and regulatory frameworks to better characterize the human dimensions of current conditions watershed-wide and to better plan diverse options to improve integrated water resources management (IWRM). In addition to human dimensions analysis, SNA also served as part of an Adaptive Co-Management Decision Support System (ACM DSS) for monitoring and assessment to analyze how management options that increase social network bridging ties, reduce network fragmentation, improve leadership measures of centrality, and increase in number and strength flows of resources and information work to improve sustainability and resilience of water resources management frameworks. Understanding how SNA might apply to water resources program management served as a practical application for SNA Workshop demonstration and to further discussion into relation to other potential applications. Presentations by other experts from select CSU faculty and student research, federal programs, and state and local nonprofits also provided attendees with practical insight for SNA application. For context, an excerpt from the dissertation describing how SNA was employed in the case study of the Bear Creek Watershed Association (BCWA) for watershed-level nutrient management follows in Section 1.5.2.

1.5.2 Example of SNA Applied to the Bear Creek Watershed

Figure 10 depicts the BCWA before research began: members are shown in red, participants in blue, and external support in green. Although partly controlled by the limited boundary analysis, it correctly demonstrates the strong *hub-spoke* character of BCWA. The central hub represents the BCWA full-time manager. The two small, close clusters represent the two organizational groups managing Evergreen Lake and Bear Creek Reservoir, who provide staff time to support both lake and watershed-wide monitoring.

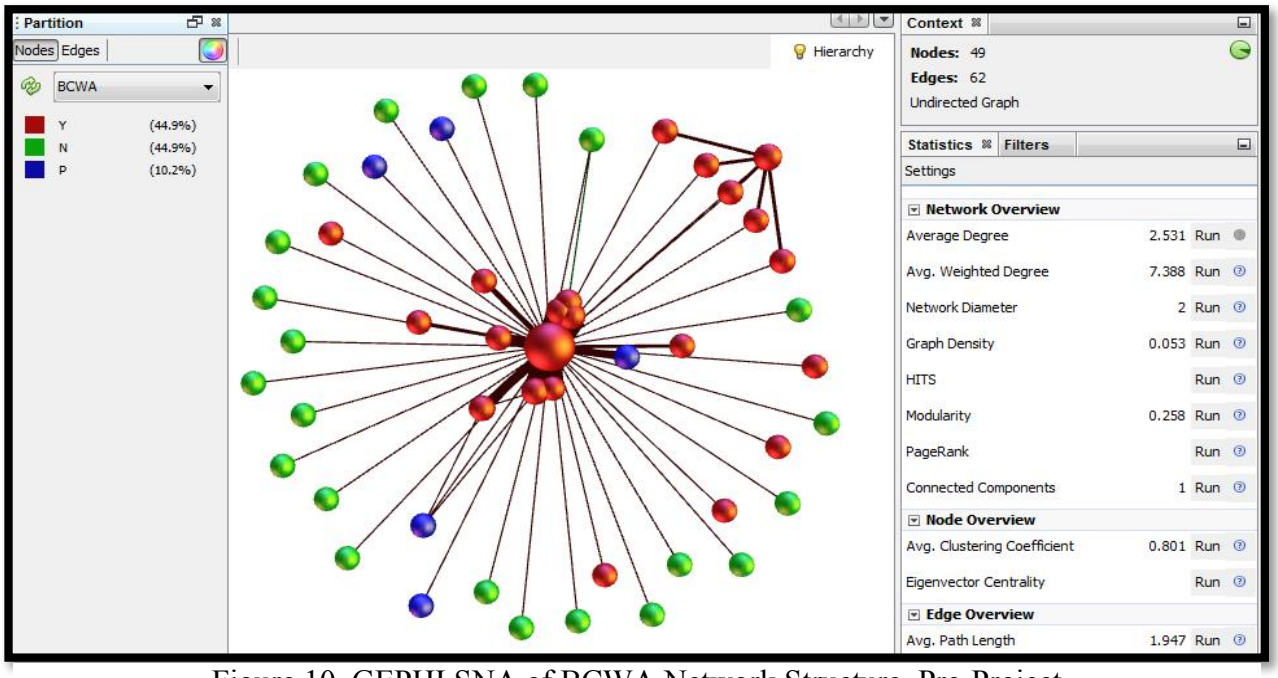


Figure 10. GEPHI SNA of BCWA Network Structure, Pre-Project

This six-member core is also most responsible for decision making and technical analysis. Even though each member organization has many other ties, only the primary ones that they share with BCWA are shown. About half of resources that BCWA employs are obtained from outside its membership, including: federal and state agencies and statewide organizations, other watersheds, and technical experts.

Figure 11. demonstrates the significant difference achieved by adding a formally trained *network weaver*, the researcher. By systematically focusing on developing a relationship with each BCWA node in Figure 10, and more local, state, and federal landowners in the watershed; community groups; and academic experts, the addition of this temporary hub greatly increased connectivity and reach.

Unfortunately, in the case of most research projects, upon project completion, this temporary hub simply vanishes, leaving little gained. The network may even become more vulnerable when the project ends, because certain nodes may have become dependent on new paths to information, resources, and relationships throughout research project development. Therefore, it is critical that researchers consider these risks before choosing to conduct

participatory research design. In this instance, the researcher actually lives in the watershed and had committed to two additional years of service in order to more effectively introduce nodes to one another and foster their collaboration. This will allow the secondary hub to convert from a bridging role to that of a less important facilitator. In this way, the central cluster will gain redundancy, making the loss of the new hub later less important. It will also be important to to help the network mature to a more stable core-periphery structure as described in Section 1.4.7 before the BCWA manager must retire after thirty years of service.

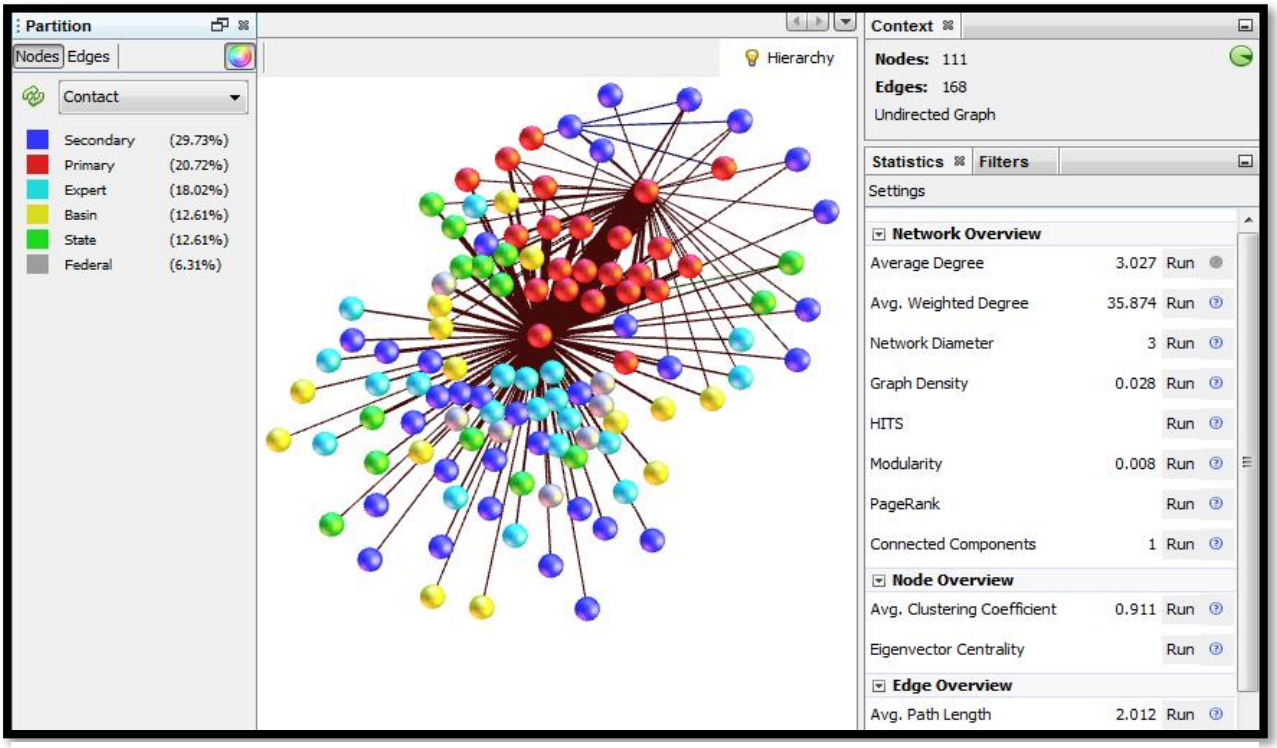


Figure 11. Improved Network Structure through Addition of a Trained Network Weaver

The Project Management Institute (PMI 2013) uses a formula to calculate the communication channels that could potentially develop from adding more nodes to a social network as:

Communication Channels = $\frac{N\ (\mathrm{N}-1)}{2}$ **Equation 1.** Communication Channels of Nodes = N

In this case, the second hub increased accessible nodes from 49 to 111. Therefore, adding a single network weaver increased potential communication channels from 1,176 to 6,105, more than five times more! This does not even consider how the network will continue to expand as more BCWA members and participants take on greater leadership in network development, allowing redundant bonds to form across weak bridges to strengthen them further.

Allowing network expansion to occur naturally is unlikely to be optimal. Instead, as the research hub begins to move from core to facilitator, other strategic network weavers should be developed through formal SNA instruction. Equation 1 indicates that training others in SNA and giving them focused expansion roles is likely to provide an even larger, more diverse, and less vulnerable network structure over time.

Another important improvement stems from the fact that each new relationship is unique and dynamic. The new hub provided different information and understanding to return to the original hub as *secondary information* from even its original primary contacts. This informed both the manager's choices and the overall direction of the BCWA board. By encouraging BCWA to adopt an online management system, a formal new project evaluation policy, and study and regulatory changes, this research has improved adaptability. This occurred because of the increased diversity in information and resources available through access to five time more potential ties, each consisting of a unique new pattern of interactions. However, it also allowed BCWA to developed a new level of understanding of their organization from an *outsider's perspective*. This improved their ability to question underlying assumptions of how they had conducted business for more than thirty years. Change was not especially difficult, because it was an emergent property of the network evolution.

It is incorrect to assume that change is always positive. In fact, the main use of Equation 1 is to help project managers gauge the complexity of their project team and stakeholders to manage communications risks (PMI 2013). In contrast, governance of complex social-ecological systems must attempt to attain a similar level of social structure complexity. Systematic focus and enculturation towards cooperative, inclusive structure prevents the disadvantages of complexity from overwhelming the benefits. Network expansion through the application of watershed program best management practices is another method to prevent mismanagement. An effective watershed program is too complex to be managed by a single watershed manager, or even a single layer of management roles. Instead, individuals and consultants must each play a specific, professional role in providing diverse technical, legal, accounting, management, and outreach assistance. In each role, the watershed program team must be formally trained and directed to build their own social networks vertically and horizontally to best access tools and resources to build resiliency in that particular technical, organizational, educational, or legal need. Each discipline in the program team must also develop cross-disciplinary links and broad system understanding to better manage watershed complexity.

2.0 REVIEW OF METHODS USED

The focus of the SNA Workshop was to explain how SNA can be used to better evaluate organizational ties, knowledge and resource exchange, and regulatory frameworks to improve analysis, implementation, and ongoing assessment of water resources, natural resources, and environmental management practices at the watershed scale and beyond. The workshop presented SNA as a useful tool in implementing a systematic approach to IWRM through ACM.

2.1 SNA Materials

The SNA Workshop was based on SNA introductory texts, research, and applied examples more fully enumerated in the SNA Workshop Website Links. The first seminal work in Social Network Analysis (Wasserman & Faust, 1994) served as the foundation for the SNA Workshop. More recent SNA guidebooks (Borgatti et al. 2013; Easley & Kleinberg 2010; Hanneman & Riddle 2005; Knoke & Yang 2007; Prell 2012) reinforced the enumeration and definition of all SNA concepts to ensure that no critical components of SNA theory and its modern application were neglected in SNA Workshop development. Additional peer-reviewed journal articles provided information on recent SNA advances for use in resources management.

2.2 SNA Software

Main features of UCINET software (Borgatti 2002) and Gephi software (Gephi 2013) and examples were briefly introduced in the SNA Workshop based on research experience and related tips and caveats from several dedicated online communities. Tips on using Gephi, Netlogo, and R I-graph were also provided to attendees. Additional supporting resources were provided through the SNA Workshop website Software Links and E-Resources sections, as well as, *attendee-only* software demos and tutorial links. Appendix F also includes the results from a full-day SNA workshop with GEPHI software training that was not included in the original grant. Appendix F also includes GEPHI installation and training information to ensure usability.

2.3 Target Audience

Social Network Analysis Techniques for Water Resources Management Workshop was designed to reach multi-disciplines in science and technology related to water and resource management. Graduate students were particularly targeted, because of their deeper scientific study of water and natural resource problems in an additional four to eight years of study. They would also most likely take decision making positions in these fields that would most benefit from social science tools training not traditionally included in many technical programs.

Table 1. Student Attendance Goals

Student Attendance Goals	**Classification**	**Area of Study (Discipline)**
Workshop attendees #1-5	Masters and PhD	CSU College of Agricultural Sciences
Workshop attendees #6-10	Masters and PhD	CSU College of Engineering
Workshop attendees #11-15	Masters and PhD	CSU College of Natural Sciences
Workshop attendees #16-20	Masters and PhD	CSU College of Natural Resources
Undergraduate attendees	Sr. Undergrads	CSU Science and Engineering Depts.
Faculty attendees	Interested Faculty	CSU Science and Engineering Depts.

2.4 SNA Workshop Website

In order to promote an ongoing online collaborative to enable attendees to continue to gain support and skills, a sophisticated SNA Workshop website was developed at http://sna.wateractionnetwork.org. Tools included online registration, discussions, contact form, and tabbed references. The Links section were thought to be particularly useful, as they referenced introductory books, SNA software, online courses and e-books, applied examples, and notable Colorado-based collaboratives. Registering for the workshop automatically through the website allowed attendees to also partake in online discussions and gain full website access to materials. This ensured attendee numbers were known in advance, and that each student was already familiar with SNA workshop content details. The main website tabs included:

1. **Why** – you should attend, from both a student and professional perspective
2. **Dates** – which schedule could be easily updated to enable future offerings
3. **Register** – a simple one step registration process, validate by email
4. **Agenda** – details on every item to be covered in the SNA Workshop
5. **Links** – SNA introductory books, software, and online resources; SNA used in applied ACM, CPR, and resilience practice to water and natural resources management; and examples of Colorado collaboratives that exhibited relatively high network maturity
6. **Discuss** – threads to share views, which began with determining the best workshop dates, describing your research and experience in SNA, and your personal learning objectives, but were expanded following the course based on attendee interests as they unfolded
7. **Contact** – Online contact form to obtain more information and answer questions

2.5 Instructional Design

The SNA Workshop facilitator had taught to diverse federal and state agencies and other group collaboratives for decades. However, care was still taken to use a variety of instructional theory and tools to ensure that the SNA Workshop would be particularly effective. The ExCEED model provided as a University of Texas instructional series to CSU Civil and Environmental Engineering faculty in 2011 focused on clear objectives, engaging presentation, relating to prior knowledge, stimulating critical thinking about the subject, application scenarios, and opportunities for self-assessment. The Research Based Instruction (RBI) method focused more specifically on meeting 9 principal objectives, including:

- Setting objectives and providing feedback
- Reinforcing effort and providing recognition
- Cooperative learning
- Cues, questions, and advance organizers
- Nonlinguistic representations
- Summarizing and note taking
- Assigning homework and providing practice
- Identifying similarities and differences
- Generating and testing hypotheses (Dean 2011).

In the months leading up to the SNA Workshop, the facilitator met several times with CSU *The Institute for Learning and Teaching* (TILT) instructional designers to review SNA Workshop materials. This included an outline, agenda, presentation, handouts, schedule, marketing materials, post-workshop evaluation, and homework. These repeated brainstorming sessions led to improved teaching tools and more comprehensive adherence to RBI goals.

2.6 Securing Speakers

During marketing and through previous contact with CSU faculty and students in the field, several experienced researchers and practitioners were recruited to share their lessons learned in coalition building with SNA Workshop attendees. Even if not specifically using social network analysis, the group used these practical presentations to discuss how SNA might compliment their work or reveal important underlying network structure or application tips.

For comparison, research-oriented and federal program speakers were placed in Session #1 on Wednesday, 10/23/13, whereas, nonprofit and consultant speakers presented in Session #2 on Tuesday, 10/29/13. The goal was to determine which type of speaker best seemed to engage attendees and interest students in particular. This would be determined by counting the different attendees that asked questions or later interacted with the speakers and the time and level of interest they appeared to have doing so.

Table 2. SNA Workshop Expert Speakers

Date	**Expert**	**Organization / Position**	**Topic**
W10/23/13	Melinda Laituri	CSU Professor, Ecosystem Science and Sustainability	Participatory GIS for Cultural Resources (Mongolia, New Zealand)
W10/23/13	Heidi Huber-Sterns	CSU PhD candidate in Forest Sciences	Analysis of Organizational Brokers in Panama Watersheds
W10/23/13	Nina Burkhart	USGS, Social Science Research Analyst	Legal-Institutional Analysis Model (LIAM), Advocacy Coalition Framework
W10/23/13	Kristin Leong	NPS, Human Dimensions Program Manager	NPS Human Dimensions Program
T10/29/13	Rachel Hasgen	Groundwork Denver (GWD)	Sustainable Community Development
T10/29/13	Steve Malers	Open Water Foundation	OWF OS Statewide Software Collaborative
T10/29/13	Becky Fedak	Brendle Group	Toledo-Lucas Counties – going beyond green

2.7 Workshop Marketing

It was anticipated that it would be very difficult to find students willing to devote an entire weekday evening to the SNA workshop under heavy course loads and daily homework. This was expected to be especially difficult because students in technical fields may not consider social science instruction of much utility. Therefore, an extensive marketing campaign was developed to reach as many students as possible using the methods listed in Table 3. below.

Table 3. Methods of Marketing the SNA Workshop

Method	Location	Estimated Prospect Reach
News & Calendar	Colorado Water Institute website	800
Online Event List	The Institute for Learning and Teaching	400
Online Event List	CSU Today website and daily email	5,000
Inflow Newsletter	Prominently listed, linked for watersheds	150
Group email	Civil and Environmental Engineering graduate students	500
Group email	Agricultural Science graduate students	500
Group email	Forestry graduate students	500
Group email	Computer Science graduate students	500
Group email	Center for Collaborative Conservation	50
Group email	Women & Minorities in Engineering	200
Group email	Enviromental Governance Working Group	30
Group email	Computer Science graduate students	200
Group email	Chemistry graduate students in water	20
Seminar Handout	Nancy Dickson on Sustainability Science	25
Class Visit / Flyer	SOCR 421 Crop & Soil Management Sys	30
Class Visit / Flyer	NR 505 Concepts in GIS	30
Class Visit / Flyer	CE680A Water/Enviro Integrated Research	7
Class emails	Request to faculty to email to class	20
Flyer posted	Engineering, Weber, NatRes, Foresty, CS, Ag Science, & other locations	1,000
Advisor/Faculty	Class announcement or direct invite	20
Facilitator Invite	Direct Emails to Experts and Others	10
Brought by friend	Someone going asked them to come, too	8
Word of mouth	Someone already interested told them	100

2.8 Workshop Logistics

Since CWI has been able to secure CSU classrooms, computer labs, and support services for other projects, it was anticipated that these resources could be obtained at no direct cost to the project, which indeed proved to be the case. However, the first thought was to secure a computer room or at least one with a *smartboard* and advanced student interactive tools. Unfortunately, such a suitable location could not be secured for the dates and timing desired, so a conference room was selected instead. This required the one session planned to be adapted into two distinct session offerings to allow anticipated attendees to fit in the smaller space. In the end, this provided several distinct advantages. The large oval table that accommodated 15 attendees allowed for everyone to face one another, facilitating a lively discussion throughout and building rapport. Each attendee also wrote their name on a placard, which built a further sense of congeniality.

Shared learning was further enhanced by periodic breaks for dining and discourse. Since the conference room and an adjacent CWI storage room both had refrigerators and supplies, food was bought in ahead of the meetings and served as it became evident that attendees were reaching information overload.

2.9 Workshop Recording

The workshop was recorded both days to better capture all transactions and look for ways facilitation and pace could be improved in the future. Echo 360 software was to be used to capture the on-screen presentation clicks, but the facilitator neglected to remember to activate it for either session. Although analysis was still accomplished through the video recordings of both sessions, especially to capture the speakers, attendees, and other non-presentation components, the Echo 360 results could have been used to study slide pacing, mouse clicks and other measure of instructional utility for future planning purposes, so it may be employed later.

2.10 Spring Follow-on SNA Instructional Experience and Evaluation

In the spring of 2014, SNA training techniques were further tested in three additional formats. First, SNA research results were provided in a 30-minute segment of a three-person expert panel on SNA applications. The panel was jointly hosted by both federal government agencies and academic institutions through a program called the Interactions of Society and the Environment Seminar Series (ISESS) and was held in an instructional room of the CSU Morgan Library. Survey results and related information are shown in Appendix D. Next, a shorter version of the half-day workshop was presented during one class period of a communications course for Metropolitan University at Denver, One World-One Water Center (OWOW) undergraduate students. Materials included a detailed 19-page summary handout of SNA for water management and personal impact. An excerpt from the handout and survey results are included in Appendix E.

One frequent comment from both of the Fall 2013 half-day SNA workshops was a desire to learn SNA software, which could not be introduced in the half-day session nor included in the scope of the grant. However, an opportunity arose in the Spring of 2014 to include SNA as a full-day session in a methods course for the CSU Natural Resources college, Department of Human Dimensions, Conservation Leadership through Learning (CLTL) program. The full-day session permitted software training to be included. Students could explore four different SNA GEPHI software demos built around Colorado collaboratives that they had studied in class and to which they had already applied a variety of other qualitative and statistical methods in previous weeks. The detailed agenda, survey results, and useful GEPHI software follow-up tips from this full-day SNA workshop with GEPHI software are included in Appendix F.

3.0 DISCUSSION OF RESULTS AND THEIR SIGNIFICANCE

3.1 Attendee Makeup

The goal of a minimum of 20 attendees was achieved, with 23 attendees comprising the two sessions of 9 attendees in Session #1 on Wednesday, October 23, 2013 and 14 attendees in Session #2 on Tuesday, October 29, 2013. Marketing also proved effective in obtaining a diverse mix of targeted disciplines (Figure 12). Spring 2014 follow-up included 20 attendees for the ISESS session, 11 students for the OWOW session, and 19 students in the CLTL full-day workshop. Over 70 students, faculty, agencies, and professionals were exposed to SNA overall.

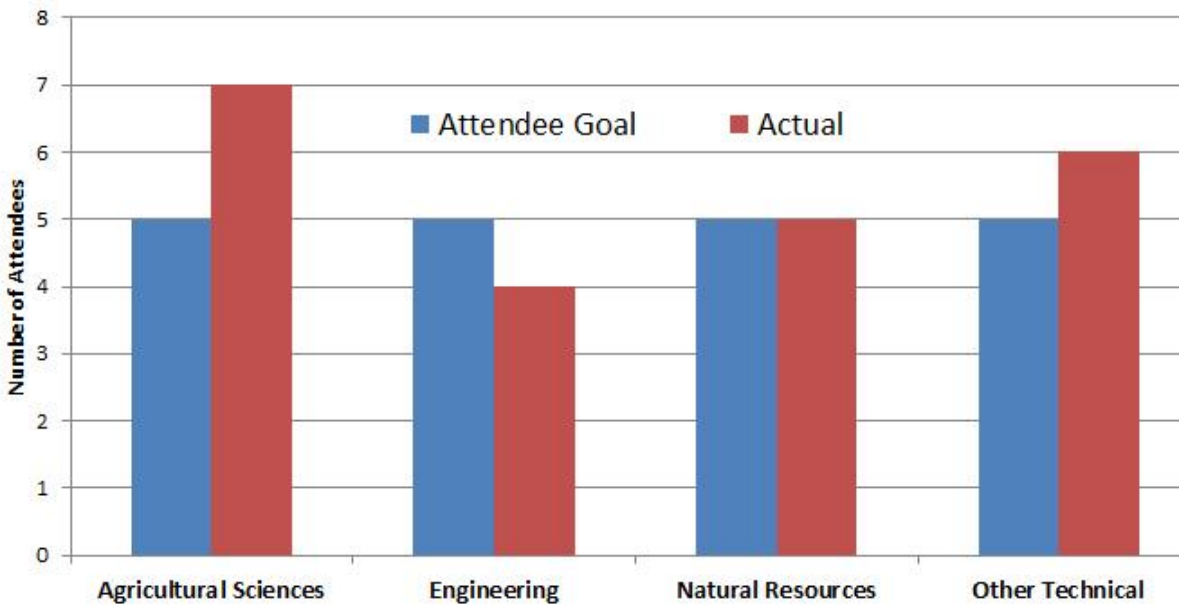


Figure 12. Targeted vs. Actual Attendee numbers by Discipline

Instead of only graduate students attending the Fall workshops, fewer students attended (13 students total), but more attendees came from diverse federal agencies, including USGS, NPS, FWS, and EPA, two non-profits (one statewide and one focused in the Denver Metro), and three visiting professors / university extension workers and one retired professor in agricultural sciences (10 non-students in total). Rather than detracting from the workshop, this diversity of attendees enriched the ongoing discussion about how the SNA concepts and tools discussed might be or had been applied practically with important caveats.

Students were composed of two seniors, eight master's students, and 3 doctoral candidates (Figure 13). Evaluations seemed to indicate that the seniors felt somewhat overwhelmed by the content and doctoral candidates felt that materials could have been covered in more analytical depth. Non-students seemed most comfortable with the pace and content for its professional applicability. The three visiting professors enjoyed presenting their international perspectives and seemed particularly keen on using the SNA knowledge gained in teaching and practice upon return to their respective countries.

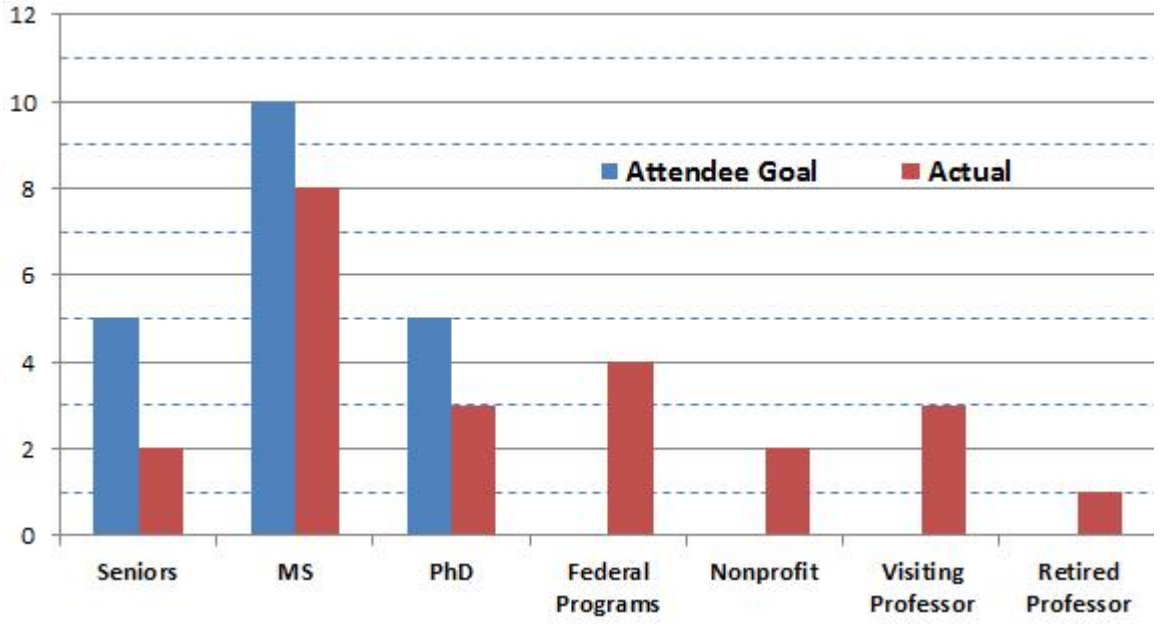


Figure 13. Attendees Educational Level or Non-student Work Classification

3.2 Workshop Evaluation Results

The effectiveness of the SNA workshop was judged by responses to post-evaluation surveys completed by all attendees. Results of the Fall 2013 half-day workshops are included in this section, while the results of additional Spring 2014 follow-on SNA workshop testing in other instructional formats that was not directly support by this grant are included in the appendices.

3.2.1 How did you learn about the SNA workshop opportunity?

It was expected that most attendees would mark more than one method of marketing that helped them become aware of the opportunity, but surprisingly nobody marked more than one, even though they were specifically asked to check *all that apply*. Despite flyers being posted prominently throughout several technical departments, only one person came because of seeing one of them. More commonly, a friend was already going, or at least told them about the opportunity, if not a professor or the student's advisor. About thirty percent of attendees learned through their department graduate student listserv or another related group email. Nobody found the course in TILT, Today, or CWI online calendars, though these are the only sources that appeared for finding the course through an internet search, and they are available to all students internally, as well as, many potentially interested professionals. The facilitator also invited two nonprofits, one researcher, and one federal worker to serve as experts, who then choose to register for the course, as well. Three students also came because the facilitator had visited one of their classes or a related seminar they attended to directly share the opportunity with them. Since students indicated that they are bombarded with many opportunities for their very limited

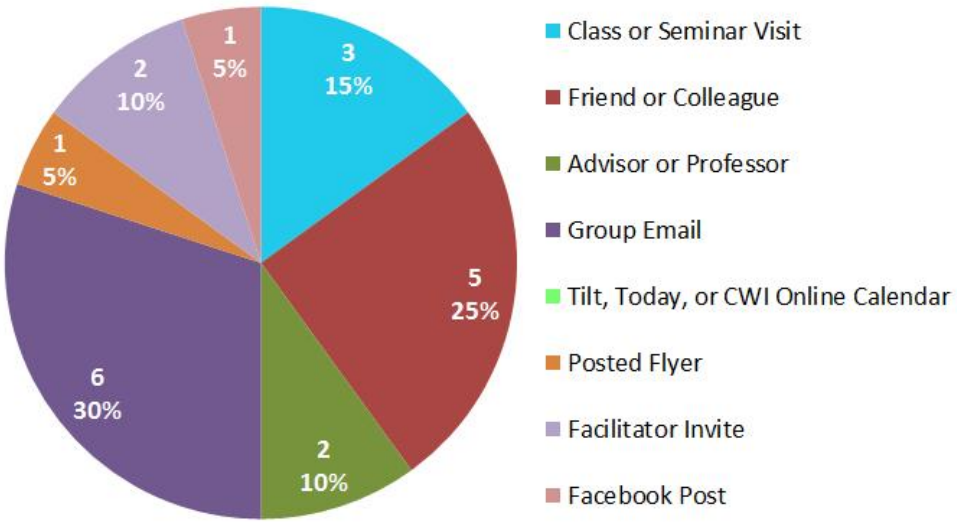


Figure 14. How Attendees Learned about the SNA Workshop Opportunity

time, only a personal appeal from a friend, professor, or the facilitator, or from a trusted group email source were indicated here to be effective outreach tools, rather than online calendars and flyers, which are not found through relationships. Results are shown in Figure 14 and Table 4.

Table 4. Methods of Marketing the SNA Workshop and their Actual Effectiveness

Method	Location	Estimated Prospect Reach	Estimated Actual Attendees
News & Calendar	Colorado Water Institute website	800	0
Online Event List	The Institute for Learning and Teaching	400	0
Online Event List	CSU Today website and daily email	5,000	0
Inflow Newsletter	Prominently listed, linked for watersheds	150	0
Group email	Civil and Enviro. Engr. graduate students	500	1
Group email	Ag Science graduate students	500	1
Group email	Forestry graduate students	500	1
Group email	Computer Science graduate students	500	0
Group email	Center for Collaborative Conservation	50	1
Group email	Women & Minorities in Engineering	200	0
Group email	Enviromental Governance Working Group	30	1
Group email	Computer Science graduate students	200	0
Group email	Chemistry graduate students in water	20	0
Group email	Other student group listserves (5+)	100	1
Seminar Handout	Nancy Dickson on Sustainability Science	25	1
Class Visit / Flyer	SOCR 421 Crop & Soil Management Sys	30	1
Class Visit / Flyer	NR 505 Concepts in GIS	30	1
Class Visit / Flyer	CE680A Water/Enviro Integrated Research	7	1
Class emails	Request to faculty to email to class	20	1
Flyer posted	Eng., Weber, NatRes, Forestry, CS, Ag Science, & Other	1,000	1
Advisor/Faculty	Class announcement or direct invite	20	3
Facilitator Invite	Direct Emails to Experts and Others	10	3
Brought by friend	Someone going asked them to come, too	8	2
Word of mouth	Someone already interested told them	30	3

3.2.2 Why did you participate in this workshop?

On average, attendees chose more than one reason for attending the SNA workshop, though only one attendee chose more than two reasons.

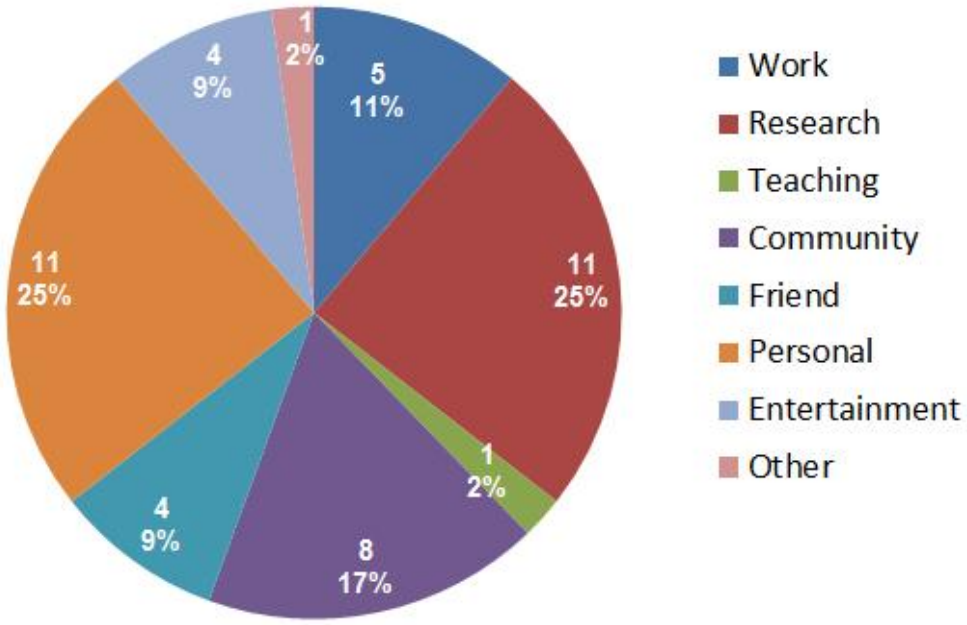


Figure 15. Reasons for Attending the SNA Workshop

As shown in Figure 15, research and personal interest were equally important reasons for attending at 25 percent each. Community was the next most common reason (17 percent), followed by a work quandary, at a friend's suggestion, or for entertainment (about 10 percent each). Only one respondent indicated that teaching these techniques to others was a reason for coming.

3.2.3 Overall Level of Satisfaction

On a satisfaction scale from 1 to 10, the SNA workshop received an 8 (10 attendees) or 9 (6 attendees) by the majority of attendees (Figure 16). More importantly perhaps, beyond simply a rating of perceived satisfaction, based on the post-workshop evaluation responses, not a single attendee went away without having learned valuable new information about SNA, learning from each other, and having new ways of analyzing networks and more consciously understanding the web of relations in which they operate, and its underpinnings in sociological constructs.

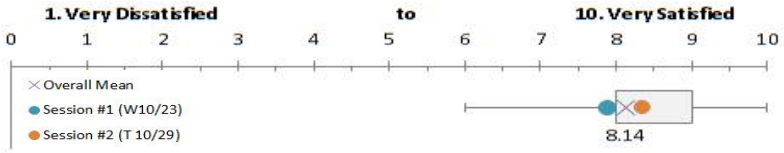


Figure 16. Over Level of Satisfaction with the SNA Workshop

3.3 Specific Aspects of the Workshop

Attendees were asked to rate specific statements about the workshop from 1 (strongly disagree) to 6 (strongly agree) as to their effectiveness. Results are shown in Figure 17.

3.3.1 Interaction Encouraged Rated Highest

Impressively, over eighty percent of attendees *strongly agreed* that interaction was encouraged. This had been a specific goal of the facilitator in applying the *learning-by-doing* concept of adaptive management to the workshop. In addition to having to each ask at least one question of the expert speakers, attendees also received a check mark for every question or comment they provided. During the SNA concepts review, the facilitator asked anyone who had not responded as often as others to answer one of the questions each concept slide included to help students relate it to application. This kept everyone animated and involved, and many unexpected tips and expansion of concepts occurred through this more shared, RBI-based learning experience.

3.3.2 Speakers Were Useful

Attendees agreed that the applied techniques that expert speakers presented were useful. The first speaker of Session #1 described the importance of traditional / indigenous knowledge in community development. The first speaker of Session #2 indicated that regional analysis worked best if facilitators went to where each specific group of stakeholders already met, rather than trying to compel such groups to send a single representative to a coalition meeting where they would not feel as comfortable speaking and their viewpoint might be more easily overwhelmed by so many competing interests. Therefore, it was interesting that although presenting very different projects, the first expert presenter in both sessions had independently determined that public meetings were not a substitute for trust-building relationships. Therefore, it became an important theme of both workshop sessions to consciously work to significantly involve each group in a community as early in any process as possible to build relationships and shared knowledge that might more effectively contribute to a later decision point.

3.3.3 Instructor Was Knowledgeable

Following interaction encouraged, the next highest rating the workshop received was that the instructor appeared knowledgeable. This was important assurance, since the workshop was presented by an engineer, rather than a social scientist. By providing direct understanding of values, beliefs, norms, and sanctions, and organizational and institutional constructs, the trainer still assisted attendees in understanding SNA measures in terms of how people, groups, and cultures actually interact. Attendees noted that this helped them become less judgmental by better understanding that underlying values and beliefs and the structure of cliques led people to perform their situational roles as they do. This knowledge allowed at least some attendees to begin to judge others values and actions in terms of structure and less personally. It also provided insight into how to use competing statuses and more effective bridging methods to meet different people in their own preferred environment and to respect their various *ways of knowing*, rather than overvaluing academic knowledge.

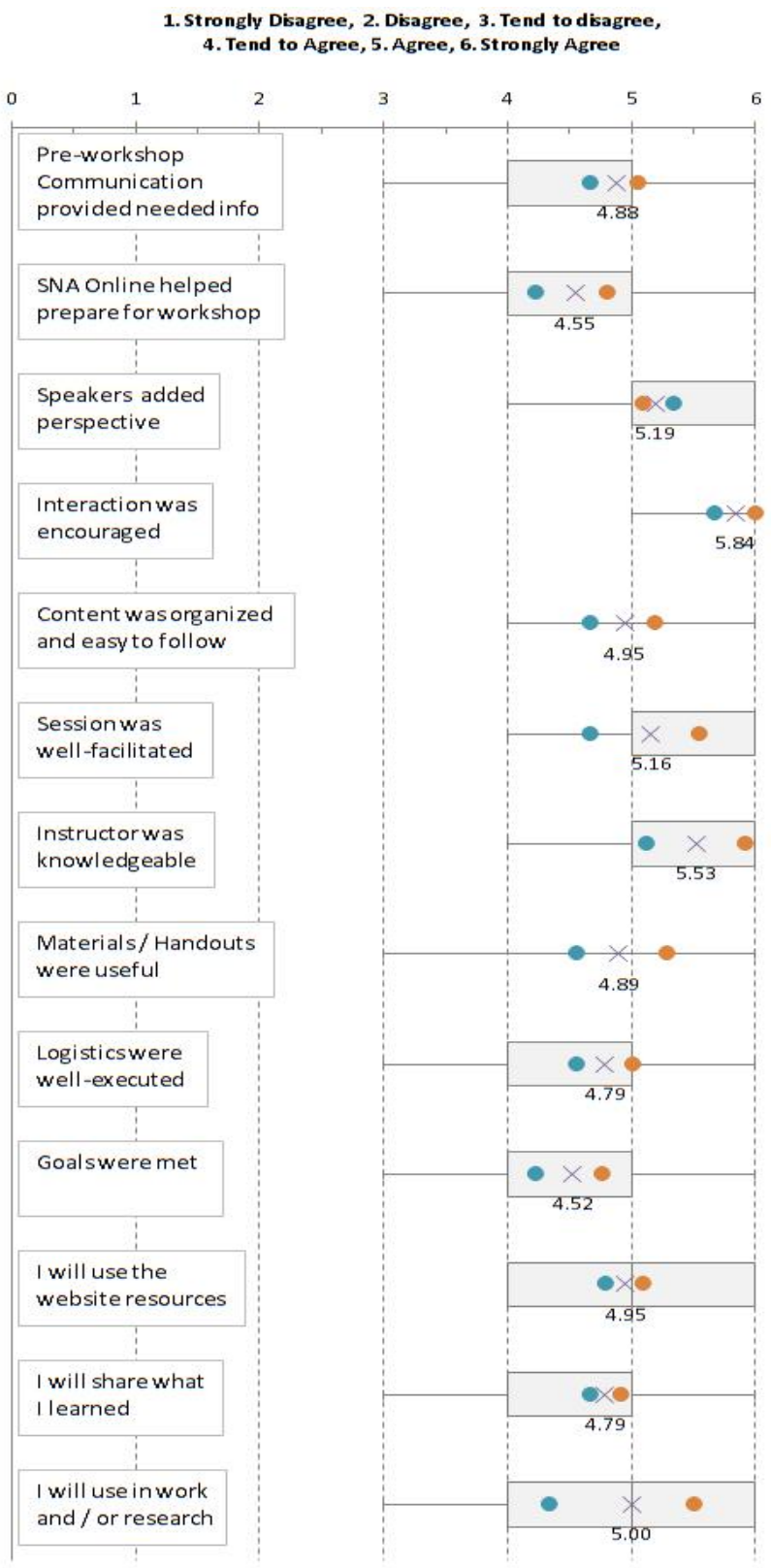


Figure 17. Relative Agreement with Statements about Different Aspects of the Workshop

3.3.4 Second Session Improved Over First

Several changes were made in Session #2 held Tuesday, 10/29/13 based on feedback received from attendees in Session #1, Wednesday, 10/23/13, which improved ratings. For session #2, the entire slide stack was provided as a handout, as well as, more software tool tips, and a handout for each expert including a fact sheet and / or an SNA diagram. Experts were required to tie their information more specifically to SNA and keep their presentation and Q&A shorter. Food was brought ahead of time and placed in the refrigerator to avoid disruption or waiting when the caterer did not show up. For these reasons, average scores for facilitation rose from 4.7 to 5.5, logistics increased from 4.6 to 5.0, and handout usefulness increased from 4.6 to 5.3. Through these improvements, even the knowledge of the instructor increased from a mix of 5 and 6 to a solid 6, because in Session #2 more time was available to cover concepts in depth and provide more useful scenarios related to water and natural resources. Overall satisfaction also increased from a 7.9 to an 8.3 and the likelihood of applying what was learned increased from a 4.3 to a 5.5. This demonstrates how important it is to make workshop

changes based on every aspect of a required comprehensive post-evaluation survey to improve the workshop continually over time, in the same way adaptive management principles teach practitioners to continually assess every policy and project to improve resource management over time.

3.3.5 Attendees of Session #1 Were Provided Improvements through Follow-up Resources

It was not sufficient that Session #2 improved over Session #1, without correcting aspects of the workshop that affected Session #1 attendees' ability to obtain full benefit. Therefore, based on Session #1 feedback, a SNA Gephi software demo was added to the SNA workshop website (http://sna.wateractionnetwork.org) to allow all attendees to become more comfortable using such free SNA tools. All the additional handouts from Session #2 were provided to Session #1 attendees through a new *attendee-only* Materials tab. Finally, since several attendees in both sessions had suggested it, a CSU student club is being considered to allow attendees to continue to practice with SNA software and learn more from each other and one another's challenges. Several Session #1 attendees emailed to note that these additions pleased them and allowed them to obtain even more perceived benefit from their SNA Workshop experience. Hopefully, this will increase their likelihood of pursuing SNA further, as continued collaborative learning was one of the main objectives to be achieved.

3.3.6 Attendee Follow-up Plans: Use the Companion Website and Apply What They Learned

The evaluation ratings also indicated that on average, attendees tended to more strongly agree that they would use the website resources in follow-up (and that was even before all workshop materials and the software demo had been posted, which should increase usage further) and that they would apply what they learned.

3.3.7 Slightly Less Agreement with Other Important Workshop Aspects

It had been hoped that by asking attendees to post their personal learning objectives and related research or work interests in the online discussion before the workshop, that many would have become familiar with the SNA Workshop website resources beforehand. However, most reported that they had not yet visited the website, nor felt comfortable using it as an *online collaborative*, the primary method planned for continued learning and sharing. Instead, there was strong preference to meet in person monthly to improve SNA skills over time together.

It was also expected that attendees would want to share knowledge with others, but personal, community, or research interests dominated and teaching was only of interest to one attendee, so sharing their learning was not rated as highly as originally expected.

The three objectives expressed in workshop marketing materials included:

- Review what you know about social network analysis
- Learn the SNA systematic, structured approach to analyze groups
- Explore how to apply SNA to water and natural resource problems

Some attendees did not feel that these goals were fully met, and explained in comments that this was because the workshop seemed a bit rushed and more time was needed for both

software and practical applications, since as an introduction, the workshop focused on key SNA concepts. Therefore, a software demo was added to the website, along with more practical links, and planning has begun to start a CSU student club for those interested. In this way, attendees can continue to gain knowledge and shared experience in SNA, if they so choose. A longer term goal will be to develop the workshop into a semester-long course with a textbook and a rich set of online materials that has already begun forming at the SNA Workshop website to permit other institutions to pattern a similar SNA /ACM / Resilience course upon this experience soon.

3.3.8 Most valuable?

Most attendees felt that the overview of SNA concepts was the most useful, though a few also indicated the expert speakers, or the software introduction were also important. Throughout the workshop, the social framework that was taught at the beginning of the session to underpin SNA, including embedded values, beliefs, norms, and sanctions in various groups and cultures, as well as, statuses, roles, organizations, and institutions, served as an effective explanatory mechanism and SNA framework.

The spiral model of community development, which is derived from the SNA Workshop facilitator's own research, was cited by three attendees as the most valuable. This method recommends in the first year (initial stage of development) to establish a framework of online data, analysis results, and tools to build a stronger understanding and focus among existing membership in a watershed association or other already formed coalition. This model incrementally develops capacity. This contrasts with a more traditional watershed planning approach which includes large public meetings, in which only a few interests may actually be represented under a scarcity of information, which can lead to a firming of entrenched positions with fewer options for later engagement. Instead, SNA is used to strategically build the alliance in subsequent stages as capacity better permits newcomers to more effectively participate significantly as they are brought in incrementally into appropriate capacities.

3.3.9 Least Valuable?

In Session #1, the expert speakers did not adhere to their allotted time well and too much time was permitted for questions, so this reduced the time available for SNA concepts and techniques. Therefore, in Session #2, each speaker provided a fact sheet and / or drew a SNA diagram to facilitate their presentation and keep it to the time permitted with limited questions following each. Even so, some attendees in both sessions wanted more live demos, rather than static presentation of the software – less why, more how. However, this would have been difficult without a solid understanding of SNA concepts, which most attendees lacked and reported as the most valuable portion of the workshop. The workshop did cover SNA software input preparation and use in brief and provided a Quick Tips handout for each of four different software for attendees to follow up on their own, yet this did not seem to suffice for some.

To address this desire for more SNA tool practice, discussion is ongoing about forming a faculty-sponsored or program-sponsored group that would meet on-campus monthly to continue to work together to delve into the software and more specific examples. In addition to the Quick Tips for software use already provided for UCINET, Gephi, Netlogo, and R-igraph, TILT ECHO

360 software was also used to develop an SNA software demo for the course materials section of the websites that only attendees can access, which was well-received by those who reviewed it.

With an overall rating of more than 8 out of 10 for satisfaction and the list of the many tips students learned that could actually be applied to more effective water and natural resource management through systematic network management, and since several attendees felt rushed or even overwhelmed, a semester-long course will now be developed, which the SNA workshop facilitator will teach and build into a course manual for further replication.

3.3.10 How has your perspective changed?

By clarifying how easy SNA data is to build and SNA software is to use, several students realized that they may be able to use it in their research. In fact, more than three attendees brought specific research problems with data that the student facilitator discussed with them before or after class to help plan SNA software input and analysis. This demonstrated the potential of agent-based SNA modeling in one instance for a dynamic, longitudinal study of three groups of wild horses with decades of lifecycle data for each.

The facilitator reminded attendees how critical it was for them to use the concepts and software very carefully to never judge groups or individuals. Analytically understanding motives, values, and other characteristics could characterize the network structure and its behavior with less bias, which was commonly mentioned as an important take-away. These social factors and a SNA technician's ability to use many paradigms to understand different aspects of the system and the attributes of the nodes and links that may explain the network's development and structure was mentioned in question response 5, 6, or 7 as something they will not forget. Both in research and practice, attendees have almost universally promised to be more analytical and less judgmental in more systematically and strategically seeking not to leave out any group of potential consequence as they build coalitions moving forward.

3.3.11 Network Features You Will Now Focus On More

Another important measure of workshop success was determining if each attendee actually took away some SNA concept to more consciously focus on in analyzing and building networks. Nearly a third of attendees mentioned understanding the importance of bridging ties and measures of betweeness centrality to better determine who are brokers and where gaps exist that could lead to vulnerabilities, if not filled. Others understood that not only are bridging ties important, but bonding ties that increase cohesion (trust and social capital) of already connected groups. By increasing network redundancy, losing one link is then not as critical, with many alternate pathways (a.k.a. node equivalence – one node interchangeable with another).

3.3.12 What did you learn from one another and the expert presenters?

The workshop was noted for its high level of participation, in which every attendee was encouraged to question and share tips, which led to a very collaborative learning environment. In addition to the survey results, this was also evident in the smiles, nods, and interest that remained throughout, in spite of the workshop's long length. The oval table in the Physics Conference Room around which up to 15 attendees could sit comfortably facing one another (Figure 18), and placards with first names in front of each participant helped build this sense of equality. The

facilitator even called on quiet attendees that monitoring indicated had not yet joined the conversation to ensure that they were also invited into the lively conversation. In more than one instance, this direct inclusion led a formerly quiet attendee to become more engaged in the conversation moving forward. The success of these participatory techniques will be furthered in future offerings.

Figure 18. Oval Table Facilitated Shared Learning

The usefulness of real world experts and the expertise of every attendee present was effectively leveraged. Even though a few attendees complained about the time it detracted from software, the deeper, broader understanding of the topic in a real world context from a diversity of perspectives is likely to better equip attendees to use SNA effectively and contextually through this vibrant shared learning experience. This is why, in addition to the knowledge of the instructor, both the *level of participation encouraged* and the *utility of speakers'* ratings received the highest levels of agreement.

Response to this question also specifically noted that the USGS expert introduction to the Legal-Institutional Analysis Framework (LIAM) as a complimentary tool was useful. Other knowledge gained from others included the importance of valuing different ways of knowing; including traditional, local, and indigenous knowledge systems in design and decisions; including every group, not just those that show up; and going to where the leader lives or a group is already meeting instead. Several times, the importance of understanding underlying values and building trust through direct relationships, perhaps by reaching out to someone in another status / role than the one in direct opposition to one's own role was shown to be another potentially useful avenue for extending collaboration.

3.3.13 Will you use SNA now?

Many attendees planned to try out SNA software, or at least hand diagramming, to more systematically analyze a network for research, understanding, or development purposes. The short homework assignment required to receive the SNA workshop certificate of attendance also facilitated this goal.

However, nearly as many attendees planned to simply use SNA concepts, the network paradigm, and related tips and discussion to more effectively work with other groups and people. Not judging any person or group was repeatedly mentioned as an important take-away, since we all judge, though once you become consciously aware that you are doing so, it may be easier for at least some attendees to more systematically analyze rather than judge why and how social network structure exists and how it might be altered. Clearly, some attendees felt empowered by this knowledge to more strategically build relationships and bridges. This alone may be considered an important benefit of attendance. It also provides a rational for NIWR / CWI to continue to fund non-traditional instructional forms and cross-disciplinary instructional efforts.

3.3.14 Next Steps?

The final two evaluation questions asked attendees how to follow-up with online discussion topics or other workshop sessions. Since Session #1 attendees indicated that rather than an online collaborative, a monthly SNA campus group would help them more, the Session #2 attendees were also asked specific recurring days and times they might consider participating in ongoing, monthly get-togethers for further SNA knowledge and technique development and to practice on specific datasets related to water and resource management. Nearly half of attendees indicated that they would like to be included in such face-to-face follow-up. Online tools, beyond the workshop materials, videos, and transcripts were not favored. Surprisingly, there was not even much interest in online demonstrations or webinars.

3.3.15 Additional Comments

The most common comment was disappointment that even more could not be covered, especially the software. However, several attendees felt the material was already rushed or reported feeling overwhelmed or a little below the level of the workshop. This leads to the already reported conclusion that a semester-long course should be developed to chunk the materials into smaller bites, provide more time for facilitator interaction between meetings as needed with those who might be struggling, and to allow time to thoroughly cover software techniques in detail. Therefore, the facilitator is actively seeking a department or program that would be interested in hosting an SNA course based on this SNA Workshop by Fall 2014 or Spring 2015. This completion report, the online website, and the course materials will demonstrate the validity of the methods and need for this course, as well as, the facilitator's ability to analyze and evaluate on an ongoing basis to continually improve content and delivery. The Spring 2014 experiences also demonstrate that in addition to continuing to offer a half-day introductory SNA workshop, SNA for technical managers can be package in a variety of alternative instructional formats for a variety of different communities and purposes.

4.0 PRINCIPAL FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

4.1 Lessons Learned

…In Research – in teaching the SNA Workshop, the facilitator became aware of certain recurring themes that could be covered in more depth in a semester-long course, such as effective use of agent-based models for dynamic, longitudinal studies and other SNA software techniques

…In Preparation – including real-world experts in the workshop proved extremely valuable to many of the attendees, but carefully focusing their talks with SNA diagrams, fact sheets, and set time limits was critical to ensure a good balance. Eating together built rapport and led to important side discussions, so this should be included when feasible.

…In Marketing – friend-to-friend, worker-to-co-worker, boss-to-subordinate, advisor-to-advisee, professor-to-student or notice through respected email listservs that are not overused, seemed best to reach the target audience. Online calendars and posted flyers, even though technically reaching a larger exposure audience, did not attract nearly as many avid attendees.

…In Delivery – in analyzing the first session, the student facilitator noted certain repeated phrases that could be consciously eliminated and other delivery issues that could be corrected. This will lead her to regularly continue to record all workshops, courses, and seminars to continue to assess and improve. More delivery practice when materials change could have also improved the pace or focus to better address some of the comments.

…In Follow-up – whereas it was expected that attendees would be impressed by all the online tools, resource links, and discussion boards to participate in an online collaborative, in reality, most attendees felt only a scheduled face-to-face monthly group follow-up would allow them to continue moving forward. Therefore, if enough interest can be developed, 2014 meetings may be scheduled in a CSU computer lab with pre-installed software to ensure this foremost follow-on request has been addressed. Hopefully, within a semester or two, a semester-long version of the SNA workshop materials will provide students a more thorough and well-paced alternative.

4.2 Next Steps

There is some interest by certain CSU programs and academic institutions in other parts of the state to offer the SNA Workshop. Some of the federal workers who attended either would consider it for their program or another in their agency. A semester-long SNA course and textbook is also in planning, based on the demonstrated viability and utility of the SNA Workshop achieved.

Appendices includes some of the marketing and survey instruments employed that will continue to serve this and other SNA instructional development purposes. Appendices D through F list additional results from alternative instructional formats that will also prove useful.

REFERENCES

IMPORTANT NOTE: To expedite document access, an international standard book number (ISBN) has been included for each book, and a digital object identifier (DOI) number has been included for each article. Enter the DOI number in the http://dx.doi.org/ search box to access the reference from the publisher of the article. Enter the ISBN number in the http://www.isbnsearch.org/ search box to access book details from vendors, or enter the ISBN in a library search to access a copy from your institution. To the extent possible, the newer ISBN-13 rather than the ISBN-10 code is used to avoid the infrequent case in which two books were given the same reference number. If neither an ISBN or a DOI is available, to the extent possible, a direct online access link to the actual resource is included following the reference. This is most likely to occur for federal, state, and local watershed documents. References to other resources occur in the text itself where the material, such as personnel communication, is cited.

Banathy, B. 1996. Designing social systems in a changing world. Springer-Verlag, Berlin. (ISBN-13: 9781475799811)

Berkes, F. 1989. Common property resources: ecology and community-based sustainable development. Belhaven Press, London, UK. (ISBN-13: 9781852930806)

Bodin, O. and B. Crona. 2009. The role of social networks in natural resource governance: What relational patterns make a difference? Global Environmental Change 19 (2009): 366–374. (DOI: 10.1016/j.gloenvcha.2009.05.002)

Bodin O. and C. Prell. eds. 2011. Social Networks and Natural Resource management: Uncovering the Social Fabric of Environmental Governance. Cambridge University Press, Cambridge, UK. (ISBN-13: 9780521146234)

Borgatti, S. P., M. G. Everett, and L. C. Freeman. 2002. UCINET for Windows: Software for Social Network Analysis. Harvard, MA: Analytic Technologies. https://sites.google.com/site/ucinetsoftware/home. *Accessed* February 2014.

Borgatti, S. P., M. G. Everett, and J.C. Johnson. 2013. Analyzing Social Networks. Sage, Los Angeles. Companion website. *Accessed* February 2014. (ISBN-13: 9781446247419)

Carpenter, D., K. Esterling, and D. Lazer. 2003. The Strength of Strong Ties: A Model of Contact-Making in Policy Networks with Evidence from U.S. Health Politics. Rationality and Society, 15:411. (DOI: 10.1177/1043463103154001)

Checkland, P. 1999. Systems Thinking, Systems Practice. In Soft Systems Methodology: a 30-year Retrospective. John Wiley & Sons, Ltd. NY. (ISBN-13: 978-0471986065)

Dean, C. B., Hubbell, E. R., Pitler, H.; Stone, B. 2011. Classroom Instruction That Works: Research-Based Strategies for Increasing Student Achievement (2nd ed.). McRel: Denver, CO. (ISBN-13: 978-1416613626)

Easley, D. and J. Kleinberg. 2010. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. Cambridge University Press. http://www.cs.cornell.edu/home/kleinber/networks-book/networks-book.pdf. *Accessed* March 2014.

Freeman, D.M. 1992. Choice against Choice: constructing a policy-assessing sociology for social development. University Press of Colorado: Boulder, CO. (ISBN-13: 978-0870812378)

Freeman, D.M. 2010. Implementing the Endangered Species Act on the Platte Basin Water Commons. University Press of Colorado: Boulder, CO. (ISBN-13: 978-1607321835)

Gephi. 2013. Gephi Network Visualization and Analysis Open-Source Software. Gephi Consortium. http://gephi.org/about/. *Accessed* March 2014.

Granovetter, M. S. 1973. The Strength of Weak Ties. American Journal of Sociology, 78(6): 1360-1380. http://www.jstor.org/stable/2776392. *Accessed* March 2014.

Hanneman, R.A., and M. Riddle. 2005. Introduction to Social Network Methods. University of California, Riverside. *Accessed* March 2014. http://faculty.ucr.edu/~hanneman/. *Accessed* March 2014.

Holzmann, V. 2013. A meta-analysis of brokering knowledge in project management. International Journal of Project Management 31: 2–13. (DOI: 10.1016/j.ijproman.2012.05.002)

Hordijk, M. and I. Baud. 2011. Inclusive Adaptation: Linking Participatory Learning and Knowledge Management to Urban Resilience. In Otto-Zimmermann, K. Ed. Resilient Cities. Springer, Netherlands. (DOI: 10.1007/97894-007-0785-6_11)

Knoke, D. and S. Yang. 2007. Social Network Analysis, Series: Quantitative Applications in the Social Sciences. Sage Publications, NY. (ISBN-13: 9780262521901)

MEA. 2005. Living Beyond Our Means: Natural Assets and Human Well-Being. United Nations, Millennium Ecosystem Assessment. http://www.maweb.org/documents/document.429.aspx.pdf. *Accessed* February 2014.

Ostrom, E. 2005. Understanding Institutional Diversity. Princeton University Press, Princeton, NJ. (ISBN: 9781400831739)

Plummer, R., B. Crona, D. Armitage, P. Olsson, M. Tengo, and O. Yundina. 2012. Adaptive Comanagement: A Systematic Review and Analysis. Ecology and Society 17(2): 11. http://www.ecologyandsociety.org/vol17/iss3/art11/. *Accessed* February 2014.

Pratt, A. 2010. Federal Bureaucracy and Locality: A Case Study of the Uncompahgre Valley Water Users' Association's Management of its Water Commons. Colorado Water Institute

Special Report 18. Colorado State University. Fort Collins, Colorado. http://www.cwi.colostate.edu/publications/sr/18.pdf. *Accessed* February 2014.

Prell, C. 2012. Social Network Analysis: History, Theory, and Methodology. Sage Publications, NY. (ISBN-13: 9781412947152)

Rodela, R. 2012. The social learning discourse: Trends, themes and interdisciplinary influences in current research. Environmental Science & Policy, 25:157-166. (DOI: 10.1016/j.envsci.2012.09.002)

Thiry, M. 2011. Ambiguity Management: The New Frontier. PMI North-America Global Congress, Dallas TX. http://marketplace.pmi.org/Pages/ProductDetail.aspx?GMProduct=00101332900&iss=1. *Accessed* February 2014.

Walker, B., and D. Salt. 2012. Resilience Practice: Building capacity to absorb disturbance and maintain function. Island Press, Washington, D.C. (ISBN-13: 9781597268011)

Wasserman, S. and K. Faust. 1994. Social Network Analysis: Methods and Applications. Cambridge University Press, Cambridge, UK. (ISBN-13: 9780521387071)

Zolli, A. and A.M. Healy. 2012. Resilience: Why things bounce back. Simon & Shuster: NY. (ISBN-13: 9781451683806)

APPENDIX

FREE! Social Network Analysis Workshop for Water and Resource Management

When: Wednesday, October 23rd **OR** Tuesday, October 29th
Time: 4PM – 8PM **(includes free dinner!)** Choose preferred day.
Where: Engineering Bldg-E, Rm. 126, Physics Conference Room
Cost: Absolutely FREE! + earn certificate and points for prizes!!
How: REGISTER and more details at ***sna.wateractionnetwork.org***

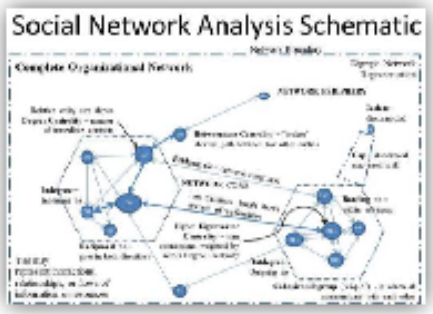
- ✓ **Review** what you know *and don't know yet* about social networks and human dimensions of technical problems
- ✓ **Learn** systematic, structured approach to analyze groups
- ✓ **Explore** how to apply SNA to resource problems and more

Physics Conference Room 126

SE entrance = E-Wing
Engineering Bldg. is NE of Lory SC

Workshop Schedule

4:00-4:30 Introductions, Roundtable, Scenarios
4:30-5:00 Challenges of Integrated Management
5:00-5:30 SNA theory and FUNdamentals
5:30-6:00 BREAK! for pizza, subs, drinks, snacks
6:00-6:30 Social Network Analysis methods
6:30-7:00 Adaptive Co-Management concepts
7:00-7:30 Applications to Water & Resource Mgmt
7:30-7:50 Improving your own networks, Tips
7:50-8:00 Wrap-up, Next steps, Join collaborative!



sna.wateractionnetwork.org

More questions??? Call (303) 238-0419 or complete *Contact tab* on the website or contact: margaret.herzog@colostate.edu

For more details, visit the website or scan QR code>

EXHIBIT B. SNA WORKSHOP POST-EVALUATION FORM

POST-WORKSHOP EVALUATION for
Social Network Analysis Workshop for Water and Resource Management
4:15 - 8:15 PM, TUESDAY, OCTOBER 29, 2013

Purpose: Please evaluate this *experimental* SNA Workshop to determine how it might be improved. We will keep your responses **confidential**, so please be candid in your remarks. (10 points)

1. How did you learn about the SNA workshop opportunity? Please check all that apply.

   ☐ Class visit ☐ Colleague ☐ Group Email ☐ Calendar ☐ Posted Flyer ☐ Other

   Please explain _____

2. Why did you participate in this workshop? Check all that apply.

   ☐ Work quandary. You hope to figure out a solution to a specific issue you came across at work.

   ☐ Research interest. This workshop aligns with your own academic interests or research topic.

   ☐ Teaching interest. You would like to teach a similar type of workshop or content area.

   ☐ Community interest. You wish to build or expand a group collaborative, nonprofit, or others.

   ☐ Friend's suggestion. A colleague recommended the workshop to you or was going, too.

   ☐ Personal interest. You would like to improve your network for job hunting, advancement, etc.

   ☐ Entertainment. It sounded fun, the food was free, and I wanted to earn points and prizes.

   ☐ Other: If other, please specify:_____

   Please explain _____

3. What aspects of the SNA Workshop were most valuable to you? And why?

   _____

   _____

4. Least valuable and why? Or what would you change, add or delete about the SNA Workshop?

   _____

   _____

5. How has this workshop changed your thinking about social network analysis or other topics presented?

   _____

   _____

6. What network features will you now focus on more when you are analyzing or building networks?

   _____

   _____

7. Reflecting on your interactions at this workshop, and what other attendees and speakers presented; what was the most important thing your learned from others, rather than the facilitator/instructor.

   _____

   _____

8. How will you (or might you in the future) use or apply what you learned at the SNA Workshop?

   _____

   _____

Please complete both sides – 10 questions and Evaluation Matrix Page 1 of 2

Margaret Herzog (303) 238-0419 water2share@gmaill.com http://sna.wateractionnetwork.org

POST-WORKSHOP EVALUATION for
Social Network Analysis Workshop for Water and Resource Management
4:15 - 8:15 PM, TUESDAY, OCTOBER 29, 2013

9. What online discussions, resources, or other tools might you'd like added to the SNA Workshop website (http://sna.wateractionnetwork.org)? Also, what days/times might you attend recurring monthly meetings?

_____

_____

10. Do you have any suggestions for future Social Network Analysis focused follow-on workshops?

_____

_____

SNA Workshop Scaled Ratings – please X or Circle the number that best applies to each item.

	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
The pre-workshop communications gave me the information I needed about the SNA workshop.	1	2	3	4	5	6
The SNA Workshop website links and resources were useful in preparing for the workshop.	1	2	3	4	5	6
Invited speakers added important perspective.	1	2	3	4	5	6
Class participation/ interaction was encouraged.	1	2	3	4	5	6
Content was organized and easy to follow.	1	2	3	4	5	6
The workshop sessions were well-facilitated.	1	2	3	4	5	6
The instructor was knowledgeable.	1	2	3	4	5	6
Presentation materials and handouts were useful	1	2	3	4	5	6
The logistics for the workshop were well-executed: space, breaks, food, location, time,etc.	1	2	3	4	5	6
The GOALS of the SNA workshop were met: **Review** what you know about SNA **Learn** structured, systematic SNA approach **Explore** how SNA can be applied effectively	1	2	3	4	5	6
I will use the *SNA Workshop* website to help apply the learning I gained from this workshop.	1	2	3	4	5	6
I plan to share what I learned with others.	1	2	3	4	5	6
I will use what I learned in my work / research.	1	2	3	4	5	6
Please use this space to comment on any of your ratings, particularly if you rated any below "3."						

Please indicate your general satisfaction with this workshop by circling the appropriate number:

Very dissatisfied 1 2 3 4 5 6 7 8 9 10 **Very Satisfied**

Please comment to explain your rating; what aspects of the training could be improved, or other comments?

_____

_____

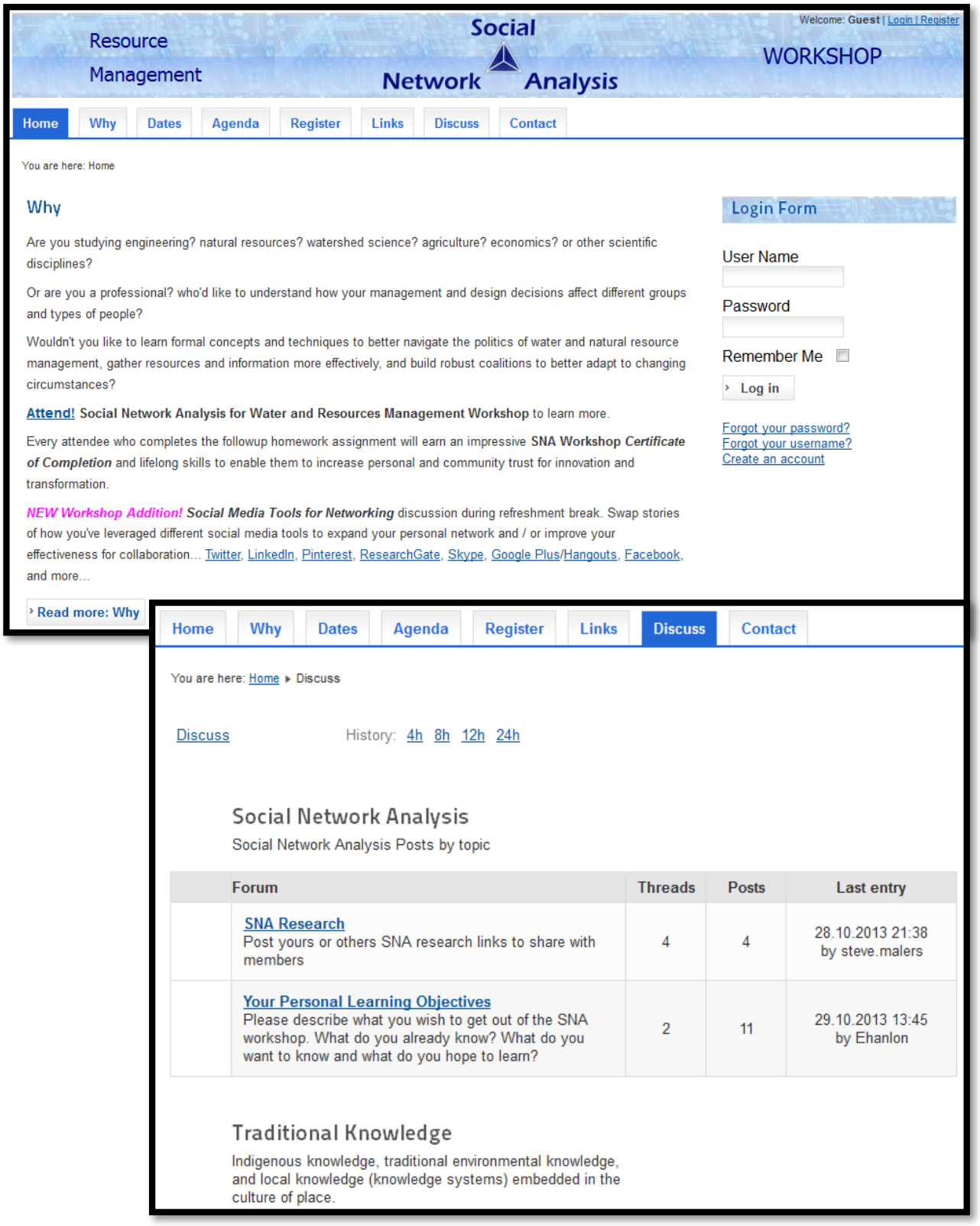
_____

Thank you for your time and participation!

Please complete both sides – 10 questions and Evaluation Matrix Page 2 of 2

Margaret Herzog (303) 238-0419 water2share@gmaill.com http://sna.wateractionnetwork.org

EXHIBIT C. SNA WORKSHOP COMPANION WEBSITE (http://sna.wateractionnetwork.org)



Home | Why | Dates | Agenda | Register | Links | Discuss | Contact

You are here: Home ▸ Links

REFERENCES

Intro | Software | E-Resources | Applied | Collaboratives

SNA in Resource Management

Bodin, O. and B. Crona. 2009. The role of social networks in natural resource governance: What relational patterns make a difference? Global Environmental Change 19 (2009): 366–374.

Must read!
Bodin O. and C. Prell. eds. 2011. Social Networks and Natural Resource Management: Uncovering the Social Fabric of Environmental Governance. Cambridge University Press, Cambridge, UK.

Cumming, G.S. 2011. Spatial Resilience in Social-Ecological Systems. Springer-Verlag, Berlin.

Dopplet, B., M. Scurlock, C. Frissell, and J. Karr. 1993. Entering the Watershed: A new Approach to Save America's River Ecosystems. The Pacific Rivers Council. Island Press, Washington, D.C.

Fabiani, D. and T.F. Buss. Eds. 2008. Reengineering Community Development for the 21st Century: Transformational Trends in Governance and Democracy. M.E. Sharpe. Washington, D.C.

Jedd, Theresa. 2013. Accountability and Legitimacy in Networked Governance: Transboundary Forest Conservation. Colorado State University Press: Fort Collins.

Rodela, R. 2012. The social learning discourse: Trends, themes and interdisciplinary influences in current research. Environmental Science & Policy, 25 (January 2013): 157-166.

Adaptive Co-Management

Armitage, D., F. Berkes, and N. Doubleday. eds. 2007. Adaptive Co-management: Collaboration, learning and multi-level governance. UBC Press, Vancouver, Canada.

Armitage, D. and R. Plummer. eds. 2010. Adaptive Capacity and Environmental Governance. Springer-Verlag, Berlin.

Bourget, L. ed. 2011. Converging Waters: Integrating Collaborative Modeling with Participatory Processes to Make Water Resources Decisions. U.S. Army Corps of Engineers, Institute for Water Resources (Maass-White Series),

Intro | Software | E-Resources | Applied | Collaboratives

SNA Collaboratives

International Network for Social Network Analysis - SOCNET Listserv, ***Connections*** Journal, ***Data Exchange Network*** and more excellent resources for SNA researchers

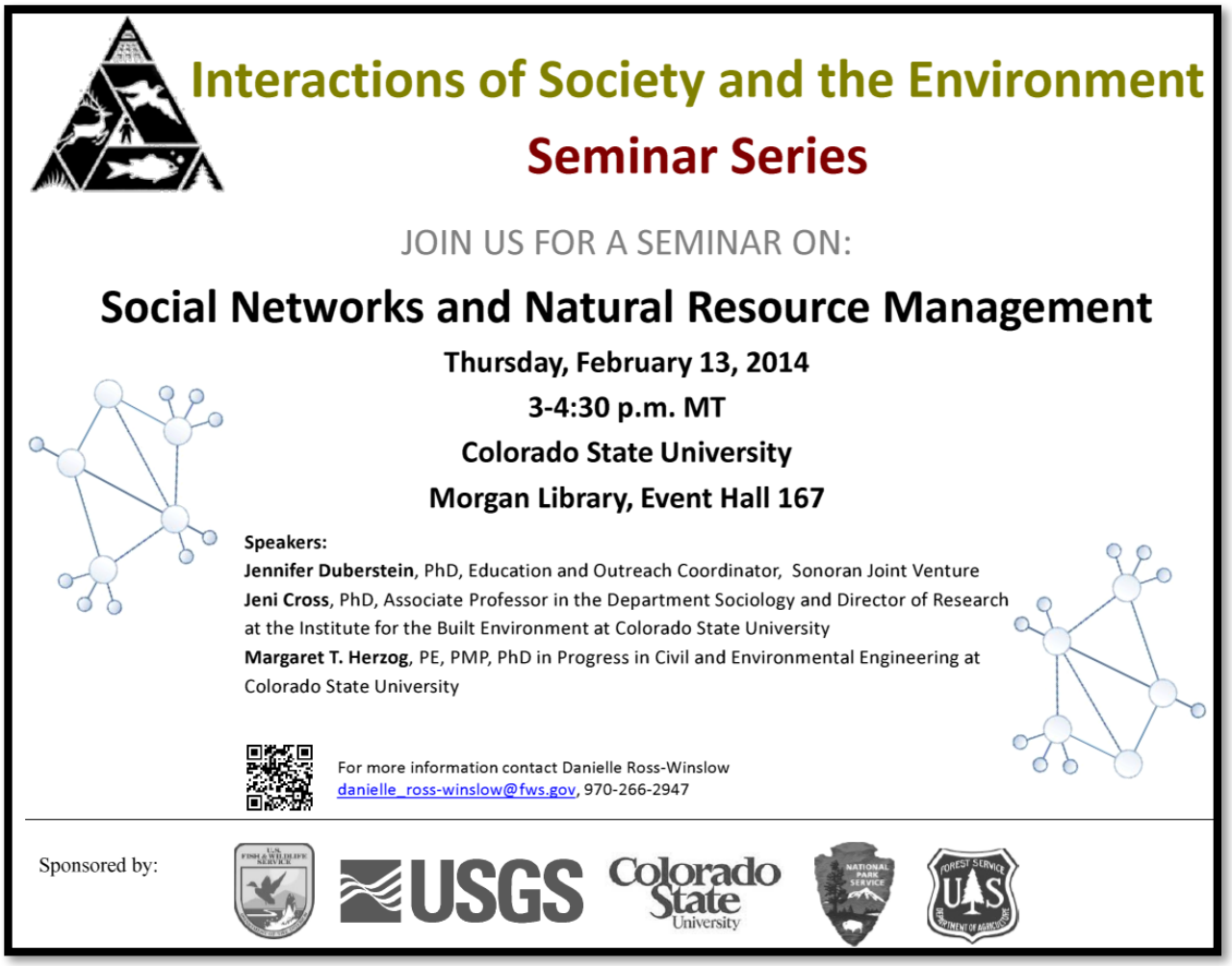
Colorado Collaboratives

Alliance for Sustainable Colorado - advancing sustainability through collaboration

Coalition for the Upper South Platte - collaboratively manages the watershed, weeds, and wildfire risks from the SP headwaters SW of Denver to Strontia Springs Reservoir

Collaborative Conservation Learning Network (CCLN) - ideas, connections to help worldwide collaborative conservation efforts become effective and sustainable

EXHIBIT D. INTERACTIONS OF SOCIETY AND THE ENVIRONMENT SEMINAR SERIES (ISESS) SPRING 2014: SOCIAL NETWORKS AND NATURAL RESOURCE MANAGEMENT POST-EVALUATION SURVEY AND RESULTS



Herzog Dissertation Survey Questions for ISESS Seminar: Social Networks and Natural Resource Management Thursday, February 13, 2014

Purpose: Please help me complete my research by answering a few survey questions to improve the SNA portion of my *Adaptive Co-Management Decision Support System* (ACM DSS) dissertation.

1. What is your current status (you can check more than one)?

☐ Undergraduate ☐ Grad Student ☐ Researcher ☐ Professor ☐ Water / NR Manager

☐ State Govt. ☐ Federal Govt. ☐ Nonprofit Group ☐ Other (list) _____

2. How did you learn about the *Social Networks and Natural Resource Management* Seminar?

☐ Dept/Group Email ☐ Posted Flyer ☐ Friend told me ☐ Other _____

Post SNA Seminar Questions – please X or Circle the number that best applies to each item, 6 is high

	Strongly Agree!	Agree	Tend to Agree	Tend to Disagree	Disagree	Strongly Disagree
I already knew a lot about social networks before today.	6	5	4	3	2	1
Having three different speakers was better than one type.	6	5	4	3	2	1
I think SNA can help modify nat. resource user behavior	6	5	4	3	2	1
I think SNA can expand outreach to neglected groups.	6	5	4	3	2	1
SNA can help to design better *rules of engagement*.	6	5	4	3	2	1
SNA can make government more responsive to citizens.	6	5	4	3	2	1
Adaptive Co-Management/ Resilience made sense to me	6	5	4	3	2	1
I will likely apply at least one new SNA concept.	6	5	4	3	2	1
I will recognize network gaps and work to bridge them.	6	5	4	3	2	1
I will more consciously close triads to increase network cohesiveness and redundancy and info and resource flow	6	5	4	3	2	1
I may try to use free SNA software now, like GEPHI.	6	5	4	3	2	1
I will more consciously consider networks in my life.	6	5	4	3	2	1
I may expand my use of social media online now, too.	6	5	4	3	2	1
This seminar taught me new SNA research applications.	6	5	4	3	2	1
This seminar was worth attending!	6	5	4	3	2	1
Please use this space to comment on any of your ratings, particularly if you rated any below "4".						

Would you be interested in participating in a <u>CSU SNA student organization</u>? Y or N

If Yes, please enter your **email** for more info and select level of support _____@_____

☐ **Faculty Sponsor!** ☐ **Student Officer!** ☐ Participant ☐ Other Support (food, venue, etc.)

Please comment on CSU SNA club idea and your potential support _____

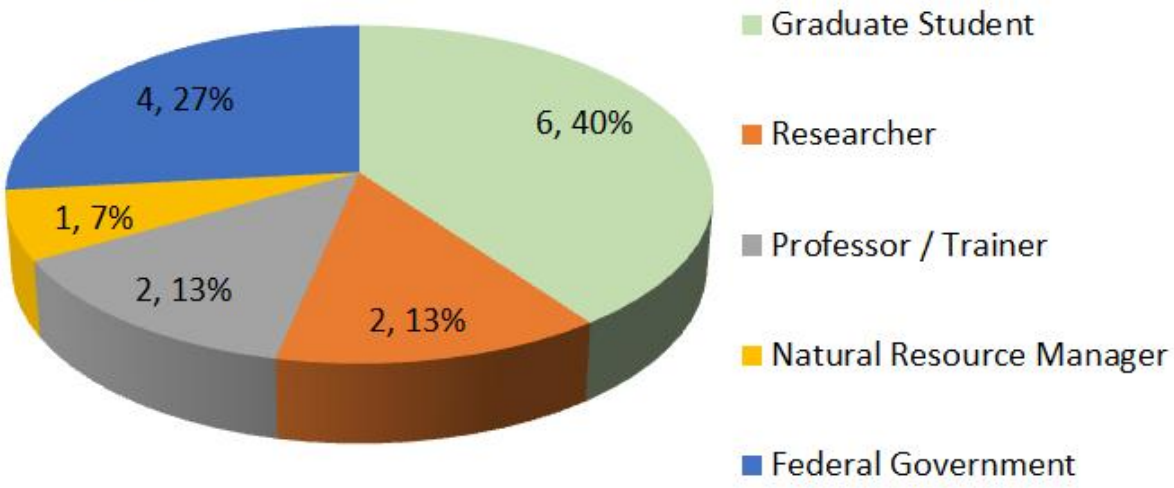
_____

_____

Thank you for your time and participation!

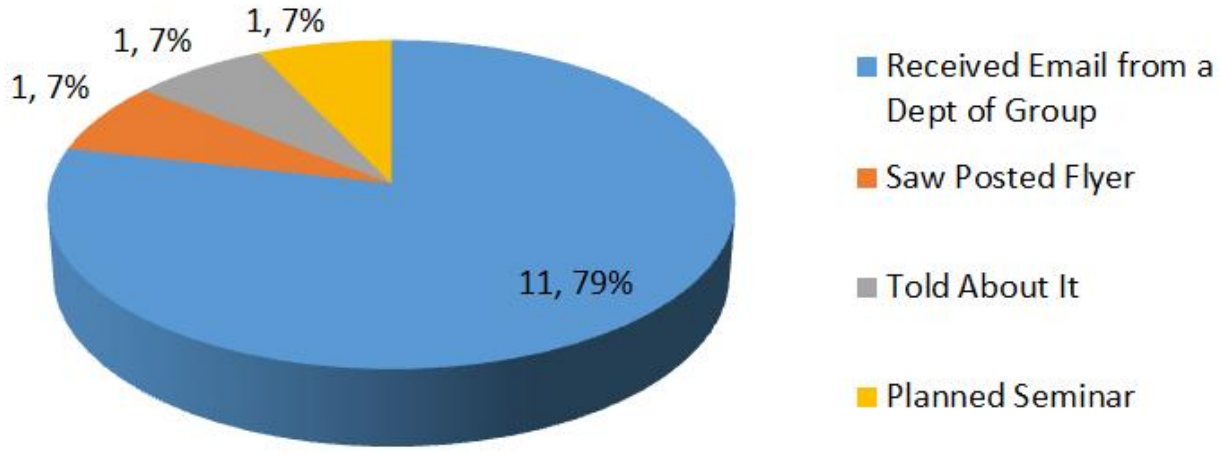
Please WRITE any comments related to the seminar or this survey on the back ⇨

2014 ISESS Social Networks in Natural Resources Seminar
Attendee Type



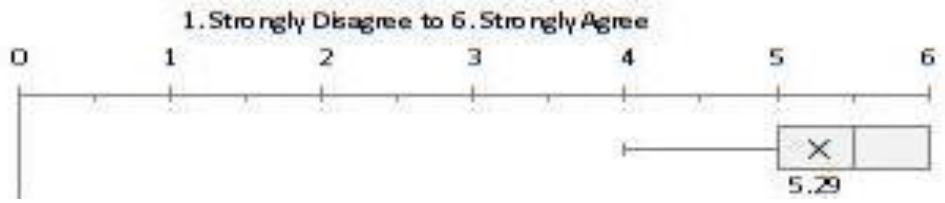
14 / 20 attendees responding. One respondent indicated two different statuses.

2014 ISESS Social Networks in Natural Resources Seminar
How learned about seminar topic and schedule



14 / 20 attendees responding

Response: Seminar Satisfaction Question: ***This SNA Seminar was worth attending!***



Relative Agreement with Statements about Different Aspects of the ISESS Workshop

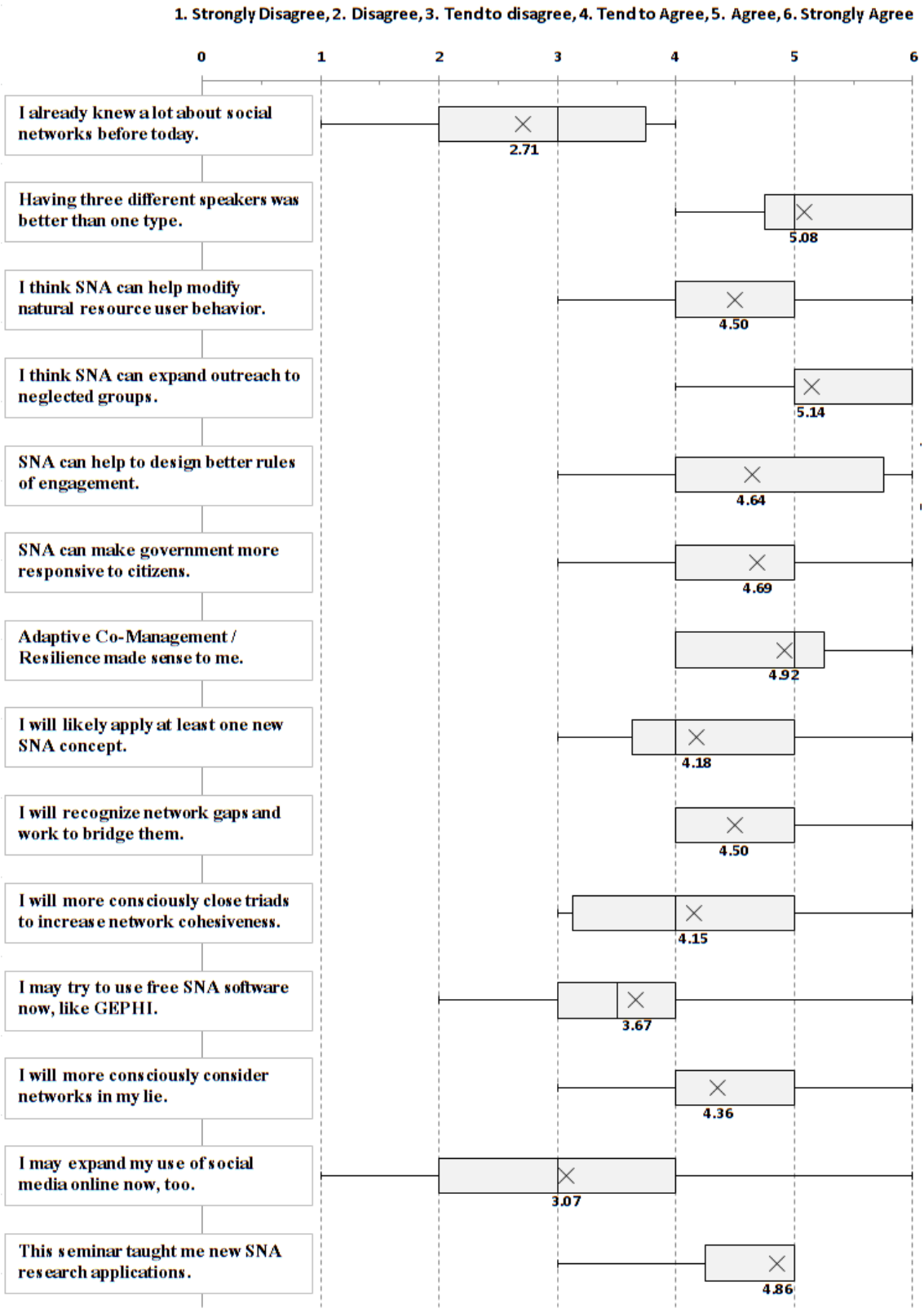


EXHIBIT E. METROPOLITAN UNIVERSITY AT DENVER ONE WORLD ONE WATER PROGRAM: SNA SEMINAR OF ONE-HOUR AND FIFTEEN MINUTES PRE-SEMINAR HANDOUT, POST-EVALUATION SURVEY AND RESULTS

Two-Excerpts from OWOW Pre-Session Reading (Copyright© 2014)
In Social Network Analysis for Water Resource Management
Monday, March 31, 2014

OWOW Pre-Session Handout Excerpts

Introduction

Social Network Analysis (SNA) determines how entities are organized in relation to one another. In my research, SNA was used to evaluate existing group ties, knowledge and resource exchange, and regulatory frameworks to improve overall social network structure by increasing the density of relationships and expanding ties. The SNA session on Monday, March 31, 2014, will teach you how to improve the groups in which you work, play, and live by using what you learn to improve communication amongst the group and how to cooperate more effectively with other groups.

This session with help you learn how to use sociological principles to more systematically improve relationships and flow of information and resources – individually, organizationally, and institutionally.

>>>> SNA Theory and Examples from Section 1.5 Discussed <<<<

Conclusion

On Monday, I will be handing out my slides and I hope you will take notes. I want you to seriously think about the groups in which you operate and how you can apply what you learn to improve their function and connectivity like I did in this watershed example. I hope this will make your life richer by more fully valuing each person you meet as a unique connector to many other new and wonderful relationships and resources. I hope you will work hard to make each group in which you find yourself more interdependent, so that you may accomplish your goals more effectively. I hope you will use this knowledge as a network weaver to connect many diverse groups together by being the initial bridging link and then increasing connectivity by getting even more people in the different groups to strengthen the connection. I hope these skills not only help you find a great job by becoming a member of diverse groups to meet important people who can get you desired connections, but once on the job, I hope these skills make you a more valuable network weaver for your company to grow business and better complete its mission. May your relationships always delight!

POST EVALUATION FOR OWOW SESSION
Social Networks for Water Resources Management
Monday, March 31, 2014

Purpose: Please help me complete my research by answering a few survey questions to improve the SNA portion of my *Adaptive Co-Management Decision Support System* (ACM DSS) dissertation.

1. What is your major (you can check more than one)?

☐ Natural Resources ☐ Education ☐ Biz/Legal ☐ Engineering ☐ Computer-Related

☐ Social Sciences ☐ Urban Planning/Architecture ☐ Medicine ☐ Other (list) _____

2. Was did you learn from the *Social Networks for Water Resources Management* Seminar?

☐ Sociology ☐ Network Diagrams ☐ Importance of Cooperation ☐ Other _____

Post SNA Seminar Questions – please X or Circle the number that best applies to each item, 6 is high

	Strongly Agree!	Agree	Tend to Agree	Tend to Disagree	Disagree	Strongly Disagree
I already knew a lot about social networks before today.	6	5	4	3	2	1
Sociology and SNA concepts made sense to me.	6	5	4	3	2	1
Adaptive Co-Management/ Resilience made sense to me	6	5	4	3	2	1
I may try to use free SNA software now, like GEPHI.	6	5	4	3	2	1
I can see how SNA can help diverse groups cooperate.	6	5	4	3	2	1
I think SNA can expand outreach to neglected groups.	6	5	4	3	2	1
Cooperation can help cope with unexpected events.	6	5	4	3	2	1
I will likely apply at least one new SNA concept.	6	5	4	3	2	1
I'll more consciously consider networks in my life now.	6	5	4	3	2	1
I will more consciously close triads to increase network cohesiveness and redundancy and info and resource flow	6	5	4	3	2	1
I will recognize network gaps and work to bridge them.	6	5	4	3	2	1
This seminar might help me get a job or a better job.	6	5	4	3	2	1
I may expand my use of online social media now, too.	6	5	4	3	2	1
This seminar taught me new ways to use SNA to win!	6	5	4	3	2	1
This seminar was worth attending!	6	5	4	3	2	1
Please use this space to comment on any of your ratings, particularly if you rated any below "4".						

Thank you for your time and participation!

Please WRITE any comments related to the seminar or this survey here

_____

_____

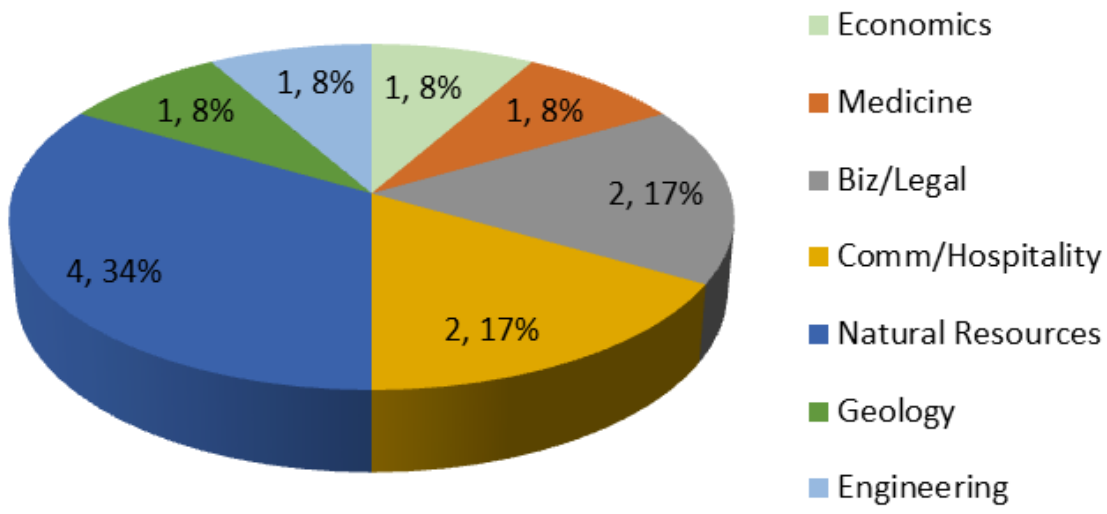
_____

_____

_____

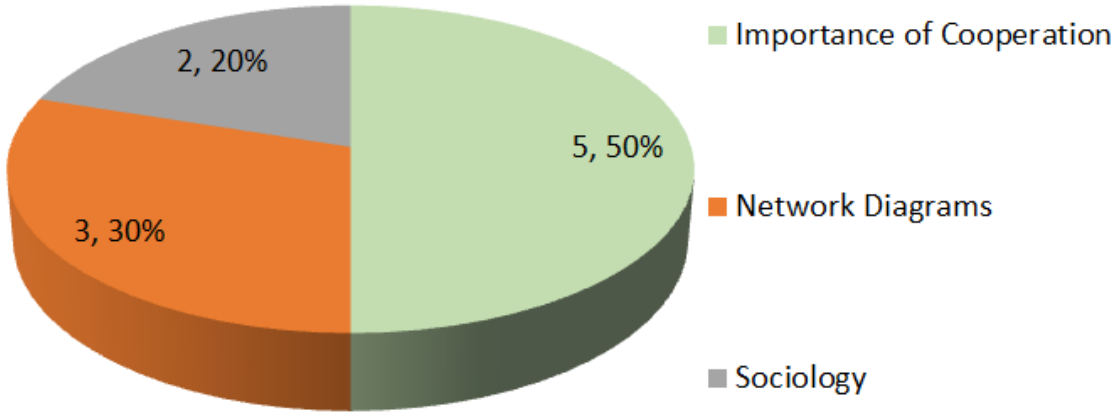
_____

2014 OWOW Undergraduate Seminar Attendee Type



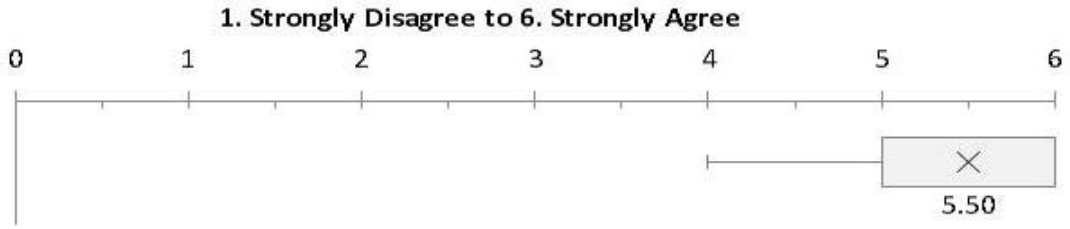
9/9 attendees responding. Some respondents indicated more than one major.

2014 OWOW Undergraduate Seminar Question: What did you learn?



7/9 attendees responding. Some respondents indicated more than one topic.

Response: Seminar Satisfaction Question: ***This SNA Seminar was worth attending!***



Relative Agreement with Statements about Different Aspects of the OWOW Workshop

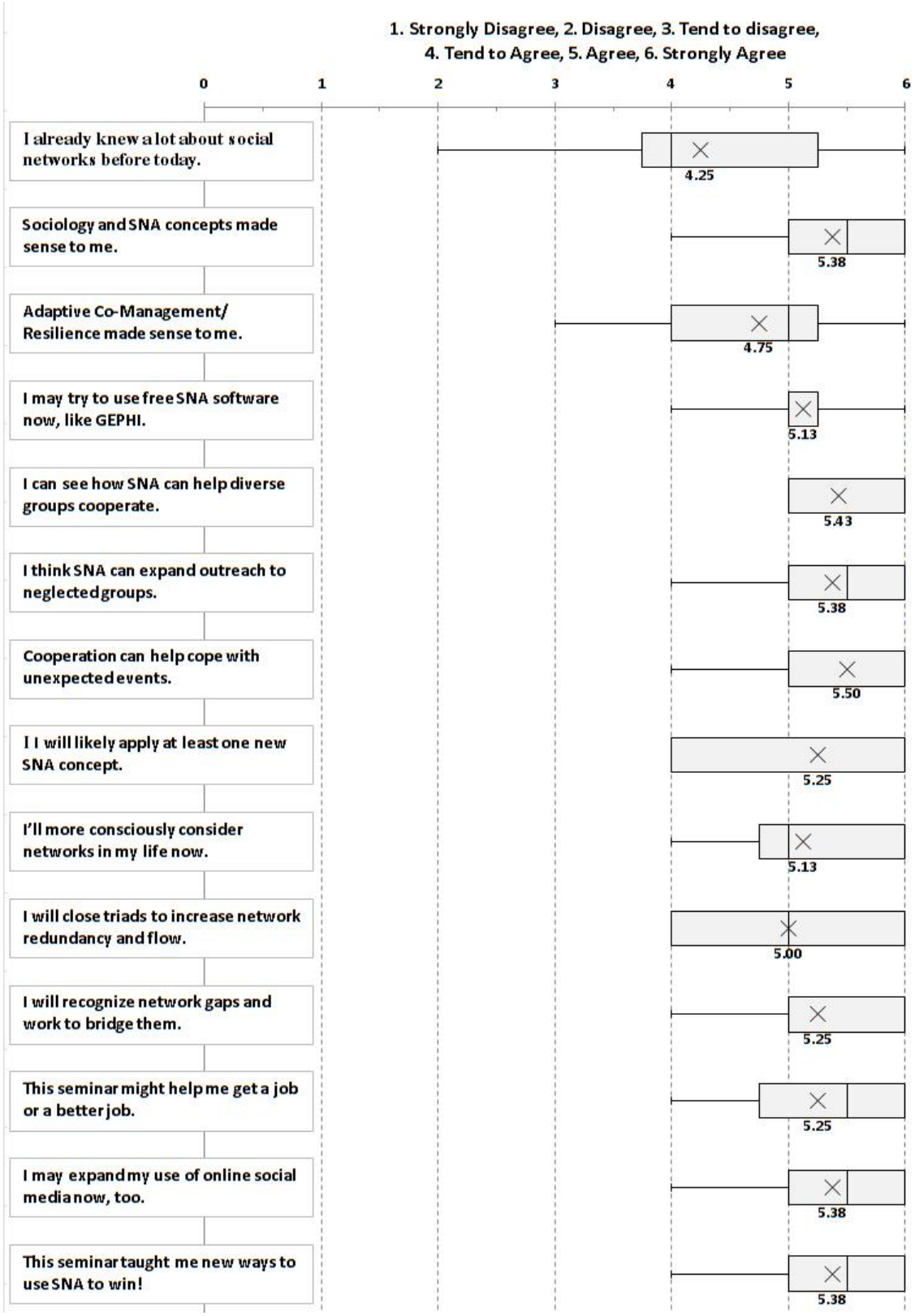


EXHIBIT F. CSU CONSERVATION LEADERSHIP THROUGH LEARNING FULL-DAY SNA WORKSHOP AND INTRODUCTION TO GEPHI SOFTWARE: AGENDA, SURVEY AND RESULTS, HW, AND POST-WORKSHOP FOLLOW-UP RESOURCES FOR GEPHI

Social Network Analysis (SNA) Techniques for Water & Natural Resources Management

9 AM – 4 PM
Friday, April 11, 2014
Forestry 212

Purpose:	Introduction to SNA Concepts, Methods and Software Techniques	**Facilitator:**	Margaret T. Herzog, PE, PMP, PhD in progress Civil & Environmental Engineering, WRPM

Please read:	**Agenda**, Definitions, GEPHI download instructions with usage tips, Pre-Workshop readings
Please bring:	Laptop with GEPHI *pre-installed*, Thoughts on your social networks and the different role(s) you play in each

Agenda

Benefits	Develop techniques to foster shared understanding of the social-political-economic context in which water and natural resources are managed and regulated; Use this knowledge to improve social network maturity
Concepts	Underlying Sociology Constructs, Network Theory, Bonding & Bridging Ties, Core / Periphery Structure
Techniques	Network node and link development, Layout, Display, Calculating network measures, Analyzing results
Applications	Conservation, Collaboratives, Watershed or Recreational Program Management, Nonprofits, International
Practical	GEPHI software practice using demo data from the collaborative you selected to interview in conservation class, Tips and Tricks (plus, if time: Longitudinal & Spatial Techniques for SNA in time and space)

Additional Information

Special notes:

This full-day workshop in Social Network Analysis has been included in your *methods* curriculum as another potential tool in your expanding toolbox to study the complex human systems affecting ecological function.

Have you ever heard the saying, "*The whole is greater than the sum of its parts?*"
Well, this is particularly true in reference to social networks, because the nodes (people or groups), through the selection and strength of their connections, determine *who is related to whom*, and how information and resources flow through the network. These *emergent properties* (only apparent in study of the whole) create *social capital* – the *value of position* in the social network structure.

By learning SNA concepts and more systematic methods to analyze social networks, you will be able to better connect humans with their environment, integrate knowledge across disciplines, obtain more sustainable program funding and participation, and reflect together on past actions to better plan future direction.

Please visit the companion SNA workshop website at: http://sna.wateractionnetwork.org
for a more detailed topical agenda and many useful links: including free online textbooks, MOOC courses, applied references, and more exemplary Colorado collaboratives.

Finally, I study SNA in the context of Adaptive Co-Management and Resilience Practice applied to complex social-ecological systems, which I will briefly discuss. Please visit the free-access, peer-reviewed online journal Ecology & Society and the international collaborative Resilience Alliance to learn if these conceptual frameworks and related methods will become as useful to you as they have become to my work and research.

POST-WORKSHOP EVALUATION for
CLTL Conservation Methods: Social Network Analysis Workshop
9 AM - 4 PM, FRIDAY, April 11, 2014

Purpose: Please evaluate this SNA Methods Workshop to determine how it might be improved. We will keep your responses **confidential**, so please be candid in your remarks.

1. How had you learned about SNA *before* attending the workshop? Please check all that apply.

   ☐ Previous Course ☐ Research ☐ Work ☐ Online Tools ☐ Colleague ☐ Other

   Please explain _____

2. What is/are the most likely reason you may use SNA methods in follow-up? Check all that apply.

   ☐ Work quandary. You hope to figure out a solution to a specific issue you came across at work.

   ☐ Research interest. This workshop aligns with your own academic interests or research topic.

   ☐ Teaching interest. You would like to teach a similar type of workshop or content area.

   ☐ Community interest. You wish to build or expand a group collaborative, nonprofit, etc.

   ☐ Personal interest. You would like to improve your network for job hunting, advancement, etc.

   ☐ Online community research. You may use LinkedIn InMaps, CU-Denver PartnerTool, other

   ☐ Other: If other SNA usage plans, please name:_____

   Please detail plans here _____

   _____

3. What aspects of the SNA Workshop were most valuable to you? And why?

   _____

   _____

4. Least valuable and why? Or what would you change, add or delete about the SNA Workshop?

   _____

   _____

5. How has this workshop changed your thinking about social network analysis or other topics presented?

   _____

   _____

6. What network features will you now focus on more when you are analyzing or building networks?

   _____

   _____

7. Reflecting on your interactions at this workshop, and what other attendees shared; what was the most important thing your learned from others, rather than the facilitator/instructor.

   _____

   _____

8. How will you (or might you in the future) use or apply what you learned at the SNA Workshop?

   _____

   _____

POST-WORKSHOP EVALUATION for
CLTL Conservation Methods: Social Network Analysis Workshop
9 AM - 4 PM, FRIDAY, April 11, 2014

9. What online discussions, resources, or other tools might you like added to the SNA Workshop website (http://sna.wateractionnetwork.org)?

_____

_____

10. Do you have any suggestions for future Social Network Analysis-focused follow-on workshops?

_____

_____

SNA Workshop Scaled Ratings – please X or Circle the number that best applies to each item.

	Strongly Disagree	Disagree	Tend to Disagree	Tend to Agree	Agree	Strongly Agree
The pre-workshop communications gave me the information I needed about the SNA workshop.	1	2	3	4	5	6
The SNA Workshop website links and resources were useful in preparing for the workshop.	1	2	3	4	5	6
SNA fit well in conservation methods & tools.	1	2	3	4	5	6
Class participation/ interaction was encouraged.	1	2	3	4	5	6
Content was organized and easy to follow.	1	2	3	4	5	6
The workshop sessions were well-facilitated.	1	2	3	4	5	6
The instructor was knowledgeable about SNA.	1	2	3	4	5	6
Presentation materials and handouts were useful	1	2	3	4	5	6
The logistics for the workshop were well-executed: space, breaks, food, location, time,etc.	1	2	3	4	5	6
The SNA workshop met goals of the outline: SNA Concepts, SNA for NR Governance, GEPHI software techniques and collaboratives demo practice, Potential application wrap-up	1	2	3	4	5	6
I will use the *SNA Workshop* website to seek additional resources, demos, and materials.	1	2	3	4	5	6
I plan to share what I learned with others.	1	2	3	4	5	6
I will use what I learned in CLTL research.	1	2	3	4	5	6
I will use what I learned in summer field work.	1	2	3	4	5	6
Please use this space to comment on any of your ratings, particularly if you rated any below "3."						

Please indicate your general satisfaction with this workshop by circling the appropriate number:

Very dissatisfied **Very Satisfied**

1 2 3 4 5 6 7 8 9 10

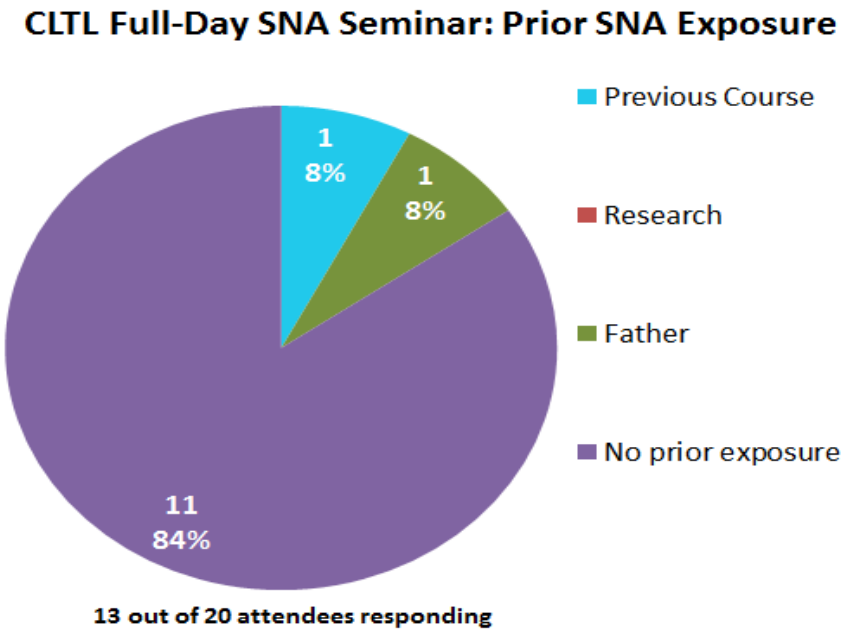
Please comment to explain your rating; what aspects of the training could be improved, or other comments?

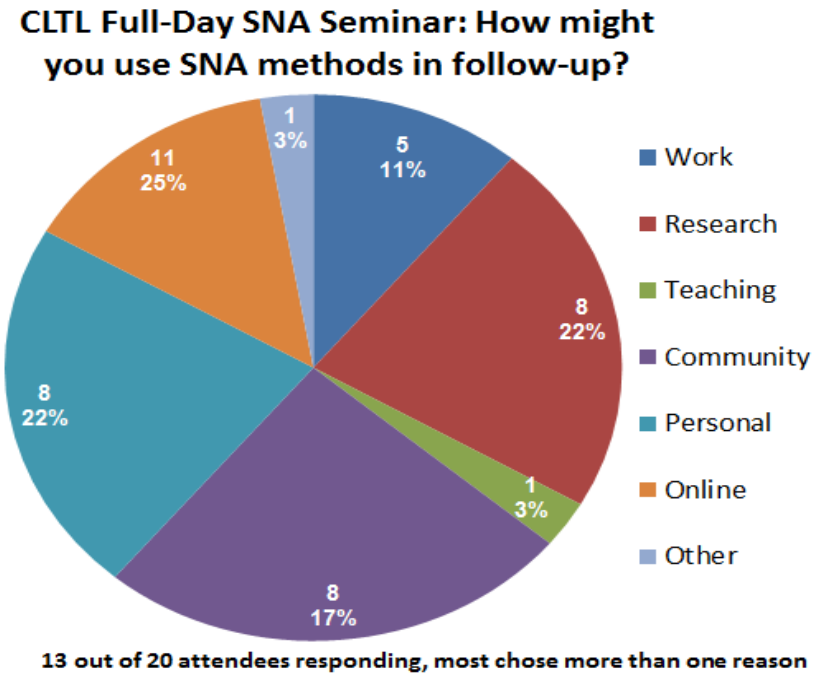
_____

_____

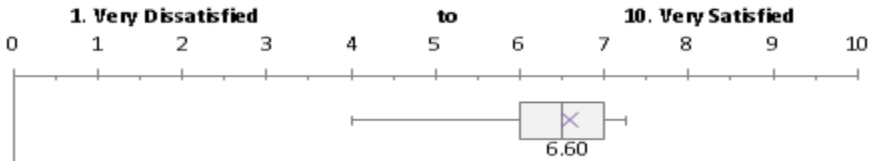
_____

Thank you for your time and participation!

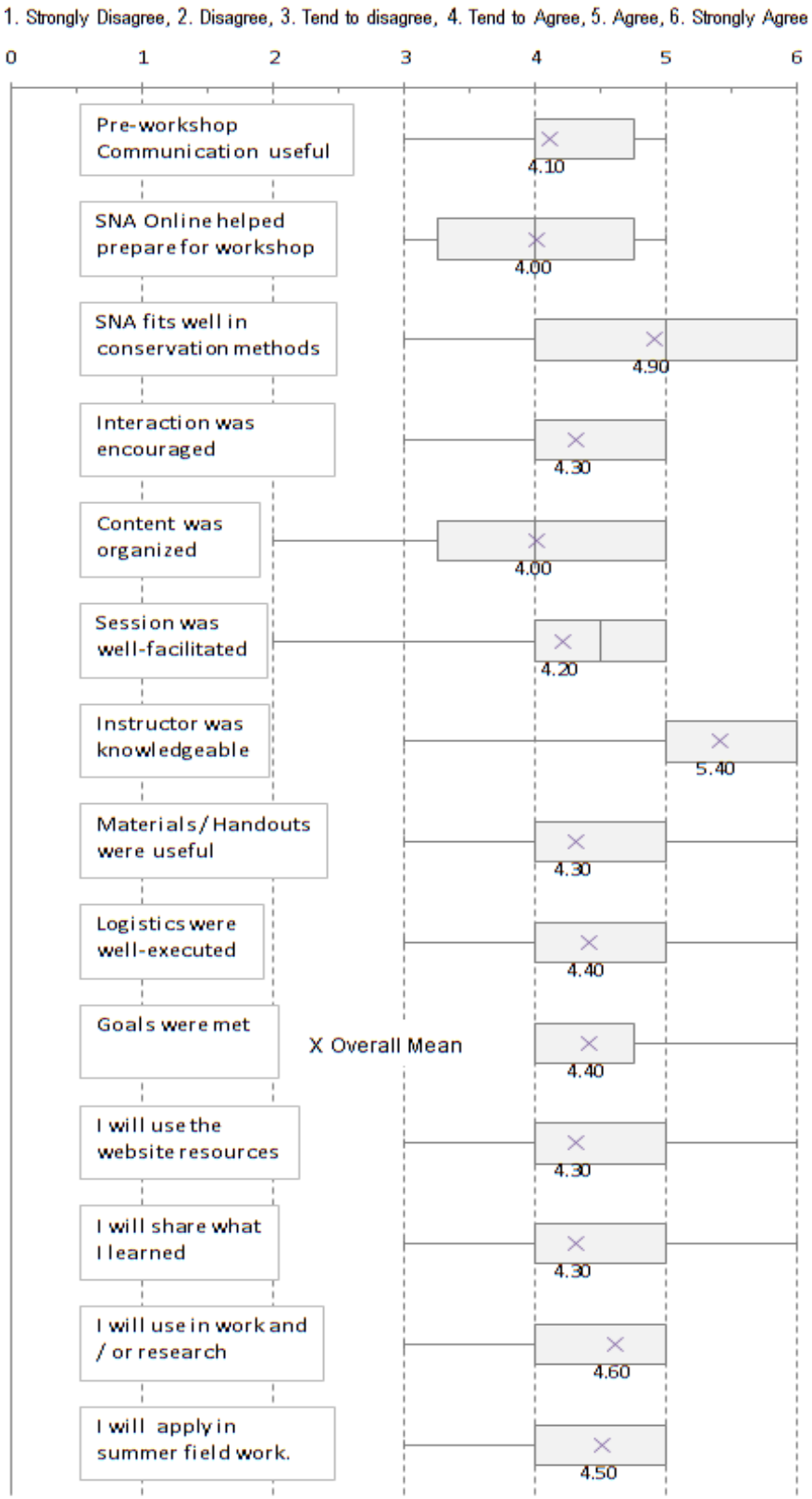




Response: Seminar Satisfaction Question: ***This SNA Seminar was worth attending!***



Relative Agreement with Statements about Different Aspects of the CLTL Workshop



CLTL Follow-up Email: MORE GEPHI SNA methods support + STOP JAVA UPDATES!

1 message

Margaret Herzog <mtherzog@rams.colostate.edu> Sat, Apr 12, 2014 at 1:15 PM

****

Shared learning for adaption always leads to improved practice!

Nice job troubleshooting together through the different OS and technical difficulties until GEPHI worked for most of the group!

If you are still having problems (or getting annoying Java popups now) see below to make sure the *right* Java version is installed and controlled.

PLEASE KEEP PRACTICING WITH GEPHI AGAIN SOMETIME USING THE EXPANDED HELP BELOW

1. Graphical User Interface overview
2. Layout types, and when to use each
3. Visualization and interactive tools
4. The purpose of each SNA statistical metric
5. Spreadsheet import
6. Network filtering
7. Dynamic (longitudinal) network analysis

Don't forget to also review the original Gephi Tips page and Gephi Tutorial QuickStart you received in the pre-class materials, too! Of course, all these resources and more can also be found at the SNA Workshop companion website. You can practice with additional Gephi datasets from the Gephi Wiki and get more learning aids and support from the user community.

Important Installation Note

Gephi runs on a Java Virtual Machine (JVM), so some of you who don't already use other java-based tools had to install JAVA runtime (JRE) to make it work.

Java X for OS X 2013-005 may work better with new Apple Maverick installations though.

Make sure you downloaded the 64-bit version, if you have a 64-bit machine for best performance with large files.

CLTL Follow-up Email: STOP JAVA UPDATES! UCINET ALTERNATIVE, Help!

TO STOP ANNOYING AUTOMATIC JAVA UPDATES

1. Go to the Java Control panel for your OS (find it for Windows Users, Mac users)

2. Chose the second tab, Update, and uncheck and confirm that you don't want automatic updates (see How for Windows, How for Mac)

3. Close and reopen the Java Control Panel to make sure the *Check for Updates Automatically* is now unchecked

4. When you wish to *manually* update Java JRE, return to the panel update tab, and choose *Update Now*.

UCINET - Best alternative for $40 for students
If GEPHI is not working well for you, a SNA alternative may be UCINET, which I also use,
but it costs $40 for students (more otherwise) and requires learning adjacency matrix data entry.
However, it doesn't seem to experience large file size issues nor redraw problems.
It includes more complex analysis tools and affiliation network analysis (two-mode - inferred relationships through joint project/event participation).

PLEASE REPLY WITH ANY TROUBLESHOOTING TRICKS YOU FOUND so future users will experience enhanced GEPHI performance from your sharing.

Please don't hesitate to contact me for troubleshooting through Skype, if you need further assistance!

Margaret

Margaret T. Herzog, PE, PMP
CSU CIVE WRPM PhD in progress
Topic: Operationalizing Collaborative, Adaptive Watershed Management
Email: margaret.herzog@colostate.edu
Phone: (303) 238-0419

Seize life today, for tomorrow is only today's hope...
Carpe diem quam minimum credula postero - Horace

Find me at ResearchGate, LinkedIn, Twitter, WordPress, Pinterest