Social Network Analysis
And the Evaluation of Leadership Networks

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Abstract

Leadership development practitioners have become increasingly interested in networks as a way to strengthen relationships among leaders in fields, communities, and organizations. This paper offers a framework for conceptualizing different types of leadership networks and uses case examples to identify outcomes typically associated with each type of network. One challenge for the field of leadership development has been how to evaluate leadership networks. Social Network Analysis (SNA) is a promising evaluation approach that uses mathematics and visualization to represent the structure of relationships between people, organizations, goals, interests, and other entities within a larger system. Core social network concepts are introduced and explained to illuminate the value of SNA as an evaluation and capacity-building tool.

Contents

Introduction

The emergence of leadership networks is a response to a rapidly changing world that is increasingly interconnected and that requires greater learning and collaboration for solving complex problems. Leadership networks provide resources and support for leaders, and increase the scope and scale of

impact leaders can have individually and collectively. Nurturing and catalyzing leadership networks is increasingly a critical focus of many leadership development efforts, especially those that seek to develop leadership with a capacity to influence policy and bring about social and systems change.

In this paper we examine four different types of leadership networks: peer leadership networks, organizational leadership networks, field-policy leadership networks, and collective leadership networks. The choice to focus on these four types of networks grows out of our experience as consultants with clients who fund, run, and catalyze leadership networks. Often our clients are interested in using network mapping or other tools to increase the awareness of leaders about the power of networks, to further catalyze relationships and connections, and to strengthen the capacity of the network to act collectively. There is also growing interest in knowing what difference leadership networks are making.

As consultants, we often have multiple roles with our clients that include network monitoring and evaluation, and network facilitation and capacity-building. Some of our client relationships are multi-year, giving us a better opportunity to understand how networks change over time and how members begin to better use their networks to think and act strategically and collectively to achieve desired results.

From a scientific perspective, our research methods are non-traditional because we actively co-construct research projects with our clients to answer the questions they are asking about their investments of money and time (Ospina et al., 2002). While this approach gives us valuable access to leaders in the network and rich insights about how networks work, it does not conform to research studies that rigorously test hypotheses about leadership network development with experiments and control groups. We hope that our study will provide a framework that can be tested and further developed through additional research.

The rest of the paper is organized as follows: In the “Classifying Leadership Networks” section, we briefly describe our classification of four different types of leadership networks. The “Introducing Social Network Analysis” section overviews network metrics that can be used to examine leadership networks; that section is followed by “Evaluating Leadership Networks,” which identifies general categories of questions that can be used to explore various dimensions of leadership networks. The body of the paper consists of four sections, one devoted to each type of leadership network, including its defining characteristics, its value, appropriate evaluative methods, and examples. We conclude the paper with a section discussing issues and risks of SNA and leadership network evaluation, a section outlining areas for future research, and some concluding remarks.

Classifying Leadership Networks

Our leadership network classification framework is rooted in our experience in the field of leadership development and has also been influenced by the work of Borgatti and Foster (2003), Plastrik and Taylor (2006), and Provan and Milward (2006), all of whom have developed their own ways of classifying different types of networks. We have chosen to use different terms because we believe these are more intuitively understood and consistent with language used in the leadership development field.

The classification scheme is intended to be helpful to those who fund, run, or participate in networks so that they can better understand how to strengthen and use their networks effectively. Some networks may fit neatly into one of these categories, and others may be hybrids. The goal of the framework is not to create an ideal towards which networks should strive, but rather to provide a tool for network analysis. The body of this paper explains how various SNA-based evaluative methods can be used to make visible various aspects of leadership networks, and how that information is useful to network members, weavers, and sponsors.

Peer Leadership Network: A peer leadership network is a system of social ties among leaders who are connected through shared interests and commitments, shared work, or shared experiences. Leaders in the network share information, provide advice and support, learn from one another, and occasionally collaborate together. Peer leadership networks provide leaders with access to resources that they can trust. Leadership programs often seek to catalyze peer leadership networks to expand the trusted ties that leaders have with one another.

Organizational Leadership Network: An organizational leadership network is a set of social ties that are structured to increase performance. Employees, for instance, develop informal leadership networks within their organizations (relationships not visible on the organizational chart) so that they can get the advice, ideas, or resources they need to solve problems more quickly and increase their individual and organizational performance. At the inter-organizational level, leadership networks enable different organizations with shared interests to produce a product or deliver a service more efficiently.

Field-Policy Leadership Network: A field-policy leadership network connects leaders who share common interests and who have a commitment to influencing a field of practice or policy. These networks seek to shape the environment (e.g., the framing of an issue, underlying assumptions, and standards for what is expected). Effective field-policy leadership networks make it easier for leaders to find common ground around the issues they care about, mobilize support, and influence policy and the allocation of resources.

Collective Leadership Network: A collective leadership network is a self-organized system of social ties among people attracted to a common cause or focused on a shared goal. Network members exercise leadership locally. As the number of local groupings grows and there is increasing interaction, these groups begin to align and connect to form larger networks. These networks are often rooted in a sense of community and purpose; they may be driven by a desire to achieve a specific goal, or simply by the desire of each member to belong to something larger than oneself.

Introducing Social Network Analysis

Social network analysis (SNA) is a set of theories, tools, and processes for better understanding the relationships and structure of a network. In social networks, "nodes" of the network are people and the "links" are the relationships between people. Sometimes nodes are also used to represent events, ideas, objects, or other things. SNA practitioners collect network data, analyze the data (e.g., with special-purpose SNA software), and often produce maps or pictures that display the patterns of connections between the nodes of the network. These maps reveal characteristics of the network that help guide participants as they evaluate their network and plan ways to improve their collective ability to identify and achieve shared goals. (The maps in this paper were created using SNA computer programs by Borgatti (2002) and Brandes and Wagner (2004)).

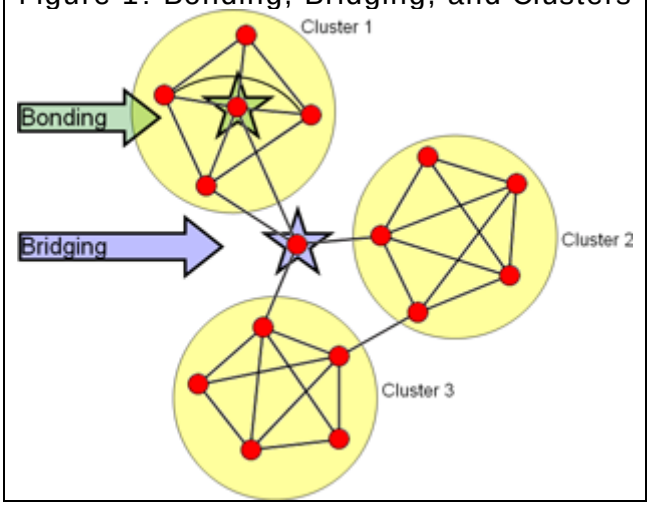
Basic Network Concepts

Many mathematical techniques are available to measure networks (Wasserman and Faust, 1994); here we highlight a few that are especially useful for those who participate in, run, and fund leadership networks. Later in the paper we demonstrate how to use these metrics to understand and evaluate specific leadership networks.

Bonding and bridging

Bonding and bridging are two different kinds of connectivity that we distinguish. Bonding denotes connections in a tightly knit group. Bridging denotes connections to diverse others. See Figure 1 for an illustration. These terms are commonly used in the social capital literature (Putnam, 2001). In the SNA literature, bonding and bridging are often called "closure" and "brokerage" (Burt, 2005); also, "strong ties" and "weak ties" are important related SNA concepts that we incorporate into our bonding-bridging usage (Granovetter, 1983). Analyzing network data to measure bonding and bridging helps to predict important outcomes such as efficiency and innovation: bonding indicates a sense of trusted community where interactions are familiar and efficient; bridging indicates access to new resources and opportunity for innovation and profit (Burt, 2005).

Figure 1: Bonding, Bridging, and Clusters



Clusters

A cluster in a network is a tightly knit subgroup where bonding is occurring. Finding clusters is one of the most important leadership network applications of SNA, specifically used to illuminate important subgroups that were previously unrecognized. Clusters can be displayed visually with a network map, as shown by the three highlighted clusters in Figure 1. Algorithms that find clusters work by measuring local variations in density and links per node, two fundamental network metrics described below.

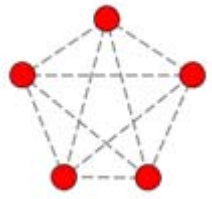
Core and Periphery

Many networks feature a core/periphery structure. The core is a dominant central cluster, while the periphery has relatively few connections (Borgatti and Everett, 1999).

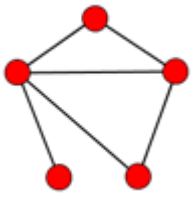
Density and Links per Node

Density is the number of links that exist in a network divided by the maximum possible number of links that could exist in the network. Figure 2 shows an example of this calculation:

Figure 2: An example of density



Between 5 nodes, there are a maximum Of 10 possible links



Therefore, a network with 5 nodes and 6 links has density = 0.6

Roughly speaking, density can be used to define clusters as follows: a cluster is a local region in a network with relatively high density and relatively few

links to other clusters. Formal mathematical definitions of clusters and algorithms for finding clusters are surveyed by Brandes and Erlebach (2005).

Links per node is the total number of links divided by the total number of nodes in the network. Continuing with the example from Figure 2, a network with a total of 6 links joining 5 nodes has 1.2 links per node. Density and links per node both have strengths and weaknesses when used to assess leadership networks. In general, we recommend links per node as a more intuitive metric for leadership networks: It is much less prone to misinterpretation than density. We say more about this in the "Issues and Risks" section of this paper.

Bridgers and Betweenness Centrality

Bridgers are individuals in a network who have connections to different clusters. Finding bridgers is the flip side of finding clusters, and bridgers can be highlighted visually just as clusters can; there is one notable bridger in Figure 1. Bridgers in a leadership network provide valuable opportunities for innovation, growth, and impact; yet bridgers are easy to overlook. Finding bridgers is an important application of SNA in leadership networks.

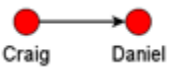
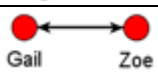
Finding bridgers in a network is typically done with the calculation called betweenness centrality (Freeman, 1979). This calculation indicates how often one individual is likely to be an important relay point between other network members. Another metric used to find bridgers is network constraint (Burt, 2004, 2005). An individual's network constraint measures the extent to which he links to others that are already linked to each other. Low network constraint means that an individual has links to others who are not already linked to each other. High betweenness centrality and low network constraint both indicate bridging.

Hubs and Indegree Centrality

Hubs are individuals in a network with the most influence. Whether hubs bridge across clusters or bond within a cluster (or some combination), they are highly sought-after by other network members.

Finding hubs of influence in a network usually starts with tracking directed links as opposed to undirected links. Figure 3 illustrates the distinction:

Figure 3: Directed and undirected links

Link type		Example relationship
	Undirected	Alice and Bob have spoken with each other.
	Directed One-way	Craig knows who Daniel is; Daniel does not know who Craig is.
	Directed Two-way	Gail seeks advice from Zoe, and Zoe seeks advice from Gail.

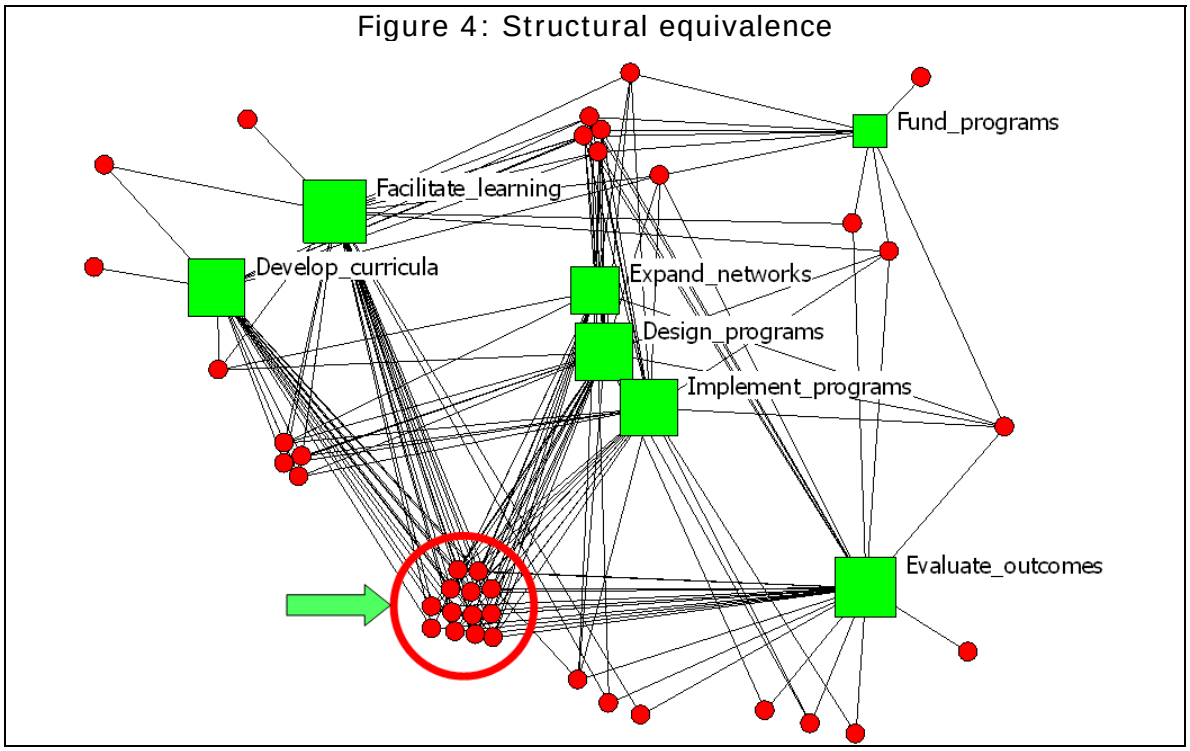
Given a network of directed relationships (e.g., “knows of,” “seeks advice from”), indegree centrality (or just “indegree”) counts how many relationships point towards an individual; this provides a simple measure of influence (Freeman, 1979).

More advanced influence metrics build on indegree and consider not just how many others seek the advice of a particular person, but also how influential those other advice-seekers are. A person whose advice is sought by someone who is highly influential may have a higher influence score than one whose advice is sought by many non-influencers. Bonacich and Lloyd (2001) overview several advanced influence metrics and explain how most of them compute nearly the same thing. In most cases, we recommend using indegree, because it communicates the basic point without unnecessary complications.

Structural Equivalence

Amazon.com made structural equivalence famous as the calculation behind its recommendations: “People who bought books A and B also bought books C and D.” This Amazon.com example considers both people and books as members of a single network. Links in this network join people to the books they have purchased. People who buy mostly the same books have high structural equivalence; people who buy mostly different books have low structural equivalence.

Figure 4: Structural equivalence



Structural equivalence in leadership networks is based not on shared reading lists but rather on shared activities, goals, or interests. For example, Figure 4

displays members of a leadership network as circles and their professional activities as squares. Links indicate which people engage in which activities. The larger squares denote the more common activities. The layout of the map places people next to those who share the same activities, and it also places activities next to other activities that share the same participants (Borgatti, 2002; Gower, 1971; Hanneman and Riddle, 2005). There is a group of 13 people who engage in exactly the same set of activities; they are highlighted near the bottom left. The nodes in this group all have high structural equivalence with each other. Similarly, the three activities in the middle, “expand networks,” “design programs,” and “implement programs,” share many of the same participants; these three nodes have relatively high structural equivalence with each other.

Structural equivalence is an important metric for leadership networks. It is similar to finding clusters, in that both techniques illuminate important subgroups that were previously unrecognized. Unlike finding clusters, however, structural equivalence can work without any information about who knows whom; it is rather like Amazon.com offering to introduce people who bought the same books. For those seeking to bond or to bridge, this information is extremely useful.

Asking network members to report what relationships they have with all other network members can raise difficult challenges, which are discussed in the “Issues and Risks of SNA” section of this paper. By comparison, it is easier to collect data about which network members associate themselves with which activities, or what goals each person considers important as a member of the network. Because structural equivalence can make use of data that is easily collected, and other SNA techniques require data that is harder to obtain, it is especially valuable to have structural equivalence as a metric in one’s SNA toolbox.

Evaluating Leadership Networks

Before demonstrating how to use social network metrics to evaluate different aspects of leadership networks, we provide an overview of evaluation questions that are frequently asked about leadership networks, and briefly highlight some additional methods of network evaluation that can be combined with SNA for a richer understanding of network impact.

What to evaluate

There is a growing body of research about what to evaluate when assessing networks (Durland and Fredericks, 2005). Some useful frameworks include those developed by Provan and Milward (2001) to evaluate the network effectiveness of public sector organizational networks; Nunez and Wilson-Grau (2003) and Church et al. (2002) to evaluate international social change networks; Diani (2003) to evaluate social movement networks; Plastrik and Taylor (2006) to evaluate production networks; and Gutierrez et al. (2006)

and Umble et al. (2006) to evaluate leadership development program alumni networks. The context in which networks operate and the purpose for which they exist influence the focus of leadership network evaluation.

Some common evaluation topics are connectivity, overall network health, and network outcomes and impact. Below are some examples of questions in each category.

Connectivity. Does the structure of network connectivity enable efficient sharing of information, ideas, and resources? Is the network expanding and growing more interconnected over time? How far does the network reach? Does the network effectively bridge clusters (e.g., sectors, communities, fields, and perspectives)? Where in the network are there unlikely alliances?

Overall Network Health. What is the level of trust among members in the network? How diverse is the network? Are people participating and exercising leadership as they are able to and would like? Is the structure appropriate for the work of the network? What are the power relationships within the network and how are decisions made? How well do networks manage conflicts? Is the network balanced and dynamic (e.g., capable of growing more inclusive while sustaining collaboration)?

Network Outcomes and Impact. Is there evidence of greater coordination or collaboration among leaders? Does the network promote higher levels of civic participation and engagement in each of its members? Does the network make the most of scarce resources to produce desired results? Are more innovative products being developed? Is the network positively influencing policy decision-making or how resources are allocated?

How to evaluate leadership networks

Social network analysis is one tool for evaluating leadership networks. It is particularly useful for assessing connectivity within leadership networks, although it also has applications for evaluating overall network health. There are fewer direct uses for SNA in evaluating network outcomes and impact, and so we suggest using multiple evaluation methods.

Connectivity: SNA highlights who are core and peripheral members of the network; identifies where bonding and bridging are occurring; and points towards who has influence in the network. What is missing from a structural focus on connectivity is the story behind the connections (e.g., what did people do together). Social network maps can be used to stimulate people to tell these stories. There are a number of other methodologies that are also useful with groups, organizations, and communities to help them uncover the "collective story," such as Photovoice (Wang, 2006), Q-methodology (Militello et al., 2008), Most Significant Change (Davies and Dart, 2005), Critical Moments Reflection (McDowell et al, 2005), and participatory story-building (Church et al., 2002). While we do not discuss these methods in this paper, we urge readers to explore and use a variety of different methods when

evaluating network connectivity in order to get a full picture of where there are important relationships and connections.

Overall Network Health: In evaluating the overall health of a leadership network, it is important to gather perspectives from a diverse group of network members. SNA can help inform this process. For example, the core and the periphery of a leadership network may be quite distinct, and people located in a variety of positions across the network should be included in an evaluation. Network maps can also be used by participants to stimulate conversation about how well the network is functioning. Other useful assessment tools for evaluating network performance are provided by Nunez and Wilson Grau (2003) and Gajda and Koliba (2007). Gadja and Koliba have developed a framework for assessing the quality of dialogue, decision-making, action, and evaluation by communities of practice that is equally applicable to leadership networks, especially those that are goal-oriented.

Network Outcomes and Impact: Network outcomes may be found in communities, organizations, fields, and individuals. At this stage there are few techniques for using SNA to evaluate network outcomes and impact. We recommend using interviews, case studies, and traditional survey methods to identify network outcomes. Evaluating network outcomes at the community level is more challenging because it is not always as clear who to gather data from (Behrens and Benham, 2007; Plastrik and Taylor, 2006). Results-based evaluation approaches such as EvaluLEAD (Grove, Kibel, and Haas, 2007) and Results-Based Accountability (Friedman, 2005) have been used successfully by network-based leadership programs to focus attention on desired outcomes and to track progress towards those outcomes. While more research is needed, the Annie E. Casey Foundation has recently published a series of reports on how social networks link to family and community-level outcomes (Ahsan, 2007).

Peer Leadership Networks

Defining peer leadership

Peer leadership is the capacity of people who share similar identities, circumstances, or contexts to provide each other with trusted and relevant information, advice, and support when it is needed most. Peer leadership prioritizes listening and problem-solving among leaders in a safe environment where peers can speak openly and honestly with each other, outside the structures of power and authority within which they live and work. In recent years there has been increased investment in developing and supporting peer leadership networks (Backer, 2008). Reasons for this increase include the increasing complexity of problems and challenges that confront leaders, and the loneliness and frustration they often feel shouldering the expectations of others. The best peer leadership programs recognize that leaders have as much to learn from each other as they do from outside experts.

The value of peer leadership networks

Peer leadership networks support personal and professional growth, and leadership development. High-value peer leadership networks embrace diversity and inclusion without losing a sense of shared identity. They give leaders an opportunity to ask for advice—to admit what they do not know—without having to be concerned about negative consequences from those they supervise or from those who have power over them.

Examples of peer leadership networks

The Sierra Health Leadership Network

The Sierra Health Leadership Network includes 130+ nonprofit executive leaders from 21 northern and central California counties who work on health-related issues. All of these leaders have participated in the Sierra Health Leadership Program, a nine-month program of retreats, leadership training sessions, team action learning projects, and an alumni network. Leaders bond with each other during their leadership program experience which includes many opportunities for self-reflection, clarification of core values, and finding one's "noble cause" in conversation with others. The foundation hosts retreats three times a year to reinvigorate relationships; reinforce core learning from the program; explore new topics and ideas; and expand connections to other cohorts. In an evaluation of the alumni network, Reinelt, Kubo and Hoppe (2005) found the most important outcomes to be:

- Peer support. Listening to one another and providing support in order to reduce feelings of isolation
- Peer Coaching. Acting as sounding boards for one another to share stories and advice about challenges like how to manage boards, how to achieve financial sustainability, or how to build alliances for broader impact.
- Resources. Sharing resources with each other, e.g., speaking at each other's event, trading or providing services, getting quick reliable information to a question.
- Job assistance. Providing each other with leads to new job opportunities and job references.
- Introductions. Introducing each other to people in each other's networks.
- Collaboration. Initiating joint inquiry or collaborations around shared issues and common problems.

CompanyCommand

CompanyCommand is an Army website for junior officers to discuss challenges and seek advice from their peers. The idea for CompanyCommand grew out of nightly conversations between two company commanders who lived down the street from one another just beyond their base in Honolulu. They got together to talk through the challenges they faced in their new assignments. The value of those conversations led to the creation of the CompanyCommand website. CompanyCommand is a site "where junior

officers facing professional challenges can seek advice from others who have similar situations…. CompanyCommand is designed to help individuals improve their leadership skills through the sharing of experiences and advice" (Dixon 2006).

Featured as a breakthrough idea in the *Harvard Business Review*, CompanyCommand challenges traditional assumptions about the training of future leaders. "Instead of drawing on the wisdom of anointed experts, CompanyCommand provides young officers with knowledge based on the daily struggles of frontline professionals like themselves. Why the emphasis on peers? [Because] knowledge accumulated by experts over the years may no longer be relevant in a rapidly changing battle environment like Iraq. People have greater trust in, and therefore are more receptive to, advice from someone in their situations" (Dixon, 2006). Other benefits of peer leadership networks described by Dixon include emotional support, and answers to context-specific questions that come "just in time."

Key characteristics of peer leadership networks

The formation of close personal and professional relationships through bonding is a key characteristic of peer leadership networks. Often this is intentionally facilitated in leadership development programs through face-to-face convenings that use tools such as Open Space (Owen, 1998) and World Café (Brown, 2005) to emphasize listening, dialogue, and storytelling; or by creating opportunities for leaders to work on projects together.

Evaluating Peer Leadership Networks

Some evaluation questions to ask about peer leadership networks include:

- Has the number of connections between leaders in the network increased?
- Is there a strong network core that can sustain the network over time?
- Is the network diverse?
- Is there a high level of trust among members in the network?
- Do members share advice with each other that supports their personal and professional development, and makes them more effective leaders?
- Does participating in the network correlate with greater career success or job satisfaction?

Using SNA to Evaluate Peer Leadership Networks

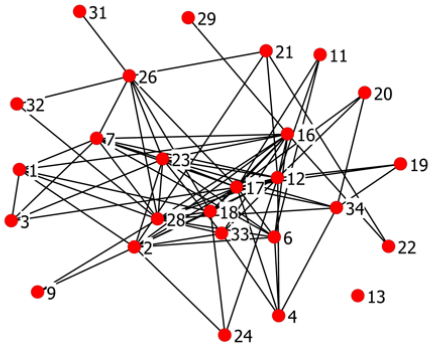
One use of SNA to assess peer leadership networks, especially those that form through leadership programs, is to take "before" and "after" snapshots of network connectivity. A "before" snapshot of relatively disconnected individuals indicates diverse recruiting; an "after" snapshot of more dense connections indicates that bonding has occurred and a trusted community has been formed.

Relationship questions such as "how well do you know this person" and "how often do you communicate one-on-one with this person" are useful survey

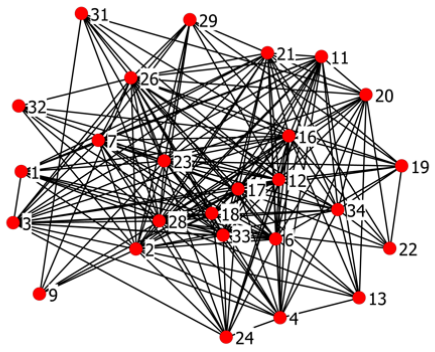
questions for this type of assessment. Allowing respondents a range of options is especially helpful (e.g., “I don’t know this person,” “I know this person somewhat,” and “I know this person well”). Successful peer leadership networks will transform many “don’t know” relationships into “know somewhat” relationships. “Know well” relationships are more likely to develop when peers collaborate on a project.

With such social network data, several interesting inquiries are possible. For example, the maps of Figure 5 show communication between members of a single peer leadership network. The maps all show the same snapshot in time, two years after the original formation of the network; however, each map highlights a different frequency of communication.

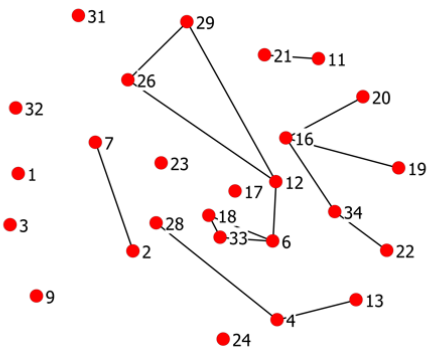
Figure 5: Frequency of One-to-One Communication in a Peer Leadership Network (Tener et al., 2007)



About once a month (not more, not less)



A few times a year or more



At least once a week

Each level of communication pictured in Figure 5 provides different insights about relationships in the network. The “at least three times a year” level is the least interesting: it confirms that everyone is showing up. The “at least once a week” level helps outsiders and/or newcomers get a quick sense of where strong relationships exist in the network; however, these relationships are usually obvious to network insiders. The most interesting map filters out both low and high extremes and presents only the mid-range, in this case “about once a month.” This mid-range map reveals the heart of the peer leadership network and its core/periphery structure. A large network core

can be a sign of strength—it is likely to hold together even if one or two people leave. A well-populated network periphery can be a sign of network adaptability—it brings new ideas and resources into the core and offers burned-out members of the core a place for sabbatical. In the "Issues and Risks" section of this paper, we describe the careful consideration required when interpreting core/periphery maps.

Organizational Leadership Networks

Defining organizational leadership

Organizational leadership is the capacity to set direction, create alignment and maintain commitment to get work done. (McCauley and Van Velsor, 2004). The exercise of leadership within organizations includes exploring new horizons, focusing collective attention, aligning and mobilizing resources, and inspiring others to participate (LeMay and Ellis, 2006). Organizational leadership also is the ability to plan, organize, implement and evaluate projects to maximize results.

The value of organizational leadership networks

Organizational leadership networks are the informal relationships that exist alongside the formal structure within an organization. They help improve innovation, efficiency, productivity, and growth by facilitating communication across departments, offices, and other boundaries (Borgatti and Cross, 2003; Cross and Thomas, 2009). Career success correlates strongly to one's position in the informal network (Burt, 2004). Also, the time one spends networking informally correlates to career success, whereas the time one spends convening more formally (e.g., meetings) can actually be counterproductive (Shipilov et al., 2007). Organizational leadership networks also refer to systems of multiple organizations that work together to more efficiently deliver services or produce a product.

Examples of organizational leadership networks

Global East

Global East (renamed) is a successful Fortune 500 corporation that operates more than 20 research and development facilities with more than 2,000 researchers and engineers. Global East depends on innovation for its success. The company leadership has recognized that informal networks as well as formal structures are critical to the success of a project and for the company. Rizova (2006) worked with Global East to identify the characteristics of its most successful projects; two of these were support from top management and open informal communication. In addition, each successful project included both a "technical star" and a "managerial star." Both technical and managerial stars are highly sought after for different kinds of advice. Global East uses SNA to help identify them, so that it can assign appropriate roles and responsibilities to maximize the opportunity for a project to be successful. The company also promotes a culture that supports

the combination of informal networks with the formal structure; for example, most lab members are involved in all projects, and the incentive structure emphasizes overall company performance as opposed to the immediate results of one project. Rizova also found at Global East that some kinds of relationships (e.g., works-with, friends-with) have very little correlation with project outcomes; success depends more on the advice networks.

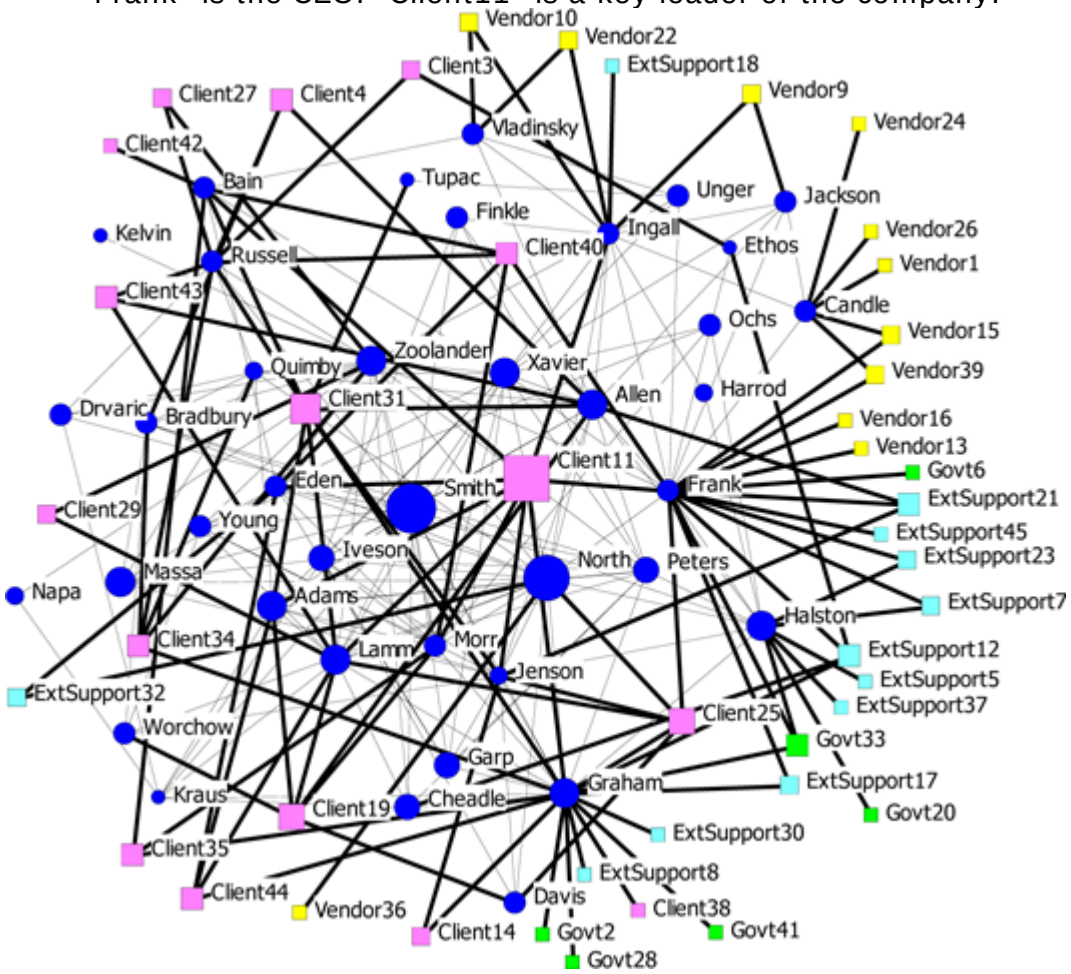
Acme Technology

Acme Technology (renamed) is a fast-growing startup that brings a radical new approach to its industry. Initially the company was organized according to expertise (e.g., engineering, manufacturing). In order to promote customer-driven innovation, the CEO reorganized the formal structure according to products, and the original formal divisions were dissolved. Acme wanted to ensure that people with similar expertise continued informally to share and learn from each other, even if formally they had been pulled apart into different teams. Acme supported communities of practice to promote this learning, and used SNA to help promote the program and assess its progress. At the same time, Acme worked to clarify paths of professional development for its employees, and SNA played a key role in this process. For example, network maps of expertise (similar to Figure 4) and advice (similar to Figure 9(a)) helped Acme get new employees on board more quickly. These same maps also revealed that Acme's unique approach to its industry—the cornerstone of its organization—resided entirely within one small group. Acme has since redesigned its program of professional development to encourage other employees to learn these key competencies.

Commonwealth Software

Commonwealth Software (renamed) is a young company with 50 employees that is planning for rapid growth. In order to grow effectively, Commonwealth started an "Emerging Leaders" program. One way the company identified emerging leaders was by examining the advice networks of its employees. Mapping this organizational network had several unintended benefits as well. The process illuminated one overtaxed senior leader and enabled him to rebalance his role. It also identified a client outside the company who had become a central leader of the organizational network. (This discovery occurred in part because employees were invited to name not just co-workers but also non-employees as people whom they sought for advice.)

Figure 6: Advice network of Commonwealth Software, including employees (circles) as well as clients, vendors, and other non-employees (squares). "Frank" is the CEO. "Client11" is a key leader of the company.



Node size indicates how many employees seek advice from that person.
Dark links join employees with non-employees.

When interviewed months later, the CEO added that the most important benefit of SNA to his company (which he also owned) was that it changed his philosophy of leadership. Maps such as Figure 6 revealed to him a new perspective on how the pieces of Commonwealth fit together. He reoriented his leadership development focus from individuals to the collective leadership system.

Key characteristics of organizational leadership networks

As mentioned by Rizova (2006) and others, organizational leadership networks need formal executive support without an imposed formal reporting structure. Interdepartmental links are key: high-performance in organizations correlates strongly to bridging. Promotions, pay raises, and good ideas all happen more often to those who are brokers between different network clusters (Burt 2004, 2005). Sometimes deliberate bonding is critical:

For example, communities of practice cultivate interdepartmental bonding (Wenger et al, 2002). Also, junior-level employees and disadvantaged outsiders (e.g., minorities) are two groups for which early bonding with the help of strong mentors is critical for long-term leadership development. As organizations change more rapidly, however, these special exceptions become rarer and organizational leadership networks grow increasingly focused on bridging (Brass and Krackhardt, 1999).

Evaluating organizational leadership networks

Some questions for evaluating organizational leadership networks are:

- Are there appropriate bridgers in the network who connect disparate locations, specialities, and silos?
- To what extent do leaders use organizational networks to foster innovation?
- Are organizations more productive and capable of getting work done?
- Does information and knowledge flow easily through the network so that it is accessible to people when they need it?
- Do organizational leaders effectively learn from projects and experiences and share that information with others?

Using SNA to evaluate organizational leadership networks

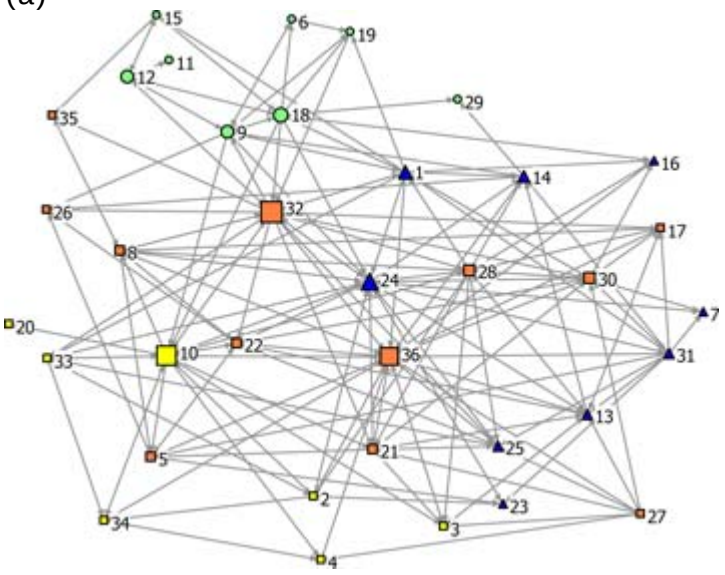
SNA has many uses for organizational leadership networks. Perhaps the most common is to reveal where bridging is happening. SNA also helps to evaluate formal organizational structures. Both of these uses are illustrated below.

Figure 7 displays the weekly advice network of Commonwealth Software. It does not display any external non-employees, unlike Figure 6. Node shapes correspond to formal departments: circles are members of administration, sales, and marketing departments; triangles are members of the software engineering department; and squares are members of the product development department. Two distinct teams within the product development department are indicated as two different colors of squares. In Figure 7 (b), thick links are used to emphasize advice-seeking within a team, while thin links indicate advice-seeking across different teams. Node sizes indicate betweenness centrality (i.e., bridging).

The CEO obtained two major evaluative insights from Figure 7. First, his high regard for one young employee was affirmed: this young man (node 36) was both influential (high indegree) and well positioned for performance (high betweenness). Second, the CEO was surprised to see the difference between his two product development teams. Both teams were similar in their connections to the rest of the company, but within Team B there were strikingly few connections. Team B occupied a different building than most of the company (including Team A), and the CEO had been concerned with promoting collaboration *between* these two offices; the CEO had not realized that collaboration *within* Team B might be suffering. This insight was another important factor behind the subsequent company reorganization

Figure 7: Weekly advice network of Commonwealth Software.
Node size corresponds to betweenness (bridging).

(a)

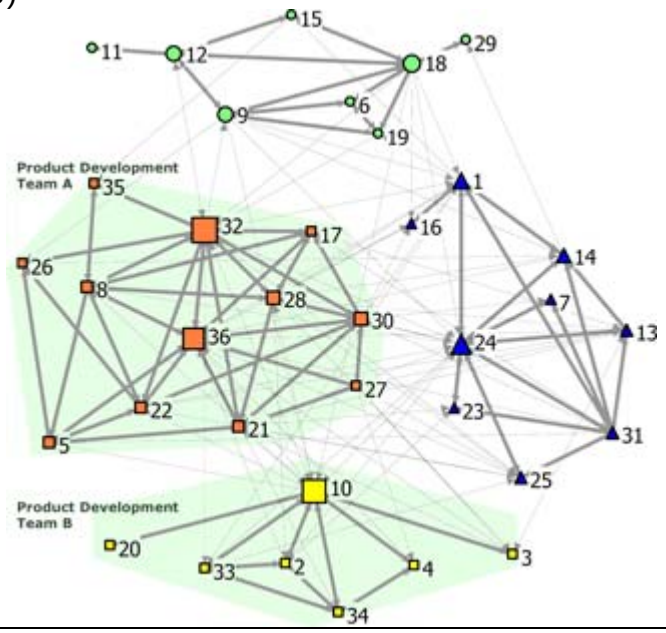


Overall view affirms key positions of senior leaders: Employees 32, 24, and 10.

Relatively high betweenness of new employee 36 confirms his status as an emerging leader.

Low betweenness of senior leader 24 raises questions about how to position him more effectively.

(b)



Departmental layout reveals contrast between two product development teams.

Team A: 3 links per node
Team B: 1.5 links per node

Other common ways SNA is used to evaluate organizational leadership networks include assessing communities of practice and mapping organizational expertise. Both of these applications are critical in the Acme Technology case study. Evaluating a community of practice is quite similar to assessing a peer leadership network, which we described in the preceding section of this paper. Mapping organizational expertise is quite similar to assessing the network roles of a field-policy network, which we describe in the next section.

Field-Policy Leadership Networks

Defining field-policy leadership

Field-policy leadership is the capacity to influence how problems are framed and solutions envisioned, to mobilize people to take action around a shared vision, to develop and enact innovative solutions to complex problems, and to participate actively in policy decision-making. According to a PolicyLink report (2003), "policy determines the way society organizes its resources, conducts its business, and expresses its values."

The field can be understood as the cultural and political landscape within which policies are made and implemented. Fields produce frames, approaches, norms, standards, and methods that guide practitioners and shape how problems are defined and researched, and what solutions are developed. We combine field and policy to emphasize both the cultural and political work of leadership that is required to influence policy decisions and transform systems. An increasing number of organizations and foundations are supporting programs and initiatives to develop field-policy leaders because they recognize that systems change requires bridging and working across boundaries of community, culture, and sector.

The value of field-policy leadership networks

Field-policy leadership networks enable leaders to work across boundaries more effectively. They have the capacity to mobilize large numbers of people around a common cause, influence the cultural and political discourse, and bring diverse perspectives into the policymaking process. Well-developed field-policy networks can influence systems change by better aligning frames, interests, and people across sectors, cultures, and communities in ways that have the potential to produce large scale effects.

Examples of field-policy leadership networks

CAYL Schott Fellowship for Early Care and Education

The CAYL Schott Fellowship for Early Care and Education is building a cadre of public policy leaders from diverse communities who are committed to working for policy changes that improve the quality and availability of early education and care for all young children and families in communities across Massachusetts. The fellowship takes 12 leaders each year through a process of identifying policy problems, researching and proposing policy solutions, writing policy papers, and advocating for policy change. Through this process, participants develop relationships with leaders who work in different regions of the state, different racial and ethnic communities, different levels of governance (city and state), different fields (e.g. education, public health) and different sectors (e.g., academic, government, and nonprofits).

The CAYL Schott Fellowship Network is more than a peer support network because its purpose is to influence early childhood policy and practice in

Massachusetts. The Network meets formally three times a year to focus collectively on how to work together more effectively to produce positive policy results that improve access to and the quality of early care and education. While the network is still in its early phases of becoming a field-policy leadership network, there is growing awareness among leaders about the power of weaving their professional networks together, identifying influential actors outside the fellowship (e.g., state and local officials, advocates, service providers, funders, those in the media and business), and intentionally building relationships with them.

National Public Health Leadership Network

The National Public Health Leadership Network brings together 7,000 graduates from statewide, regional, national, and international leadership programs that seek to strengthen the public health infrastructure around the world. These efforts were initially begun by the Center for Disease Control in 1990 in response to an Institute of Medicine report calling for increased leadership skills among the nation's (and the world's) public health leaders. The initial leadership program enrolled senior leaders from local, state and federal levels of public health, as well as public health academia, health care organizations and national health organizations. A number of the 800 leaders that this program trained went on to establish state and regional leadership programs around the country, providing a multiplier effect (Umble et al., 2007)

The network first formed among state and regional leaders who had graduated from the program and who offered each other "plenty of advice and support from those who had already walked the road." These are the characteristic qualities of peer leadership networks. Over time, however, the network began to weave independent state and regional strands together "into a common 'rope' or movement that could pull the field forward together." (Umble et al., 2007). Network members took up a number of initiatives to benefit the field of public health. They developed documents on ethical practice in public health that were officially adopted by the American Public Health Association in 2002. They issued white papers on the public health workforce, workforce development, and leadership. The Network has also developed a "Public Health Leadership Competency Framework" that includes transformational, political, trans-organizational, and team building competencies. All of these activities have strengthened the leadership of the public health field.

MomsRising.org

Momrising.org is a national on-line network of over 150,000 citizen members who are concerned about building a more family-friendly America. MomsRising.org uses the power of on-line organizing to mobilize citizen advocates around motherhood and family issues. Two recent successes included the passage of a paid family leave bill in Washington in 2007 and the prevention of the Consumer Product Safety Commission from requiring

toxic chemicals to be sprayed on furniture to make it flame-retardant. MomsRising.org wants to change the culture that tolerates workplaces, policies, and social priorities that do not support families.

One of MomsRising.org's core strategies is partnering with aligned organizations on joint campaigns and getting the word out on breaking issues to members who can take rapid action. They currently have 85 partner organizations who work together to enact family-friendly policies by mobilizing their vast grassroots networks. The partnerships enable each organization to accomplish much more with the resources they have and to more effectively promote a full-range of motherhood and family policy initiatives.

In a recent Stanford Social Innovation Review article about MomsRising.org (Gehl, 2008), featured in the magazine's "What Works" section, the author summarizes what works to mobilize moms.

- Identify issues common to all mothers
- Make it easy for members to take action
- Use existing social networks for viral marketing
- Combine forces with like-minded nonprofits

Key characteristics of field-policy leadership networks

Successful field-policy leadership networks help members find common cause with unexpected allies. They rely on bridgers who reach out and connect across diverse communities, cultures, sectors, and disciplines. Building alliances often starts slowly. Leaders first need to learn each other's language and stories, find common ground, and establish trust. Field-policy networks usually start as peer leadership networks. Once trust is established, leaders are better positioned to tap into and mobilize their networks around a common cause.

Evaluating field-policy leadership networks

Some of the questions that can be asked in an evaluation of field-policy leadership networks include:

- Is there evidence of greater sharing and collaborating across communities and sectors, at national, state, and local levels?
- Who are the bridgers in the network?
- Is the network expanding to include likely and unlikely alliances?
- Are diverse leaders aligning their priorities and working together towards common goals?
- Do people across the network share common frames (e.g., language and metaphors they use to describe problems, explain why they exist, and ways to address them)?
- Do members of the network coordinate their efforts to mobilize large numbers of citizens to engage in policy activism?
- Do members gain access to policy and field leaders through the network?

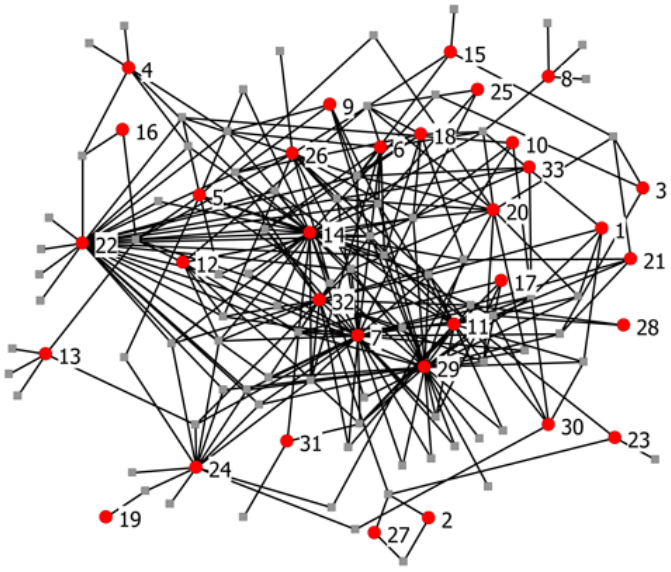
- Do networks contribute to positive policy changes? Do they contribute to creating more coherent fields of practice?

Using social network analysis to evaluate field-policy leadership networks

When using SNA to evaluate the influencing capabilities of a field-policy leadership network, it is especially helpful to expand the boundaries of the network analysis beyond the formal membership of the leadership network. One straightforward way to expand the network analysis is to conduct a two-phase survey. In the first phase, members of the leadership network report who are key external players (outside the membership). The second phase is a network survey; this survey asks network members to report not only their relationships with each other but also their relationships with key external players identified during the first phase. Even without any input from the key external players, this two-phase approach still provides a useful measure of how outside actors connect to the network membership.

The map below shows members of the CAYL Schott Fellowship as circles (labeled with numbers) and key external players as unlabeled small squares. Links represent professional collaboration between people; links between Fellows have been removed to focus attention only on which Fellows have working relationships with which key external players.

Figure 8: Collaboration network of CAYL Schott,
including fellows (labeled dots) and key external players (unlabeled dots)

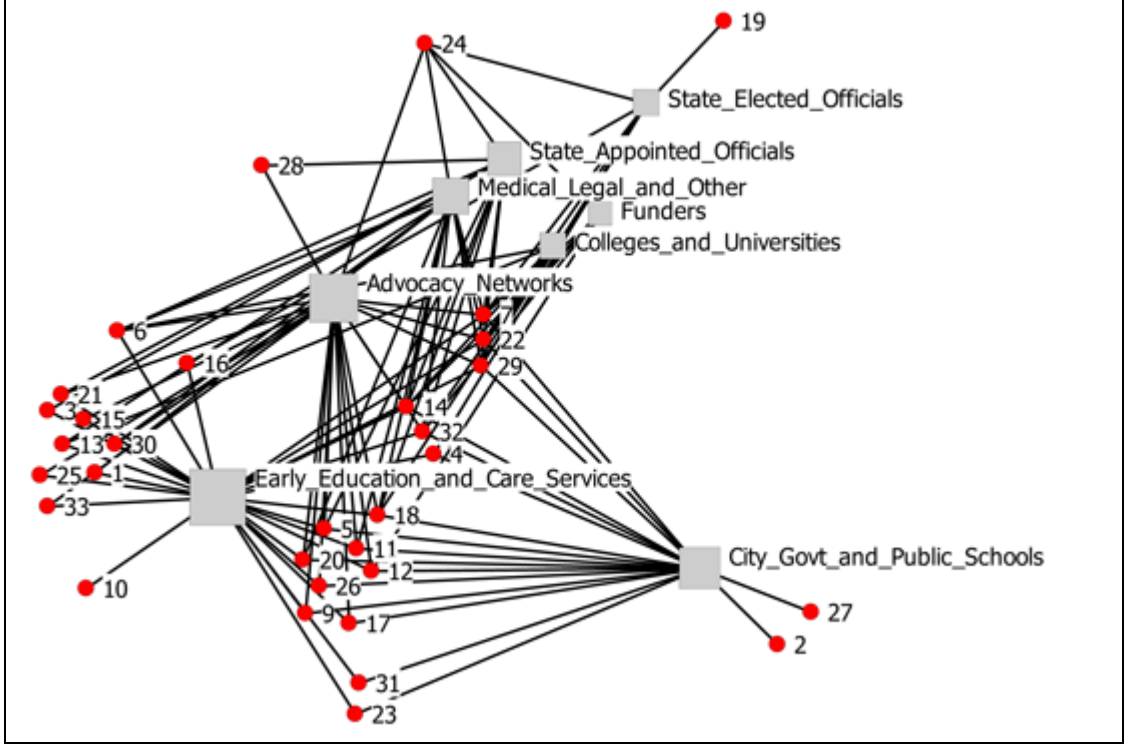


An evaluation based on the above map would of course include the names of all the external actors. The evaluative information provided by such a map includes (1) the key bridging role of network member 22, at left, who is the only member connected to four external key players, and (2) the extent to which some external actors (i.e., the small squares in the center of the map)

are already woven informally into the Fellowship Network, while other external players are accessible to only one Fellow. This kind of network information can help Fellows to access key external players who have connections to other members in the network.

Another way to link Fellows to external key players is presented in Figure 9. Each external key player in Figure 8 was categorized by the CAYL Schott Fellowship program staff into one of eight sectors. A new map was created (Figure 9), with each link indicating that a network member has worked with at least one external key player in that sector.

Figure 9: Collaboration network of CAYL Schott, summarizing connections of each fellow to eight different sectors



The layout of the map uses structural equivalence to help the CAYL Schott Fellowship Program to evaluate which people in its leadership network have similar network assets and similar network weaknesses. For instance, the leftmost grouping in the map has strong connections to early education and care services, advocacy organizations, and statewide elected and appointed officials. They are likely key players in mobilizing early care and education resources to influence the policy agenda and how policies get implemented through state agencies. This group does not, however, have contacts with city government and public schools and so may be unaware of policy ramifications at the local level. The grouping in the middle of the map would be useful allies in understanding local impact and mobilizing local resources.

In reviewing this map, Fellowship staff observed that little attention had been given to developing relationships with the media to help spread the network's policy messages. Identifying key media people and adding their names to future network surveys may be used as a catalyst for network members to focus on developing those relationships.

Collective Leadership Networks

Defining collective leadership

Collective leadership is "the capacity of a group of leaders to deliver a contribution in service of the common good through assuming joint and flexible leadership, according to what is perceived and required" (Kunkel 2005). Collective leadership "embraces diversity of people and perspectives, unleashes self-organizing and the collective intelligence that exists when people come together to act" (Gauthier 2006). At the heart of collective leadership are groups of diverse people who are connected and taking actions that positively affect themselves and their communities.

The value of collective leadership networks

Collective leadership networks rely on self-organizing of members who share a common goal. The value of collective leadership networks is in their capacity to solve problems quickly in an environment of uncertainty and complexity (Watts, 2004). Collective leadership networks also provide members with a sense of purpose that comes from the feeling of belonging to something bigger than oneself.

Examples of collective leadership networks

Mybarackobama.com

Mybarackobama.com is a portal created by Facebook co-founder, Chris Hughes, that gave supporters of Barack Obama for President a platform for self-organizing. Supporters used the platform to build relationships, share information, and act together on a scale that would have been unimaginable if it were orchestrated from the campaign headquarters. One example was how supporters used the network in the aftermath of the February 5, 2008 Super Tuesday primary. All campaign supplies in the Obama store were on back order and would not be available for 2-3 weeks. Meanwhile, hundreds of communities across the country were gearing up for primaries in March. They needed supplies. Within days people who had supplies began offering to send them to those who needed them. Supporters used open source graphics to create bumper stickers and yard signs that could be downloaded and used to produce materials quickly in local areas. Within a week an Obamacycle website was launched to coordinate the recycling of campaign supplies. This example shows how powerful networks can be for solving problems quickly when people have the tools that enable them to self-organize.

Lawrence Community Works

Lawrence Community Works (LCW) is using the power of networks to restore Lawrence, Massachusetts, a dying industrial city, that is one of the poorest urban centers in America. Bill Traynor, a veteran community development practitioner, returned to his hometown of Lawrence to become a catalyst for transforming his community. Instead of setting up a traditional community development corporation to tackle local problems, Traynor thought in network terms. The challenge, according to Traynor, was to build a constituency that was not based on organizations and roles but instead was focused on getting things done (Plastrik and Taylor, 2004).

LCW created an "open architecture" -- "a flexible structure that provides numerous opportunities for community residents to engage in civic life and connect with each other" (Plastrik and Taylor, 2004). At the heart of these connections is the opportunity residents have to share their stories and what they value about the community. Through these connections, they find common ground, and discover ways to work together to transform their community. Over 1,000 people have committed themselves to Lawrence's revitalization by volunteering in everything from community outreach to youth development. The assumptions of LCW's theory of change are the following: Civic health depends on civic engagement. If people do not know and understand each others' stories they will not trust each other enough to work together for the common good. When they do trust each other they can quickly solve local problems.

Cancer Information Service Partnership Program

The Cancer Information Service (CIS) Partnership Program is run by the National Cancer Institute to reduce the burden of cancer in minority and underserved populations, by reaching the public with information that helps people take action. CIS applies a collective leadership network approach to its mission by reaching out to partners that are dedicated to serving minority and underserved populations and have an established and trusted presence within their communities. CIS provides national resources to help regional cancer prevention efforts by offering expertise in areas such as program planning and coalition building on cancer-related topics.

Since the inception of the CIS Partnership Program in 1984, the number of organizations involved in cancer control has increased substantially. In response, the CIS has tailored their outreach strategies to meet the needs of minority and underserved populations. In 2008, the National Cancer Institute used SNA to gain a better understanding of the capacity of the CIS Partnership Program network and the partner organizations within that network. SNA illuminated the key role that state programs now play in the cancer prevention network. With this new information in hand, the National Cancer Institute is re-examining how federal programs such as the CIS Partnership Program can further those efforts. This type of re-examination is common: as a collective leadership network matures, the original sponsors

and facilitators of that network must adapt—often by focusing more on general goals and less on specific programs (Krebs and Holley, 2002).

Key characteristics of collective leadership networks

A successful collective leadership network relies on balancing two key characteristics. Control of the network must be in the hands of its users; this is a prerequisite for healthy self-organizing. Sometimes, however, core members of the network must be able to exercise veto power and keep control out of the hands of rank and file users; this is a prerequisite for long-term preservation of the group's mission. Shirky (2003) describes why and how online communities must manage participation for the sake of long-term effectiveness, including requirements such as establishing and protecting the notion of "member in good standing."

When collective leadership networks successfully empower users and preserve their core values, they can grow very large as networks of clusters. Clusters form around specific issues, local problems, or promising practices to tap the power of the collective wisdom and energy that exists within groups. The power of collective leadership networks grows when clusters are connected. An important role in connecting network clusters is the network weaver. Network weavers bridge between many clusters, as illustrated in Figure 1. They form relationships with each of the clusters, discover what they know and what they need, and then connect individuals and clusters that can assist one another (Krebs and Holley, 2002). Network weavers are highly connected to other people, have knowledge of the wider network, and are motivated to help others use the network to get their needs met (Plastrik and Taylor, 2006).

Evaluating collective leadership networks

To assess a collective leadership network, it is important to look at both the health of the network itself and the effects that the network is having on community health and well-being.

In 2005, Lawrence Community Works undertook an evaluation of its network approach to community development. Network members, network weavers, and funders were interested in what difference the network was making. Members of the LCW met to discuss how they would know if their network was healthy and what conditions were needed for the network to achieve its long-term goals (Plastrik and Taylor 2006). Here are the types of questions they asked:

- Is network membership growing?
- Is the proportion of members who are active in the network growing?
- Is network membership increasingly diverse?
- Are members engaging in multiple kinds of activities provided by the network?
- Are members coming together in different combinations in the network?
- Are members both bonding and bridging in the network?

Beyond assessing the health of the network, it is also important to look at network outcomes. LCW has documented a number of network outcomes in the Lawrence community. These include increasing civic participation, building community infrastructure (e.g., housing, parks), leveraging additional resources, improving governance and decision-making, and engaging broader participation in policy-making and budgeting.

Using SNA to evaluate and influence collective leadership networks

Evaluating collective leadership networks with SNA is challenging. Membership in the network can be very large and fluid. Clusters form for a purpose but may dissolve with members joining other clusters or becoming inactive. Collecting network data in this context is hard, and making sense of the data (e.g., mapping) is even harder. Network size and dynamics conspire against the usual approach of making network snapshots.

For many collective leadership networks, including Lawrence Community Works, SNA concepts are used to inform the administration of the program, but SNA tools are not used to evaluate the results. The benefits of using SNA in this way have been rigorously demonstrated in the context of organizational leadership networks (Burt and Ronchi, 2007). Simply presenting SNA concepts to leaders produces significant improvement in their performance (e.g., pay raises, job promotions). We have informally observed similar benefits in other leadership network settings.

When planning a long-term investment strategy, the sponsor of a collective leadership network can use SNA as an effective evaluation tool. NCI is using SNA in this way: the evaluation of its $9-million-per-year investment in the CIS Partnership Program is informed by 24 years of history and an equally long-term vision of continued support.

The day-to-day support of a healthy collective leadership network does not demand such deep consideration; it merely requires ensuring that members can find one another and form the groups they need to get things done. This is the task of a weaver. In our work with collective leadership networks, we have assisted the weaving process using SNA-based methods, often without explicitly stating that SNA is being used. Our approach is influenced by Web sites such as eBay, which acts as a virtual network weaver, making expert introductions between buyers and sellers of various products. In our simplified adaptation of this approach, we help people in collective leadership networks find those with whom they share a common passion or desire to learn, and we help identify where there are resources and expertise in a network.

One simple way to implement this approach is to ask network members what problems they care about, and what problems they are willing to help others work on. The results of such a survey can be mapped using the same

structural equivalence techniques illustrated in Figures 4 and 9; however, in many cases it is far simpler and more effective to publish a list. For example, the list can report the overall interest in each topic as well as names of people who are available to help for each topic. Such a list equips network members to find the people they need to form groups around shared issues.

A challenge in administering this kind of survey is knowing what questions to ask. Ideally, a survey would include a relatively short and specific list of all the issues that network members most care about; then the survey would invite members to indicate next to each issue their relative interest and energy. Such a survey is only successful if these questions tap the diverse passions of the members and respect the values of the core. In order to discover what these questions are, we usually conduct some sort of open-ended inquiry before defining the specific language of the actual survey.

Issues and Risks of SNA

In the preceding sections of the paper we have demonstrated how SNA can be used to analyze four types of leadership networks. The use of SNA is not, however, without risks. Careful consideration needs to be given to these issues by anyone who uses SNA as an evaluation tool. We highlight four of them here:

- Lack of privacy and related ethical issues
- Making evaluations from incomplete data
- Oversimplification and misreading
- Misuse of network measures

Our categorization of issues and risks is similar to that of Bender-deMoll (2008). Below we briefly elaborate on each category. For each one, we emphasize its implications for leadership networks and compare our perspective to Bender-deMoll's.

Lack of privacy and related ethical issues

Borgatti and Molina (2005) discuss ethical guidelines for using SNA to evaluate leadership networks. We follow their guidelines in our own work and devote special attention to privacy. In the table below, we highlight three distinct ways that network surveys lack privacy compared to traditional surveys:

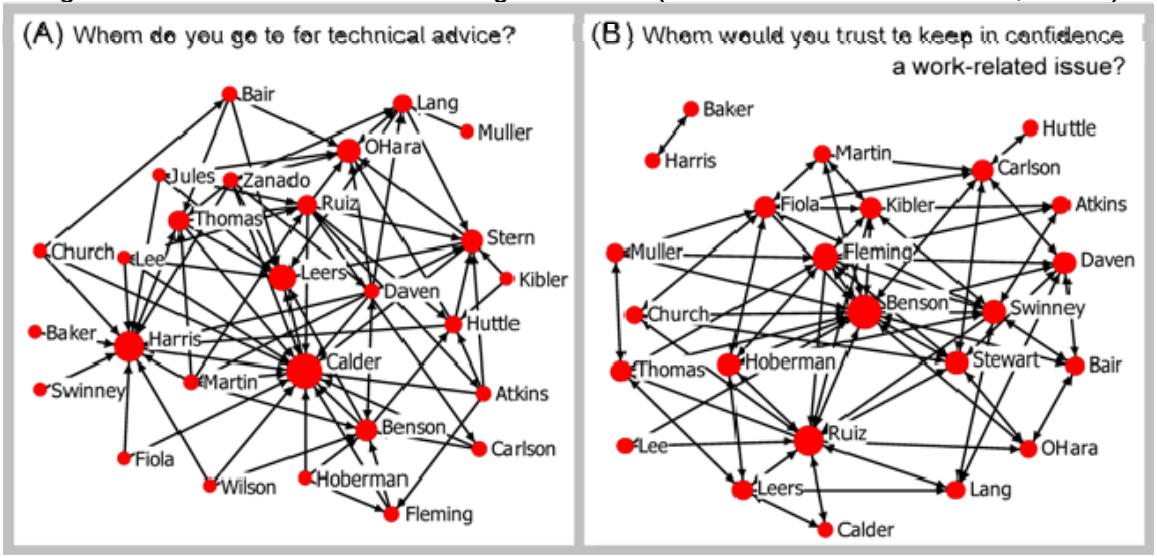
Figure 10: Lack of Privacy in Network Surveys

	Traditional survey	**Network survey**
Questions: 1st-person vs. 3rd-person	Each individual reports information about himself.	Each individual reports information about others by name.
Results: averages vs. specifics	Responses are aggregated so that individual respondents and non-respondents cannot be distinguished.	The presentation of results reveals specific responses attributed to specific individuals.

Visibility: informed consent vs. leap of faith	Survey results allow each individual to compare himself silently with the group average. Each individual can then decide what to share about himself with whom.	Survey results expose how each individual is seen by others. Each individual has no ability to preview what others have said about him before it is published.

Here we focus our discussion primarily on the third issue, visibility; then we briefly remark on the other two issues. We include Figure 11 to provide context. It shows two maps: the advice and trust networks of a single organization studied by Krackhardt and Hanson (1993). Consider the advice network (a). Someone like Swinney (far left) might prefer that others not notice that his advice is sought by no one in the network, while Calder (center), who is perhaps overwhelmed by the number of people seeking his advice, might wish to be invisible so that others would not seek him out.

Figure 11: Two views of one organization (Krackhardt and Hanson, 1993)



Two factors exacerbate the risk of exposing people like Swinney and Calder. First, they have no way of previewing what others have reported about them before those reports are published (a matter we will revisit in the "Future Research" section). Second, they may assume—incorrectly—that not responding will keep them out of the survey results. For example, suppose Calder chooses not to participate in the next survey; then those results will not show that Calder seeks advice from Leers and Harris, but they will still show who reports that they go to Calder for advice (and there will probably still be many such people). Calder's ability to remove himself from the network map depends on the survey administrator, who must be clear that "opting out" and "not participating" are two entirely different things.

The above risks faced by participants in a network survey can be mitigated with the following steps. The first step is to educate people about the value

of network data, as it benefits both each individual and the network as a whole. The second step is to explain clearly who will see the network data and what will be done with the data. The third step is to design the survey to be consistent with its intended use. For example, asking "whom do you trust"—as mapped in Figure 11 (b)—would probably be counter-productive if the survey results were to be shared openly with network members, but would be extremely valuable if the survey results were shown only to a trusted advisor who is not herself in the map.

The overall goal of the above three steps is to provide network members the ability to exercise informed consent. Clarity and transparency increase participation in the survey and acceptance of the results. Figure 12 shows how we put these steps into practice; we introduce a network survey with language similar to the following:

Figure 12: Sample Network Survey Introduction

Welcome to the Peer Leadership Network Survey.

One of the goals of our Peer Leadership Program is to strengthen the connections among those who are working to help children of low-income families in our state. Your participation in this survey will enable us to gain a deeper understanding of the current leadership network. The survey will take about 15 minutes to complete.

In order for this survey to be effective, we need participation from as many people as possible. The primary result of this survey will be a network map of who communicates with whom. The results of the survey will be shared with current network participants at our next meeting, when we will interpret and discuss them collectively. Results will also be shared with Foundation staff.

In order to participate in this kind of network survey, you must identify yourself. Even if you do not respond to this survey, you may still appear in the resulting network map based on others' reported connections to you. If you do not wish to appear in the network map, please indicate so below.

Do you grant permission to have your name appear in the network map?

- ☐ Yes
- ☐ No

There are also steps that can be taken to mitigate the other two privacy risks of network maps listed in Figure 10. The specificity of network survey results can be masked so that individuals' names cannot be inferred from the presented maps. This approach is quite practical when results are presented as an anonymized case study (i.e., the audience does not know what specific network is being displayed); however, this kind of network anonymity is extremely difficult to insure when the results are shared with the network members themselves.

Finally, we consider that each respondent to a network survey is asked to report information about others by name, rather than reporting information purely about himself. When trust among network members is in doubt, any question designed in this way can be difficult to ask. In such a situation, we recommend survey questions that elicit purely first-person information. The resulting data can then be used to create a network map of the group based on structural equivalence (as in Figures 4 and 9).

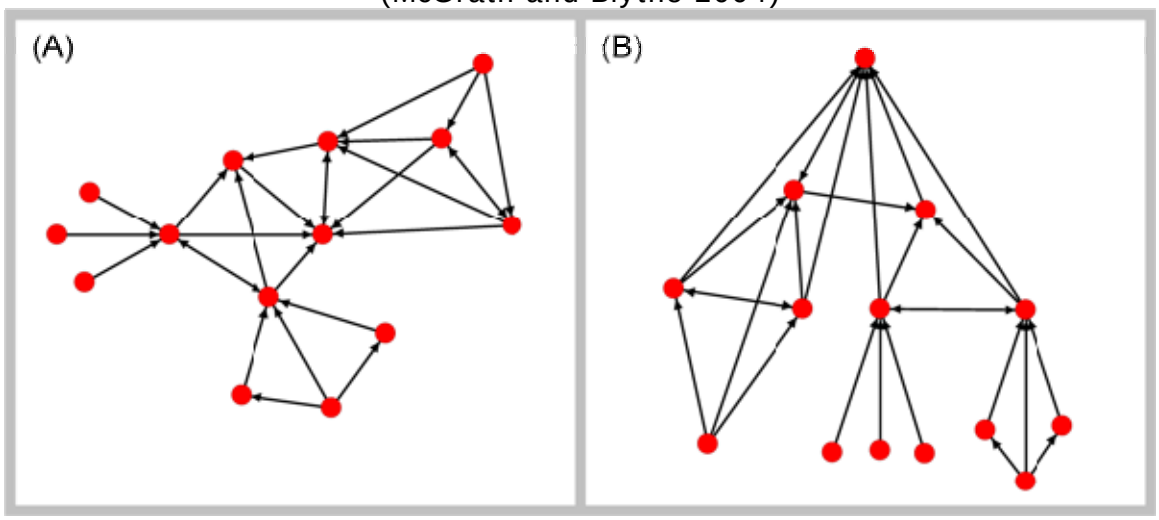
Making evaluations from incomplete data

Network survey results are much more sensitive to data omissions than other kinds of surveys. In order to produce a network map that provides network members with accurate pictures of bridging and bonding, a survey response rate of at least 75% is typically required (Borgatti et al, 2006). Smaller population samples can be surveyed in some situations, but evaluators usually cannot assess a large network by surveying small randomized samples in the same way they can with traditional non-network surveys.

Oversimplification and misreading

We caution people who use network maps to look for multiple interpretations of the data. The work of McGrath and Blythe (2004) illustrates why. They showed subjects the two organizational advice networks in Figure 13 and asked, “All other things being equal, which organization is more adept at change?”

Figure 13: Which organization is more adept at change?
(McGrath and Blythe 2004)



Responses were mixed: some thought the less hierarchical left group (A) would be better at change, because of the wealth of informal connections. Others thought the more hierarchical right group (B) would be better at change, because of the influence of the central authority figure. Very few came up with the correct answer: that networks (A) and (B) are identical.

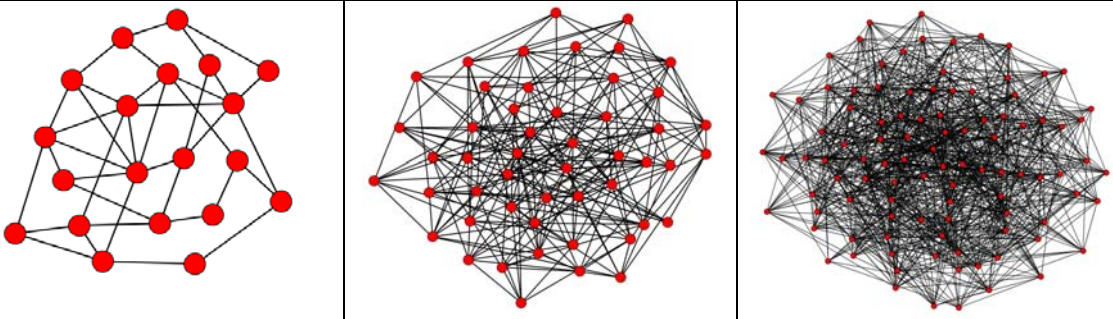
We agree with Bender-deMoll (2008): "Viewers are not used to thinking critically about network images. Like any statistical graphics, they can be easily manipulated to convey a viewpoint that would not hold up well to rigorous analysis."

One helpful rule of thumb is to rely on network maps more for raising questions than for answering them. For example, it is easy to jump to negative conclusions about peripheral members of a network, such as Swinney in Figure 11 (a). It is important to withhold premature judgment and instead ask: Why is Swinney at the periphery of the map? Possible answers include: Swinney is new; he is disengaged; or he is a vital source of expertise and innovation who bridges to a group not drawn on the map. Network data has the potential to be misused if it is not presented and discussed by skilled analysts who encourage critical thinking.

Misuse of network measures

Some network metrics are prone to misuse. One of the most common mistakes we observe in the field of SNA is the misuse of density, which is a seemingly intuitive metric that is in fact very easily misinterpreted. Density is especially prone to misinterpretation when comparing networks of different sizes. For example, the three networks of Figure 14 all have exactly the same density, even though the maps indicate how connectivity differs significantly between them. We recommend links per node as a measure of network connectivity that behaves much more intuitively than density.

Figure 14: When comparing connectivity of different networks, Links per Node is more intuitive than Density



20 nodes, 38 links Density = 0.20 Links per node = 1.9	50 nodes, 245 links Density = 0.20 Links per node = 4.9	100 nodes, 990 links Density = 0.20 Links per node = 9.9

Anderson et al (1999) explain that many network metrics, in addition to density, interact "powerfully and subtly" with network size. Leadership networks are often changing in size or being compared to other networks of different sizes. Therefore, it is critically important that practitioners account for the interaction of network size with other network measures.

Bender-deMoll (2008) emphasizes another misuse of network measures: applying a measure designed for one kind of network to a set of data

involving a different kind of network. For example, centrality means something different in an affiliation network than it does in a communication network.

Future research

SNA has become a popular methodology for a wide variety of applications, and so one major challenge facing researchers is to make sense of the proliferation of network-related results. Bender-deMoll (2008) synthesizes a wide spectrum of SNA research as it pertains to human rights programs. Kilduff and Tsai (2003) provide an even more extensive synthesis of SNA research; they go deeper into the science of SNA and devote an entire book to outlining fruitful avenues for future research pertaining to organizational networks. We recommend both of the above sources to anyone interested in the opportunities for future research that we list below.

"The jury is still out as to whether social capital measured at the individual level does indeed have effects at the community level" according to Kilduff and Tsai (2003). Despite the increasing number of leadership network case studies, there is little comparative research looking at network effects, or systematically linking those effects to desired outcomes (Provan and Milward, 2001). Studies have conclusively linked network effects to individual-level outcomes (e.g., pay-raises and job-promotions), but the contribution of network effects to organization- and community-level outcomes remains unclear. As with other approaches to leadership development evaluation, it is important to recognize that attributing changes in communities to network effects is often difficult. Nevertheless, we think comparative leadership network case studies will significantly strengthen our capacity to understand how networks evolve and function in different contexts, and how they contribute to achieving desired outcomes.

Established standards for evaluating networks do not currently exist. In order for SNA to become a tool that can be applied with validity across different contexts, we need more comparative research on how network metrics are being applied in different contexts and with what results. Such research will enable us to refine our metrics and increase the likelihood that data is being appropriately analyzed and interpreted (Bender Moll, 2008). This research will require integrating different network data sets, which is complicated by the proprietary nature of these data sets. Sharing network data sets can jeopardize both the privacy of individuals described by the data and the professional interests of those who collected the data. Sharing health information involves similar benefits and risks; we hope that efforts to promote health information liquidity (e.g., Lorence et al, 2005) will spur similar innovations in sharing network data.

Collecting network data remains problematic. Using standard survey tools to collect network data is not practical for large networks (e.g., over

200 members). Surveys are also problematic for longitudinal network evaluations, in part because they provide no easy way to manage changes to names. For example, if network member Jill Smith changes her name to Jill Jackson, then any longitudinal network evaluation must recognize that these two names refer to the same person. Whichever way she is named in a survey is open to misinterpretation by her extended network of professional contacts, who do not keep track of her personal status.

The two limitations above are being addressed to some extent by network-specific survey tools that are more streamlined than traditional survey tools and by data-mining techniques that avoid surveys altogether (Tyler et al, 2003). In addition, social software sites such as Facebook and LinkedIn are extremely effective at managing large sets of longitudinal network data; however, these sites tightly control their data, prevent downloading altogether, and so frustrate the would-be evaluator. Evaluators of leadership networks need the best qualities of surveys, data-mining, and social software, all combined in one affordable system.

Finally, we note that popular social software sites demonstrate a useful approach to one of the thorniest privacy issues of SNA: Facebook and LinkedIn users can preview information that others report about them before that information is published. (The "Issues and Risks" section of this paper describes how network surveys handle this issue.) This is another reason why we are hopeful that lessons learned in the social software space will help improve SNA data collection.

We lack constructive guidelines for creating network maps and have only begun to understand how people perceive them. We know of very few papers that have considered how people perceive network maps. Much can be done to expand on research such as that of McGrath and Blythe (2004), which we illustrated in Figure 13. In order to advance our understanding of how people perceive network maps, researchers will first have to overcome three common shortcomings of software used to create network maps: lack of creative control over layouts, difficulty drawing large networks, and a tendency to create maps that are confusing or ambiguous (e.g., by drawing nodes on top of each other and thereby hiding all but the top-most node at that location). The fields of information visualization and human-computer interaction have much to offer this overall area of research. For example, Perer (2008),who addresses SNA from the perspective of these two fields, considers how people perceive network maps, provides tools to draw large networks, and proposes a well-defined process to replace the ad hoc techniques currently used to create network maps. We hope that Perer's work invites more researchers from these fields to apply their skills to the open problems facing SNA.

Structural equivalence has received insufficient attention from the leadership network community, compared to network topics such as centrality and clustering. Netflix has famously offered a million-dollar prize

to anyone who can improve its recommendation algorithm, which is just one indication of the large volume of work on structural equivalence that the leadership network community can draw upon. We hope that the examples in this paper of applying structural equivalence to leadership networks will motivate readers to explore the topic of structural equivalence and to build on our work. Mathematical literature on structural equivalence is extensive: Wasserman and Faust (2004) provide an excellent introduction to the topic, and an up-to-date reading list can be found in the bibliography of Luczkovich et al (2005). These sources are more mathematically advanced than typical social network literature. For those who prefer less technical reading, we suggest Hanneman and Riddle's (2005) text and its section on visualizing "two-mode networks" as a helpful next step, in combination with the general introduction to two-mode networks by Borgatti and Everett (1997).

Many issues facing the field of SNA may have important implications for leadership networks. Unresolved issues in the field of SNA include the following:

- SNA represents a "structuralist" approach to organizations, fields, and communities, which complements an "individualist" approach. These two approaches have created two rival camps: "There is a pressing need for non-dogmatic research that explores issues concerning how individual differences in cognition and personality relate to the origins and formations of social networks" (Kilduff and Tsai, 2003).
- The most commonly used centrality metrics, strictly speaking, do not actually model sociological processes of interest; furthermore, many sociological processes that are interesting are not correctly modeled by any available centrality metrics (Borgatti, 2005).
- Further study is needed to understand the benefits and risks of measuring different kinds of network relationships. For example, Rizova (2006) has argued that measuring "seeks advice from" provides significant benefits in some contexts where measuring "works with" or "friends with" provides no benefit. LaBianca and Brass (2006) have pointed out that negative relationships (e.g., "do not like") are under-studied, even though they are often more informative than positive relationships. Cross et al (2003) have shown that positive and negative energy relationships (e.g., "energized by," "de-energized by") are particularly informative.

The dynamics of collective leadership networks deserve further study. Interesting avenues of inquiry include the following:

- What kinds of issues/causes most effectively lead to the formation of collective leadership networks? The general question of what makes something contagious or popular extends beyond the scope of our research, but Salganik et al (2006) suggest that network dynamics make popularity harder to predict than previously thought.
- What kinds of property rights most effectively facilitate the emergence of collective leadership networks? The open source software

community has debated this question at length: When someone receives open source property, what rights and responsibilities does that person have? Feller et al (2005) study this and other aspects of the open source community.

- What behavioral norms help build and sustain collective leadership networks? How do people communicate with each other? Evans and Wolf (2005) provide a good starting point for this inquiry. They discuss best practices of the open source software community and the Toyota Production System.
- What kinds of incentives help build and sustain collective leadership networks. How can a sponsor promote "good" behavior? Cheshire (2007) investigates the effects of incentives on information exchange, in the context of wiki contributions.

Conclusion

This paper offers two main contributions: (1) a framework of leadership networks, and (2) a discussion of how to use social network analysis to evaluate leadership networks. The paper also describes numerous research opportunities related to leadership networks and SNA, including important issues and risks.

The fundamental goal of our research has been to provide a useful synthesis of SNA for the field of leadership development. In conducting our research, we have lived the experience of bridging and bonding. As a pair of authors, we are an unlikely alliance. Our common cause is a desire to learn from our clients: those who fund, run, and catalyze leadership networks. Our framework for leadership networks has helped us to understand their work and has helped us to determine when and how to use SNA as an evaluation and capacity-building tool.

To those who are dedicated to developing and supporting the emergence of leadership, it is essential to understand how to create, develop, and transform leadership networks. We hope this paper will inspire more evaluation research on leadership networks and on how to harness and use the power of SNA for the collective good.

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