

Building Safety Partnerships Using Social Network Analysis

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Abstract

Although public–private partnerships have been useful components in public health and safety initiatives, little has been published on how to cultivate effective public health and safety partnerships for upstream social marketing initiatives. Using the development of a U.S. tractor safety alliance as an example, we illustrate how social network analysis can be used to identify organizations that are likely to be strategic partners and targets for upstream social marketing. In our project, knowledgeable informants first identified members of a national agricultural stakeholder network in the United States. Then, we surveyed the representatives of these organizations about their organizations' interest in joining a new U.S. tractor safety initiative, the connections between their own and other stakeholder organizations, and their perceptions of the organizations most able to advance a U.S. tractor safety initiative. From our analysis of these data, we identified 10 organizations that have the partnerships, resources, and interest necessary to lead an effective tractor safety partnership. These organizations will be the focus of an upstream social marketing initiative aimed at building a strategic tractor safety alliance.

Keywords

Introduction

As indicated frequently in the health and safety literature, agriculture is one of the most dangerous occupations in the United States (Hoskin, Miller, Hanford, & Landes, 1988; Myers & Hard, 1995; National Institute of Occupational Safety and Health [NIOSH], 2008). U.S. farmers are 9 times more likely to die on the job than the average American worker and each year 1 of every 100 farm workers will experience a work-related injury that results in lost workdays (National Safety Council, 2012; NIOSH Agriculture, Forestry, and Fishing [AFF] Centers, 2012). These estimates are conservative, as they do not include the vast majority of farms (78%) that employ less than 10 workers (NIOSH AFF Centers, 2012).

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There are many factors that contribute to the unacceptably high rates of farm fatality and injury. These include exposures to hazardous machinery, unpredictable and potentially dangerous animals, fatigue, and a workforce that has a relatively low risk aversion (Donham & Thelin, 2006; Murphy, 2003). Tractors, in particular, have been a considerable source of farm fatalities accounting for 37% of work-related agricultural fatalities (Murphy et al., 2010). Tractor overturns are the most frequent cause of tractor-related death (Hayden, Gerberich, & Maldonado, 1995; Murphy et al., 2010; Myers et al., 1998).

Over the years, many strategies for addressing overturn injuries have been discussed. These include installation of rollover protective structures (ROPS), tractor stability monitors, tractor safety training, legislation, community interventions, and social marketing, to name a few (Murphy et al., 2010). ROPS are 99% effective in the event of a rollover (there has been only one documented death of a worker wearing ROPS and a seatbelt, compared to the death of 1,412 workers between 1992 and 2005 in overturns where ROPS was not present; NIOSH, 1993). In 1985, changes to safety standards prompted tractor manufacturers to include ROPS as standard issue on all newly manufactured tractors. This decision was made voluntarily by tractor manufacturers, not prompted by government mandate (Sanderson et al., 2006). Although many of these efforts have been partially successful, they have also encountered considerable challenges which prevent a lasting solution to the elimination of these needless deaths.

One potential reason for the impasse is that these efforts have almost entirely been directed at influencing farm owner behavior. This is somewhat surprising in light of the widely recognized benefits of multilevel approaches, which have produced lasting solutions for many public health issues. As has been discussed in the literature, particularly in antismoking initiatives and obesity interventions, diverse partnerships made up of individuals from both the public and the private sector can have considerable positive impacts (Campbell & Conway, 2005; Hersey et al., 2012; Lando et al., 2005; Larson et al., 2009; Reddy, Yadav, Arora, & Nazar, 2012).

However, as well as being effective, partnership development can present its own challenges (Campbell & Conway, 2005; Hann, 2005; Po'e et al., 2010). Unfortunately, there has been little published regarding how to identify productive partners systematically or how to convince these partners to participate. The purpose of this report is to examine the first phase of a potentially promising approach for developing strategic partnerships. In this first phase, social network analysis (SNA) was used to map relationships in a particular network of organizations. SNA is typically used to visualize interactions between individuals, communities, organizations, countries, or other types of social units. These social network graphs and measures can be used to identify individuals or groups who have important positions and roles in a network. The second phase, upstream social marketing, can be used to encourage productive partners to participate in downstream public health or prevention initiatives. Both SNA and upstream social marketing will be used in the development of a strategic alliance aimed at decisively addressing the issue of tractor overturns. The results of the first phase of a project to build such an alliance—an SNA of potential tractor safety partners—are reported here.

Method

Identifying ROPS Stakeholder Network Members: The Knowledgeable Informant Survey

To identify potential strategic partners for a ROPS tractor safety initiative, it was necessary to develop a complete list of ROPS tractor safety stakeholders. For the purpose of our project, a stakeholder was defined as a “private company, corporation, trade association, commodity group, non-profit or public agency that may potentially be interested in or affected by a ROPS tractor safety initiative”. The strategy for identifying members of this stakeholder network involved surveying individuals who were knowledgeable about the agricultural community and tractor safety initiatives. These individuals were referred to as knowledgeable informants and included (1) directors of the nine regional NIOSH AFF Centers, (2) the

director of the National Children's Center for Rural and Agricultural Health and Safety, (3) nationally recognized agricultural health and safety researchers and engineers, (4) regional directors of United States Department of Agriculture Cooperative Extension Offices, and (5) long-term members of the National Institute for Farm Safety/International Society for Agricultural Safety and Health.

All 57 knowledgeable informants identified were e-mailed an invitation to participate in a survey. The survey was divided into four sections: (1) national or regional private companies and corporations, (2) trade associations and commodity groups, (3) nonprofits, and (4) public agencies that might be interested in or affected by ROPS initiatives. In each section, several organizations that might be possible stakeholders were listed, and informants were asked to identify individuals in these organizations who might be interested in participating in a tractor safety initiative. Informants were also asked to add any organizations (and individual contact information) which might be interested in ROPS initiatives but which had not already been listed.

Knowledgeable informants were asked to complete the survey as completely as possible and return it to the study coordinator. Participants were notified that those completing the survey would be entered into a raffle for a gift certificate. To insure a high response rate, all nonresponders received several follow-up e-mails, as well as phone calls, urging them to complete and return the survey. A master list of stakeholder organizations was created from the knowledgeable informants' responses. One or more individuals associated with each organization were identified as potential respondents, based on informants' responses and further inquiry and investigation of appropriate contacts by project staff.

Mapping ROPS Tractor Safety Stakeholders Relationships: The SNA Survey

To assess the relationships among stakeholder organizations, the project team developed a social network survey. The survey included open-ended questions about possible reasons why many tractors still lack ROPS and possible solutions for addressing this need. Network data (information that depicts ties or links to other organizations) were captured by asking respondents to check every organization in the master list that the respondent's organization works with on any matter. Then, for each organization checked, respondents were asked whether the respondent's organization works with that organization on safety initiatives. Next, respondents were presented with the full list of organizations again and asked to indicate the organizations that they thought were very well positioned to further tractor safety initiatives by recruiting partners, providing leadership, and lending support. For these questions, the order of organizations listed was randomized individually for each respondent.

In another section of the survey, respondents were also asked to indicate whether their organization had partnered with other organizations on tractor safety issues or had made financial contributions to tractor safety initiatives. In addition, respondents were asked whether their organization had any concerns preventing it from supporting tractor safety initiatives and whether it would be interested in joining a new national tractor safety initiative. Finally, respondents who indicated their organization would or might be interested in the new tractor safety initiative were asked to select the types of resources (political, financial, networking opportunities, and visibility) their organization could contribute to the initiative. The survey was pretested with several of the knowledgeable informants.

The survey was administered online. Invitations to participate in the survey were e-mailed to each of the 68 potential respondents identified. The invitation noted that all participants completing the survey would be entered into a raffle for a Kindle Fire. Several follow-up attempts by e-mail and telephone were made to engage those potential respondents who had not yet completed the survey.

Network data were analyzed with UCINET 6.216 for Windows (Borgatti, Everett, & Freeman, 2007) and NetDraw 2.084 (Borgatti, 2008). When there were multiple respondents representing a given organization, the union (combination) of their network responses was used, such that if at least one respondent reported their organization had a relationship with a particular other organization, the

Table 1. Why Has the Percentage of ROPS-Protected Tractors Not Increased Significantly in the Past Few Decades?

Cost	29%
Feel it is not necessary	24%
Time	13%
Won't accommodate ROPS	12%
They get in the way	6%
Won't fit into barn	4%
Not used much	4%
Show tractor	2%
Logistically difficult	2%

Note. ROPS = rollover protective structures.

Table 2. Please List the Most Successful Ways to Increase the Percentage of Tractors With ROPS.

Education	41%
Subsidize	39%
Regulation	9%
Attrition	7%
Insurance adjustment	4%

Note. ROPS = rollover protective structures.

relationships was considered present. Similarly, an affirmative response to any of the other questions by any of the multiple respondents representing a given organization was treated as the final response for their organization. A connection between a pair of organizations was considered present if at least one organization reported the relationship. Network graphs were drawn with a spring embedding algorithm that minimized line (link) crossings.

Organizations were classified into one of the seven organization types. The machinery category included tractor manufacturers, ROPS manufacturers, tractor dealers, and associations of machinery manufacturers. Safety organizations referred to government safety agencies, safety research agencies and associations, nonprofits committed to agricultural outreach and education, and safety councils. Insurance companies, lending companies, and professional engineering organizations comprised three separate categories. Farm advocacy and commodity organizations included political advocacy groups, as well as livestock, vegetable, dairy, and organic commodity groups. The final category included other commercial organizations, like seed companies, fertilizer companies, and food product retailers.

Results

In all, 29 of the 57 individuals who were invited to participate in the knowledgeable informant survey completed the survey. For the stakeholder network survey, 34 of the 68 organizations completed surveys. A total of 44 respondents responded on behalf of the 34 organizations.

Responses to questions asking participants to identify reasons why more tractors are not equipped with ROPS and possible solutions for these issues identified several common themes among respondents (see Tables 1 and 2). Cost was identified as a prominent reason the percentage of ROPS-equipped tractors has not increased markedly in the past few decades. Other prominent reasons identified were a belief that ROPS are not necessary, that it takes too much time to find and install ROPS and that some tractors would not accommodate ROPS. The category "show tractor" refers to the practice of restoring

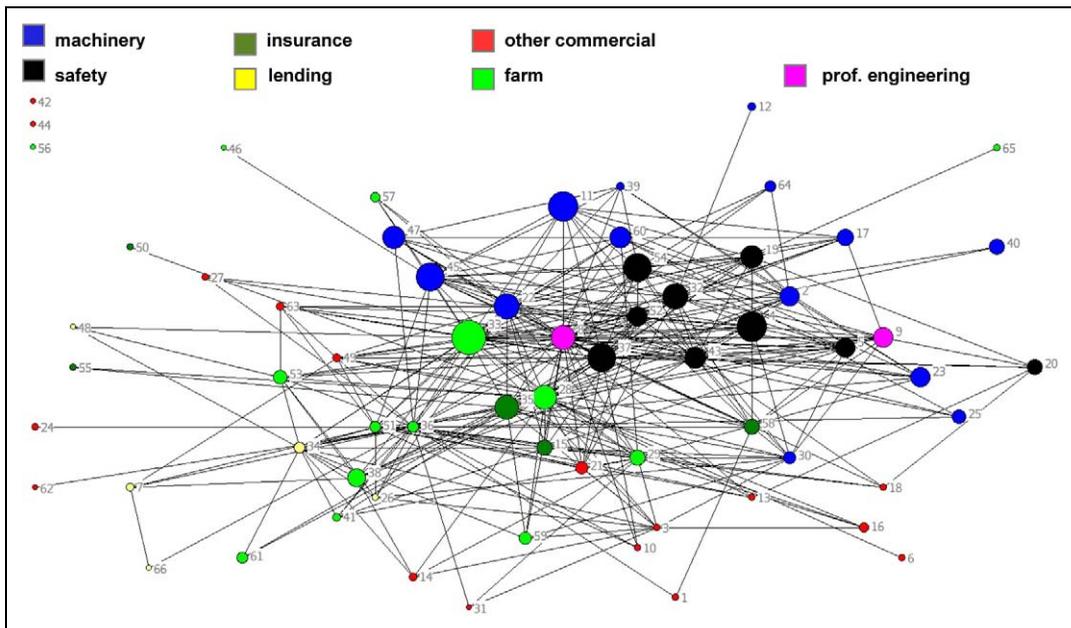


Figure 1. Sociogram of organizations working together on any matter.

antique tractors to their original condition so they can be shown at tractor shows. Education and retrofitting subsidies were two of the most frequent strategies mentioned for increasing ROPS protection.

Figure 1 shows the network of organizations in terms of working together on any matter. The circular nodes represent organizations and the lines between nodes indicate organizations that work together in some way. All but three organizations were linked to another organization. The linked organizations comprised a single component, such that these organizations were linked directly or indirectly (through other organizations' relationships) to the other organizations. The overall network structure was a core of fairly densely interconnected organizations surrounded by a periphery of nodes with few connections, mainly to organizations in the core. Figure 2 shows the network of organizations in terms of working together on safety initiatives. A similar core-periphery structure with a primary large component is present in this network, although there are more isolated organizations ($n = 18$) that did not work with any other stakeholder organization.

In the graphs, nodes' sizes are proportionate to the reputation of the corresponding organizations, with larger nodes representing a higher reputation for advancing tractor safety initiatives. An organization's reputation scores were computed as the proportion of respondents who nominated that organization as being very well positioned to further tractor safety initiatives. Node colors represent the types of organizations. In both networks, organizations of the same type tend to occupy similar regions of the network such that they have similar patterns of relationships with organizations of other types (akin to the notion of structural equivalence [Wasserman & Faust, 1994], although not measured quantitatively here). Organizations in the core of each network also tend to have the highest reputation to advance tractor safety initiatives.

To identify organizations that might represent the most strategic partners for the new tractor safety initiative, the organizations were sorted on reputation, centrality in the "works with on any matter" network, and interest in participating in the new initiative. Network centrality here refers to degree centrality, or simply the number of other organizations to which a particular organization is linked. In the "works with on any matter" network, degree centrality and another relevant measure of centrality,

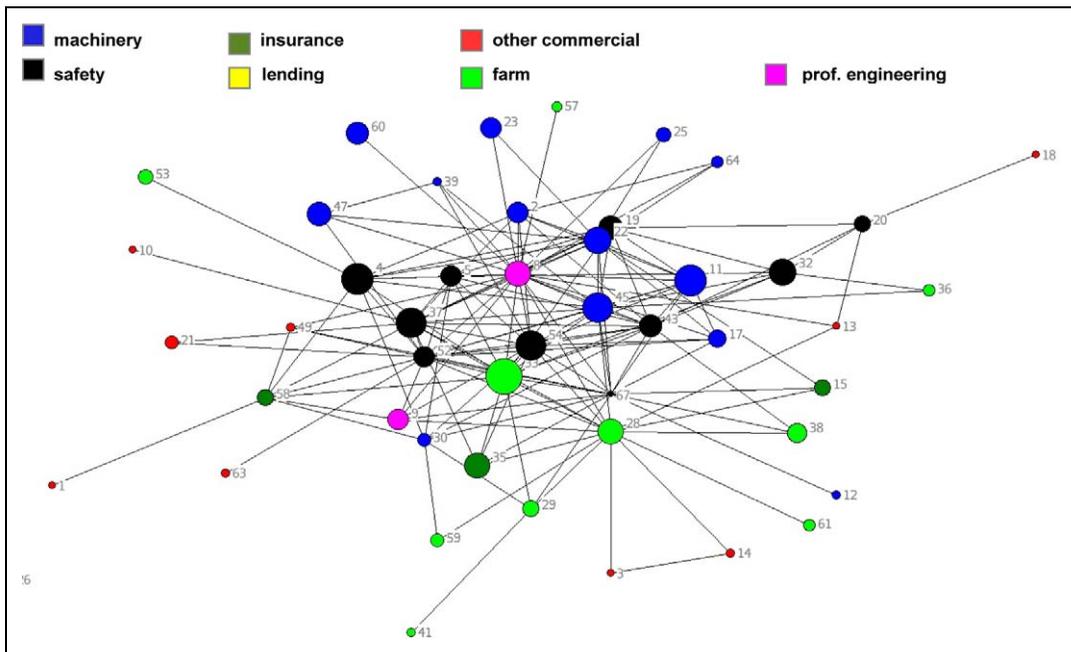


Figure 2. Sociogram of organizations working together on safety initiatives.

betweenness, are highly correlated (Pearson $r = .82$), and 16 of the 17 organizations in the top quartile of each measure are the same. There are 10 organizations that are in the top quartiles of reputation and degree centrality and had indicated interest in participating in the new initiative. These 10 organizations may be the most likely strategic partners and include 5 safety organizations, 2 machinery manufacturers, 1 farm advocacy organization, and 1 insurance company. All of these organizations reported currently working with other organizations on tractor safety issues. Eight also reported currently contributing financially to tractor safety initiatives and one reported doing so in the past. In addition, three reported willingness to contribute financially to a new national tractor safety initiative, and many indicated they could offer political support ($n = 4$), networking opportunities ($n = 8$), and visibility ($n = 8$) to the initiative.

Discussion

As mentioned in the introduction, although partnerships have been identified in the public health and safety literature as a considerably effective strategy for addressing health and safety issues, there has been very little discussion on how research methods can be employed to build more productive partnerships. The project discussed here provides some insight on how SNA can be employed to lay the groundwork for an upstream social marketing initiative dedicated to building an effective tractor safety partnership.

Looking at previous tractor safety efforts, there have been formidable barriers to creating a lasting, effective solution for unprotected tractors (Conway, 2010; Murphy et al., 2010). One potential reason these efforts have not been more effective is that previous efforts have been fractured. Although researchers and intervention developers have partnered with each other and manufacturers have partnered with manufacturers, there has never been a truly diverse partnership of private and public entities aimed at developing a national strategy for increasing ROPS installation.

Using the data collected in our surveys, it was possible to identify organizations that could provide several key partner qualities. These included (1) a high degree of connectivity to other organizations in the network, (2) a willingness to participate, (3) visibility in the community, and (4) history of involvement in such initiatives. Based on our results, it appears that tractor manufacturers, safety organizations, and farm advocacy groups are likely to have the most ideal combination of these traits. However, as indicated by Figures 1 and 2, not all farm advocacy and tractor machinery groups enjoy a high reputational score. This shows that a careful assessment of the capabilities of organizations in these groups could be warranted. It is also interesting to note that insurance, lending, and other commercial organizations did not appear to be particularly promising strategic partners by these indicators.

In addition to identifying a number of promising organizations for partnership, the data also provide information on potential opportunities for leveraging support from organizations. As is often the case, isolated organizations seeking to connect with new markets or develop partnerships of their own may benefit from participation in a tractor safety alliance. Using the social network data from this study, it is possible to identify isolated organizations that may have one or two important qualities other organizations lack and who may be seeking more connectivity to the network. As well as identifying organizations that are most likely to be productive partners, considerable emphasis will be placed on developing a diverse alliance of both public and private partnerships that represent several facets of the tractor safety issue.

Although the network data collected for this project may provide important insights to building strategic partnerships, the data do have some limitations. For example, the response rate was moderate, which means that on occasion reports of relationships (or absence thereof) were based on only one organization in a pair of potential stakeholders. Also, many organizations in the network are large, and the respondents representing these organizations may not have been aware of all of their organizations' relevant relationships, activities, and interests.

Authors' Note

The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

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