Using Social Network Analysis to Advance Traditional Qualitative Methods in Evaluation and Program Design[1]

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ABSTRACT

Social network analysis (SNA) is a technique used to study relationships between actors, such as people or organizations. It has been applied to a wide array of disciplines, on topics ranging from destabilizing Al-Qaeda to explaining campaign fundraising success. While these applications may seem far removed from the efforts of AESP members, this paper will provide insights into the innovative ways social network analysis can be used in energy-related evaluations. We start by providing parameters for the use of this technique for evaluation efforts and articulate a number of researchable issues central to evaluation that may be answered through social network analysis. Our evaluation team then demonstrates how this method was employed to conduct a more thorough process evaluation as a complementary approach to other, more traditional research techniques. We also demonstrate the value of the social network analysis approach by comparing a network map with a more traditional organization and implementation chart. We then outline other ways it was utilized, including discussion of social network analysis measures such as centrality and density. This paper aims to add value to current evaluation methods and introduce social network analysis to the best practices of program evaluation and design.

Introduction

The application of social network analysis to energy related evaluations has been limited. In this paper, we discuss how evaluators can use SNA to provide insights into program administration and coordination, thus enhancing evaluations. Social network analysis is a quantitative method used to study relationships between *actors*, which may include individuals, organizations, or even nations. It differs from other methods in that it analyzes relational data (data on the connections or ties between actors) rather than attribute data (data on the individual qualities of an actor, such as age or race). Examples of connections between actors include: sitting on the board of the same company, attending the same university, communicating daily, and contributing money to the same political group. The technique has been used to capture terrorists, to measure the social capital of CEOs, and to identify experts within organizations.

Social network analysis is used to assess the structure of networks. The focus of analysis can be on the individual actors in the network and/or the network as a whole. In this paper, we outline some parameters for using this technique in energy-related evaluations, key concepts used in social network analysis, and discuss the value it adds above standard qualitative approaches such as in-depth interviewing.

Applications of Social Network Analysis to Program Evaluation and Design

Social network analysis can be applied to programs more generally to answer questions such as: 1) Who are the important actors in a network?; 2) Does the network map correspond to the number of connections that actors are expected to have?; 3) What is the general level of linkage of the network and how does it compare to other networks?; 4) Is this a cohesive network that implies coordination?, and 5) Are there changes in the network over time? Is the network growing, and is the general level of linkage increasing or decreasing?

We describe some ways that the method can be applied below:

- **To improve program design**: Social network analysis can be used "upfront" to improve program design. Network data can be collected on the existing connections between actors, and used to provide recommendations for improved communication. Who are the central actors in the network, and are there actors who should be playing a more central role? The findings could be used to put in place structures (e.g. meetings) to improve communication. The method can also be applied toward more effective outreach. It can be used to help speed up the diffusion of innovations through identifying opinion leaders, who would then initiate the diffusion (Valente & Davis 1999). While this kind of study would likely be difficult when dealing with a large population, it could be applied to smaller networks such as one of builders, developers, and contractors.
- **Process evaluation:** There is often much desire for effective coordination to implement programs. But what does effective coordination look like and how can an evaluator assess coordination? SNA is a rigorous method that can answer whether people who should be in contact to facilitate coordination are actually in contact. In this case, the evaluator can compare the "theoretical" network to the actual network to state whether coordination is occurring and to what degree. Besides that, the analysis can help improve the process by indicating who needs to be more involved. This can be applied to both internal process evaluation and external process evaluation. For instance, SNA could be used to study a network of utilities and program administrators (i.e. "internal networks"), or market actors and trade allies (i.e. "external networks").
- **Impact evaluation:** One possible use of the SNA is as a tool to understand the ripple effects of a program to understand whether (and how) information flows from program participants to others in their network. This would be an assessment to understand whether program effects extend (through communications) beyond the individuals touched by the program. A second use of SNA is to see whether communications about a product (e.g. energy efficient lighting) increased following the program. This would involve comparing communication networks before and after the program, and could be used to determine the effectiveness of communication due to program efforts.

Key Concepts in Social Network Analysis

In this section, we introduce two concepts important to social network analysis that we used in our evaluation effort. One of the concepts, centrality, refers to who the 'important' actors in the network are. The idea is that the 'important' actors are located in strategic positions in the network (Wasserman & Faust 1994). Three measures of centrality are discussed below: degree, closeness, and betweenness.

- *Degree centrality* is based on the idea that the central actors in a network are those with the most connections to other actors. It is determined by adding up the number of direct ties an actor has to all other actors. It is a measure of actor activity as actors with high degree centralities are thought to be

the active ones in the network (Wasserman & Faust 1994). Actors who have many connections to others in the network may be in favorable positions, as they may be less dependent on other actors, and be better able to access the resources of the network (Hanneman & Riddle 2005).

- *Closeness centrality* has to do with how quickly an actor can get in touch with others in the network. Unlike degree centrality, it considers both an actor's direct and indirect ties. An actor with a high closeness score is able to get in contact quickly with many others. Also, actors with high closeness scores can be efficient at communicating information or their opinions throughout the network, and may be less dependent on others for the passing on of information (Wasserman & Faust 1994).
- *Betweenness centrality* is based on the premise that actors who are situated between many others are the central actors in the network. The idea is that actors in these positions can control the interactions of others they are situated between - they can play a gate-keeper role or prevent contact from being made (Wasserman & Faust 1994). This is a measure of the indirect links among actors in a network. Those with high betweenness centrality may be "under the surface of a network" (Durland & Fredericks 2005, 30). They may have a good deal of power because they are "on paths that provide opportunities to others, even if they are not directly connected to those others" (Durland & Fredericks 2005, 30).

The *density* of a network (the number of ties present in a network divided by the number of possible ties) is a concept relating to the network as a whole. Analytically, it is obtained by dividing the number of ties in a network by the number of possible ties. The value ranges between 0 and 1, with higher values indicating denser networks, and lower values indicating sparse networks. Density varies depending on the size of a network – increasing the size of a network leads to a decrease in the density (Wasserman & Faust 1994). Communication is thought to be better in dense networks than in sparse networks. Information can flow faster in dense networks. Density is also an indicator of "un-centralized inter-organizational cooperation" (Hagen, Killinger & Streeter 1997, 13).

Application of Social Network Analysis to the Statewide Marketing and Outreach Effort

In this section, we illustrate the value of social network analysis by drawing on findings from our 2006-2008 process evaluation of California's Statewide Marketing and Outreach (SWM&O) programs. The SWM&O efforts consist of three programs: Flex Your Power-General, Flex Your Power-Rural, and Flex Your Power-Spanish TV; each of which are implemented by different advertising firms. The Flex Your Power programs, through the ruling of the California Public Utilities Commission-Energy Division (CPUC-ED), were tasked with: 1) providing "statewide messages on simple things individual consumers can do to reduce energy consumption and their bills"; 2) increasing "consumer awareness of and participation in the statewide programs available to them," and 3)"persuad[ing] consumers to make permanent changes to their homes and businesses so that energy savings are not dependent on behavior once the energy efficiency measures are installed" (California Public Utilities Commission 2003).

Through in-depth interviews, we found that there was some disagreement between the program implementers and the CPUC-ED as the regulatory body on the role of the SWM&O programs. Namely, the SWM&O program implementers noted that their goal was to raise awareness, not change behaviors (e.g. by making permanent changes to their homes or businesses). This misalignment of program expectations and objectives was cause of some friction between the CPUC-ED and stakeholders and the program implementers. The Opinion Dynamics team sought to discern how such miscommunication could have occurred in the first place.

Our process evaluation of the SWM&O programs included over 60 in-depth interviews with program implementers, administrators, and stakeholders. The Opinion Dynamics team used social network analysis as a tool to complement and expand on our in-depth interview findings and to better quantify interactions among program implementers, stakeholders, and regulators. Namely, by having concrete data about interactions and network connectedness, our team was better able to identify specific sites for improvement among key actors and provide concrete recommendations to the program implementers and the CPUC-ED for improving communication and program leadership. Also, social desirability bias and other factors can inhibit respondents' ability to provide an objective perspective on their interactions within a network - social network analysis may be able to overcome some of these barriers by asking each actor in the network a few select and direct questions about their day-to-day interactions with others in the network. The depth interviews provided a series of initial findings that we sought to confirm, deny, or add insight to using social network analysis. To define the network, we first identified the individuals involved in the implementation of the effort based on our in-depth interviews. We asked the individuals to complete an Internet survey to assess their interactions with the other individuals in the network. We provided respondents with a list of all the other players in the network and asked questions about their interactions. [2]

In particular, through typical and innovative evaluation methods, we sought to answer the following research questions:

1. What are the possible areas for improved communication among the organizations?
2. Are the interactions the organizations reported in the social network analysis consistent with our in-depth interview findings? Also, are the interactions consistent with other in-depth interview findings?
3. Which are the central organizations in the SWM&O network?
4. What is the overall level of network connectedness (density) in the contact network? (This is used as an assessment of the potential for coordination among the organizations).

While SNA can be a valuable tool, there are also some limitations of the method. Although we initially collected information at both the level of the individual and that of the organization, we decided not to present the results of the individual analysis so as to avoid identifying individuals. Suspicion about the purpose of the research may lead some respondents to overstate their connections to portray themselves in a positive light. We addressed this by using the minimum value approach when the responses of two actors did not agree. For instance, if actor 1 reported being in contact monthly with actor 2, while actor 2 reported being in contact daily with actor 1, we recorded the minimum value as the response (here the tie would be monthly). A second limitation of social network analysis is that missing data is especially problematic. "If the response rate is R%, there will be complete information on only R% * R% of the relationships in the network" (Stork and Richards 1992, 195). We addressed this by using the responses given by others to determine the quasi-responses for the non-respondents.

## Comparison of Organizational Chart and Social Network Maps

Unlike traditional organization and network charts developed through depth interviews, social network analysis uses data collected from the actors themselves, rather than formalized roles, to develop a hierarchy of actors in a given network. Interaction data is particularly valuable because stated roles and interactions tend to favor institutionalized hierarchies of management and leadership and place importance

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[2] The information was collected at two levels: (1) that of the individual and (2) that of the organization as a whole. In order to collect data at the organization level, the Opinion Dynamics evaluation team identified a primary contact at each organization who reported on ties for the organization as a whole. For confidentiality reasons, we only present the results of the analysis at organization level.

and power in those that are at the top of an organization chart. In this section, we provide insights gained from social network maps and centrality that would otherwise be difficult to develop and populate from our in-depth interviews.

The figure below is an example of a standard organization chart that is populated based on the stated roles of each organization and actor through our in-depth interviews. This chart depicts all central actors in the SWM&O program and aims to lay out their roles with respect to one another. The arrows indicate information flows between each group of actors. In addition, the chart demonstrates a hierarchy of program guidance and oversight from the top down (beginning with the CPUC-ED).

Figure 1. Typical SWM&O Interactions Chart
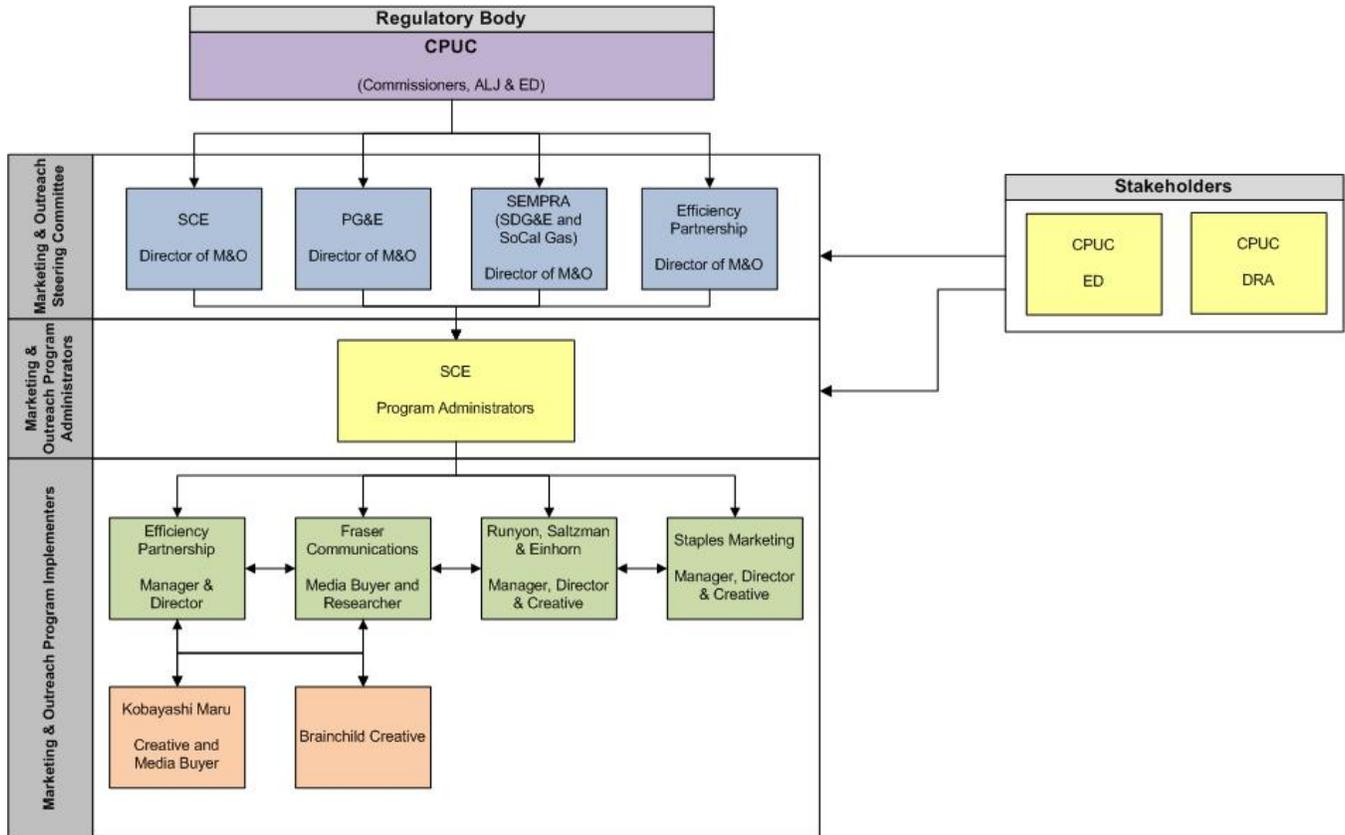
When we review the chart, it is difficult to discern the frequency of contact and importance of each actor in "getting the job done" and keeping the program's goals and objectives aligned. If we were to deduce program leadership and centrality from this chart, we would likely presume that those at the top of the chart are the most connected or central to the program's direction, e.g. the CPUC-ED as the regulatory body, and guiding the program efforts overall.

However, our social network analysis findings provide a very different perspective on actors and their importance in this network. Below, we provide a frequency of interactions network for all organizations involved in the SWM&O effort (Figure 2). This map was generated by asking each organization about the level of contact they have with other organizations. The response categories were daily, weekly, monthly, less than monthly but on occasion, and never. Organizations "never" in contact are not connected on the map.   Heavier lines denote higher frequency of interactions.

Figure 2. Atypical SWM&O Interactions Map
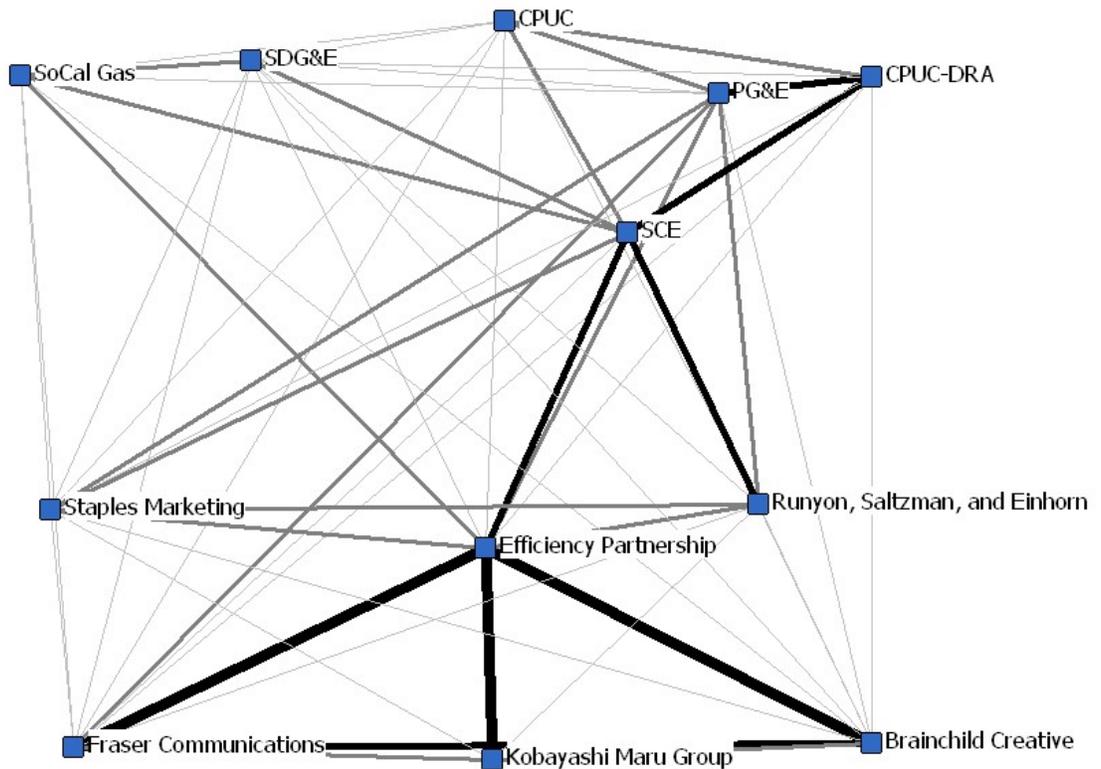
When we compare Figure 2 to the stated roles of the network actors (as represented in the organization chart), it becomes clear that one of the program implementers, namely Efficiency Partnership, whose role is de-emphasized on the organization chart, is the most frequently connected to all other actors in the network.

Centrality

In addition to measuring frequency of interactions, Opinion Dynamics sought to analyze three measures of centrality in our evaluation. We assessed the importance of individual organizations in the network by calculating degree, closeness, and betweenness.[3] The table below shows the normalized data by organization in the SWM&O network for each measure.

Table 1. All Measures of Centrality by Organization

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[3] To calculate these, we first dichotomized the frequency of contact data (set the responses to 0 or 1). Contact of at least a monthly basis (daily, weekly, or monthly contact) was given the value of 1, while responses of contact on less than a monthly basis was given a value of 0.

Organization	Normalized		
	Degree[a]	Closeness[b]	Betweenness[c]
Efficiency Partnership	72.7	78.6	36.7
SCE	63.6	73.3	25.8
PG&E	54.5	64.7	15.8
Staples Marketing	36.4	61.1	0.7
Runyon, Saltzman, and Einhorn	36.4	61.1	0.7
Fraser Communications	36.4	57.9	4.2
SoCal Gas	27.3	57.9	3.9
Kobayashi Maru Group	27.3	50.0	0.0
CPUC-ED	27.3	52.4	0.7
CPUC-DRA	27.3	52.4	0.7
Brainchild Creative	27.3	50.0	0.0
SDG&E	18.2	45.8	0.0

[a] The mean normalized degree is 37.9 and the standard deviation is 16.1.

[b] The mean normalized closeness is 58.8 and the standard deviation is 9.4.

[c] The mean normalized betweenness is 7.4 and the standard deviation is 11.7.

In terms of degree centralities, the scores for Efficiency Partnership, SCE and PG&E are all above average. Efficiency Partnership is the most central organization in the network. It has a high level of activity compared with others in the network, in that it is in contact with the most organizations. Compared to Efficiency Partnership, PG&E and below all have considerably lower scores. In terms of closeness centrality, Efficiency Partnership is again the most central organization. To reiterate, closeness centrality has to do with how quickly an actor can get in touch with others in the network. It is strategically situated to reach others. Three others, Kobayashi Maru Group, Brainchild Creative and SDG&E have the lowest closeness scores in the network, indicating that these organizations are more peripheral. With the exception of SDG&E, these findings make sense as Kobayashi Maru Group and Brainchild Creative are subcontractors to Efficiency Partnership. The betweenness scores indicate that Efficiency Partnership is again the most central organization. Compared to the organizations with low betweenness scores, Efficiency Partnership and SCE are more powerful in this network. Taken together, the measures of centrality give a sense of who are the main players in a network.

Density

In addition to identifying the central players in the network, the Opinion Dynamics team calculated the density of the network of organizations, which was found to be 0.379 (37.9%). To give context to this value, we compare it to the densities reported in a study on the network structure of organizations involved in implementing state tobacco control programs. In this study densities were calculated for several monthly contact networks. The densities ranged from 39% to 58% for state networks of 12-15 organizations (Krauss, Mueller & Luke 2004). This suggested there might be room for improvement in the amount of communication between organizations in the SWM&O.

Conclusions

As demonstrated above, our team used social network analysis to carefully evaluate the interactions

of the Statewide Marketing and Outreach actors, and to illuminate and strengthen the insights gained through our more traditional methods. Namely, our in-depth interviews found that interactions between the CPUC-ED and the SWM&O program directors and implementers are generally limited. These findings are backed by our social network analysis, which show that the CPUC-ED interacts with each of Efficiency Partnership, Staples Marketing, and RSE on a less than monthly basis. In addition, our social network analysis findings clearly demonstrate that Efficiency Partnerships is connected to the most organizations and serves as the leader of the SWM&O programs.

Reflections on the Research Technique and Process

Social network analysis is a worthwhile technique when there is the need to identify areas for improvement within networks. For example, it is appropriate when information flow or communication is breaking down. Also, as mentioned, social network analysis can provide a truer picture of position than standard organizational charts.

It is advised that researchers interested in learning social network analysis take training courses or workshops in the method and the software. These are often advertised on the INSNA (International Network for Social Network Analysis) website. When carrying out this research, it is important that researchers understand the end goal of the research and how the data will be analyzed, and design the questionnaires with these considerations in mind.

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