SOCIAL NETWORKS IN COMMUNITY CHANGE EFFORTS

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ABSTRACT

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In recent years, community change efforts have taken on new approaches to collaborating to address complex problems. Several of these approaches, systemic action research, network action research, and collective impact, use similar strategies to promote collaboration. They are discussed here as networked community change efforts (NCC). While these approaches have been implemented widely, there has been limited empirical work examining the extent to which they yield efficient networks for information sharing among stakeholders. In this analysis, I employ agent-based modeling (ABM) to examine these approaches under ideal and practical conditions. I first created an ABM to demonstrate the extent to which NCCs are efficient under ideal conditions. This model indicated that NCCs could successfully create networks to efficiently share information. Next, I conducted a qualitative content analysis of published accounts of NCCs focusing to evaluate the challenges that occur during implementation. Four key themes emerged from this analysis, suggesting that challenges in NCCs include: unsuccessful organizers, non-homophilous stakeholders, stakeholder turnover, and stakeholder power dynamics. Finally, I created a refined model, integrating the challenges from the qualitative analysis to understand efficiency under practical conditions. This model indicates that each of these problems poses a threat to creating efficient networks. In the future, stakeholders working in NCCs should consider the role these challenges might play and plan to adapt their efforts accordingly.

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INTRODUCTION

Addressing complex community problems has become a key area of focus in recent years (Kania & Kramer, 2013). Complex problems, sometimes referred to as wicked problems, are those issues that are context-specific, include many interacting forces whose relationships are difficult to discern, and do not have a single umbrella solution (Rittel & Webber, 1973). In community settings, issues like increasing educational attainment and increasing public safety have been conceptualized as complex problems (Edmondson & Zimpher, 2014; Kania & Kramer, 2013). These issues are often difficult to address through the implementation of individual programs organized by a single non-profit or community agency, and rather must be addressed through the engagement of many community stakeholders working together (Kania & Kramer, 2013).

LITERATURE REVIEW

In order to tackle these kinds of problems, communities have had to adopt new approaches to creating change. Building on existing approaches to understanding and addressing problems, like action research, several new approaches have emerged that shift the way that communities solve problems (Burns, 2007; Foth, 2006; Kania & Kramer, 2011) (See appendix A for a brief overview of each approach). While each is different, they share a common focus on the importance of developing processes for shared learning and supporting aligned efforts among stakeholders. What it means to engage in learning or aligning efforts looks very different across approaches and from one community to the next, making the idea of community change difficult to concretely define. These approaches have gained much support in the practice community, but there is still little empirical evidence supporting their effectiveness in creating community change or in shifting the structure of relationships among stakeholders to make the process of sharing information more efficient. Thus, the present analysis will address the extent to which approaches to community change are able to efficiently connect stakeholders to create a climate where change can occur.

Lewin (1946) developed the action research cycle, suggesting that a useful process for understanding an issue should include three steps: (1) learning, (2) planning, (3) acting. A facilitator frequently guides the cycle, managing the process and tracking learning over time. (Lewin, 1946; Lewin, 1947). Action research is different from other approaches to learning in the social sciences because it occurs outside of a laboratory setting and is conducted by individuals who are not typically considered scientists (Lewin, 1946). The implementation of Lewin's learning cycle usually starts with a fact-finding process to establish the current situation around a problem (learning). Next, the group of action researchers plans and implements an effort to address the problem (planning and acting). They will close out the cycle by collecting facts again and refining their efforts in order to improve upon the original attempt to solve the problem (Lewin, 1946).

Lewin's action research cycle has been implemented across many different settings, with numerous names. In organizational settings, it has often emerged in the form of action learning (Graham, 1995; Morgan, 1984, Revans, 2011), an approach more focused on learning to improve an organization, rather than research to report back to an academic context. In the context of community change work, action research and action learning have emerged in several popular approaches, including: networked action research (Foth, 2006), systemic action research (Burns, 2007), the ABLe Change Framework (Foster-Fishman & Watson, 2011a), Collective Impact (Kania & Kramer, 2011), and Strategic Doing (Morrison, 2010).

Foth (2006) suggested that the action research cycle could be implemented with networks of stakeholders, building on pre-existing groupings and developing relationships with a centralized facilitator. Doing so allows participants to examine unique parts of a problem with their densely connected immediate contacts while using their centralized facilitator as a bridge to other groups. Altogether, this structure can lead to large scale change that no individual group of stakeholders could enact on their own. Recently, many other approaches to community change have emerged, suggesting similar structures for engaging stakeholders in an action learning process, to share what they have learned and plan their work strategies collaboratively. Similar to Foth's networked action research, the systemic action research approach to change popularized by Burns (2007) suggests that a central facilitator should work independently with groups of stakeholders all engaging in unique streams of inquiry around a common problem. The facilitator supports the groups in finding common points of intersection in their inquiry streams on which they can all work together to take action.

Burns (2007) offers a case study of a systemic action research process implemented to improve an early childhood support program in Bristol, UK. The effort included four lines of inquiry, each independently examining areas of early childhood issues in the community based on stakeholder interests. Their groups had mixed success (defined as some groups moving to action around their issue of interest rather than strictly engaging in stakeholder conversations about the issue). Burns suggests that collective learning and action efforts were inhibited by an inability to keep one person as a facilitator throughout the process (an issue stemming from several incidental issues involving budgetary cycles and facilitator illness).

The Collective Impact approach also engages stakeholders in community change efforts according to five conditions: a common agenda, shared measurement system, a commitment to mutually reinforcing activities, continuous communication, and backbone support. These conditions create a space where action learning processes take place in small groups (Kania & Kramer, 2011). A backbone organization or set of stakeholders acts as the centralized entity, often bridging relationships among many workgroups, where participants share information and discuss action planning. This approach also employs a common agenda among groups and is intentional about using shared measurement systems to examine the outcomes of learning efforts among all participating stakeholders. In addition, collective impact often builds on pre-existing networks of relationships among stakeholders to begin organizing workgroups.

The collective impact approach has also been implemented in a variety of contexts, with focuses around issues of poverty reduction, health and nutrition, economic development, educational achievement, substance abuse reduction, and employment (FSG, 2013a-g). These efforts have taken on a number of different structures, generally involving smaller groups of stakeholders working with the backbone organization to connect each stakeholder to others in the network. One effort operated with multiple communities each doing independent, but linked work towards a regional change effort, sharing a backbone organization and a central steering committee, using developmental evaluation as a process for shared learning and change within the initiative (FSG, 2013d; Edmondson & Zimpher, 2014). Another had a set of goal teams and task forces working on specific sub-issues that were connected with a larger board of cross-sector representatives that guides the backbone effort (FSG, 2013e). Initial assessments of collective impact efforts have demonstrated initial success in achieving goals around issues like decreasing obesity, increasing access to jobs, an increasing attainment of postsecondary education (FSG, 2013a; FSG, 2013d; Edmondson & Zimpher, 2014).

There are also a number of other community change approaches that employ similar strategies for change. Examples include Strategic Doing, the ABLe Change Framework and the Community Quarterback approach. Strategic Doing similarly focuses on the need for learning to take place over the course of a change effort and suggests that this process is necessary to engage with network structures in community change. Specifically, networks with small clusters of stakeholders, connected through a common individual or group are leveraged as part of a change effort. Strategic Doing focuses stakeholder conversations around a set of common questions to help them think through cycles of learning, planning, and doing. Another approach, the ABLe Change Framework extends Burns (2007)'s systemic action research and uses a coordinated action learning process, where stakeholders work in small affinity groups on a common issue, communicating with a common facilitator who bridges the groups. Erickson, Galloway, and Cytron (2012) also suggest that communities choose one stakeholder to act as the "quarterback" in their change effort, taking on a similar role to the backbone in collective impact (Kania &

Kramer, 2011) or the action research facilitator in networked action research (Foth, 2006). This approach is not as explicitly iterative and learning focused as other networked change efforts, but the use of a quarterback can change the way that information flows through the network of stakeholders to determine action. Many coalitions and collaboratives use network-shifting approaches in their work as well.

Each of these approaches to change has a unique set of characteristics governing the process through which they engage stakeholders in learning and action, but they share many commonalities and begin to develop a common process for community change efforts, which will be referred to as networked community change. This process can be understood as having several components: the context, or pre-existing ecology of the community, the dynamic structure of relationships among participating stakeholders, and the use of this network structure for the purposes of sharing information to create change (see appendix A for a comparison of each of these approaches).

While many networked community change efforts discuss the structure of relationships among stakeholders, they do so from a very abstract perspective, without examining the networks of relationships that form and shift over the course of community change work. Further, the nature of the complex issues that networked community change efforts seek to address necessitate long-term assessment in order to fully understand the impact of the processes being implemented. Focusing measurement on changes in the relationships among stakeholders can provide a critical perspective on the degree to which the context in which the problem of interest exists has shifted.

The Process, Step by Step

Networked community change starts with a set of stakeholders in a community, some of whom have preexisting ties with each other (Bess, Speer, Perkins, 2012). Given that community change efforts are often implemented in communities where stakeholders have been established for some time, participants will have ties to other organizations that they share information with.

Development of a common issue. In order for networked community change work to start, participants must agree upon a common issue around which efforts will be organized. Doing so sets boundaries around which stakeholders will be included and informs the process moving forward. In ABLe Change and collective impact, this occurs through the development of a shared agenda (Foster-Fishman & Watson, 2011a; Kania & Kramer, 2011). Failing to come to a consensus about the issue of interest can create inefficiencies in collaboration (Nowell, 2009) and inconsistent efforts for change across stakeholders (Burns, 2007).

Stakeholder tie formation. Stakeholders within the community will generally have a propensity to share information with similar others and networked community change literature suggests that this is a useful process. They create ties with others who are similar to them structurally (i.e. occupy the same role in their organization; Foster-Fishman & Watson, 2011a) and who are similar in terms of interests (i.e. they want to address the same aspect of the issue of interest; Kania & Kramer, 2011). By creating ties based on similarity, participants can develop smaller, close-knit groups with others who have common experiences around the issue of interest. Existing literature on social networks in community change efforts like coalitions and collaboratives indicates that many efforts tend to self-organize around the sectors that stakeholders work within (Norman & Huerta, 2006) and network structures are often defined by the kind of work that members within them are doing (i.e., there are differences in the networks formed by direct service providers and network administrators) (Foster-Fishman, Salem, Allen, & Fahrbach, 2001). Additionally, Foth's (2006) study of networked action research builds a network exclusively on pre-existing groups of stakeholders with networks based on similarities.

This is consistent with the concept of homophily, which suggests that similar individuals are more likely to develop network ties than individuals who are dissimilar (McPherson, McLovin, & Cook, 2001).

Choosing an organizing stakeholder. During the process of developing a common agenda or common problem definition and starting a change effort, a single stakeholder or subset of stakeholders takes on the role of organizing the effort. Many names have been used to refer to this stakeholder including the backbone organization and the community quarterback (Erikson, Galloway, & Cytron, 2012; Kania & Kramer, 2011), but here they will be referred to as the organizing stakeholder. The process through which this stakeholder emerges in the process is not well defined in the literature on networked community change. In one study of the development of a networked change effort to address poverty, researchers explored process through which one organization determined whether their readiness to act as a network organizer and found that while the group was highly centralized in the network, they did not have the capacity to take on the responsibilities of acting as a leader in the change network (Evans, Rosen, Kesten, & Moore, 2013). Their findings suggest that in order for a stakeholder to become the organizer, they need to be connected to many of the stakeholders in the network and have the necessary capacity to manage the change process effectively. Turner, Merchant, Kania, & Martin (2012) indicate that the role of organizing stakeholders often changes over the course of an effort, starting with building the effort and determining its goals, then moving into a supportive role in managing data and organizing stakeholders around common issues and establishing measures to assess success.

These stakeholders also intentionally begin the development of a network for change, encouraging stakeholders to create ties and bringing them together for network activities, like meetings for information sharing. This can be seen in Foth's (2006) study of networked action research among self-organizing interest groups in an apartment complex, where entire groups were brought together by an organizing stakeholder as part of a larger network for change. Other parts of the network can be explicitly created by the organizing stakeholder and defined as a work group or action learning group (within which participants may have some pre-existing connections) (Foster-Fishman & Watson, 2011a; Kania & Kramer, 2011).

Whether or not the organizing stakeholder is a member of the community can have a substantial effect on network functioning. Provan and Kenis (2007) suggest that the role the governing stakeholder plays in a network as an outsider or a participant who leads can have several implications for network functioning, including the degree to which networks are inclusive of all stakeholders, the level of network efficiency, the network's perceived legitimacy, and the degree to which it is flexible or stable. Using outside leaders (who do not also act as participants) to govern the network can lead to a greater balance between including all stakeholders in the work and maintaining efficiency as well as increased balance of between internal and external legitimacy. Further, outside organizations tend to build greater stability in the network, compared to other forms of governance; however they do this at the expense of creating a flexible network. The value of an outside stakeholder in the process of implementing networked community change efforts has been largely unexamined, but stands at odds with the desire for a stakeholder to be connected to many stakeholders in the community (Evans, Rosen, Kesten, & Moore, 2013).

Organizer behavior & facilitation. The network of stakeholders doing networked community change builds and transforms through the relationship-building behaviors of the stakeholders. The organizing stakeholder(s) create relationships with all other stakeholders regardless of their similarity to them, as long as they do work related to the problem of interest. This stakeholder acts as the backbone or community quarterback supporting a centralized action learning process (Erickson, Galloway, & Cytron, 2012; Foster-Fishman & Watson, 2011a; Foth, 2006; Kania & Kramer, 2011). The organizing stakeholder also brings new stakeholders into the change effort who are not connected to other participants or are not well integrated into the network (FSG, 2013f). The organizing stakeholder(s) can be either individuals who are also participants in other parts of the effort (ex. one member of each sub-group) or can uniquely occupy their role as a centralized backbone for change.

Learning among stakeholders. Stakeholders use the network iteratively to share learning and action strategies with their contacts, allowing for the effort to be adaptive to changing community dynamics (Burns, 2007; Foster-Fishman & Watson, 2011b; Foth, 2006; Lewin, 1946; Lewin, 1947; Morrison, 2010). The learning process can be formalized, through shared measurement efforts, where all participants collect similar data from their constituents, which can be interpreted and translated into new action plans (Hanleybrown, Kania, & Kramer, 2012). The organizing stakeholder bridges ties between smaller clusters of stakeholders, moving information efficiently from one part of the network to another (Foth, 2006). (see Appendix B for a visual representation of this process)

Within the process of using the network, stakeholders should adjust their ties according to the efficacy of their relationships. If their ties are not useful for the issue they seek to resolve, stakeholders should seek different relationships elsewhere, unless constraints on the network dictate that they must remain connected to a particular set of individuals. Thus, stakeholders can be expected to build new ties over the course of an effort and also to lose some ties as they become irrelevant. It is important to note that this part of the process is built on the premise that organizations are working around a common agenda to address the problem of interest and that they are intentionally engaging in efforts where their work will be mutually reinforcing (Foster-Fishman & Watson, 2011a; Kania & Kramer, 2011; Milward & Provan, 2000). Not having a common understanding of the problem that needs to be addressed or the agenda for doing so makes the information sharing process less useful for stakeholders who are coming from different perspectives on what the problem is and how it should be addressed. Overall, this process ideally gives rise to several small, but densely connected groups that are linked to each other with a few ties, with the organizing stakeholder having connections to each of the groups. The small groups go by many names, including work groups, goal groups, and action learning groups (FSG, 2013g; FSG, 2013a; Foster-Fishman & Watson, 2011a). This structure reduces the burden of having to maintain ties with many other stakeholders engaged in the effort in order to participate in information sharing. Each stakeholder can have a few close ties with similar organizations and the organizing stakeholder can facilitate the efficient movement of information throughout the network.

Networks and Networked Community Change

The study of social networks offers a number of important contributions to understanding networked community change efforts. In particular, the proposed structure of a centralized organizer working with a number of workgroups resembles a small-world network. This network structure can maximize the efficiency with which resources flow through the network and can leverage participants' social capital. Developing such networks can improve the functionality of information sharing and increase effort efficiency.

Milgram (1967) found that the distance between individuals in a network is often quite short, even when they are seemingly unrelated or far removed from each other and termed it the small world phenomenon. Since Milgram's study, several others have further examined the nature of small world networks and developed theories to build upon the processes underlying this phenomenon as well as its value. Granovetter (1973) posited that weak ties had the potential to bridge clusters of strong, dense ties. Weak ties are characteristically sparse and span groups of network nodes, providing stakeholders far-reaching access to information and resources throughout the network, eliciting the small world effect in Milgram (1967). Referring to ties as 'weak,' however, does not indicate the strength of a relationship or its value among nodes, only that they are unique from those ties that exist in dense clusters of nodes. Putnam (1995) extends Granovetter's work, indicating that small world structures are ideally suited to leveraging the social capital of network stakeholders. He suggests that there are two types of social capital: bonding and bridging. Bonding represents the capital contained within densely connected, closed networks where participants can build trust. Bridging represents the capital from sparse relationships between densely connected stakeholder groups. Small world networks combine the close, dense relationships necessary for bonding social capital with the boundary-spanning relationships necessary for bridging capital. Burt (2001) introduced the concept of structural holes and boundary spanning into the social capital literature, suggesting that a the nature of structure allows nodes to take advantage of short path length throughout the network, in addition to smaller, locally dense groups of nodes. Thus, small world networks can generally be characterized as those networks in which nodes are locally dense, meaning that many of a node's ties are also tied to each other and nodes are sparsely connected to others outside of their clusters (for the purposes of this study, I will focus specifically on the definition of small worlds outlined in Watts & Strogatz (998) and Uzzi and Spiro (2005)'s process for measuring them). Sparse ties to other clusters mean that the pathway from one node to any other in the network is very short.

While there is limited research available regarding network structures in networked community change efforts, research on coalitions and collaboratives provides some important ideas about how to maximize network efficiency. This research supports the idea that structures must match the purpose of the network being developed; however, the literature remains somewhat divided about the appropriate network structures for network success. Paarlberg & Varda (2009) posit the importance of intentionality in structuring networks in community service exchanges, arguing that communities do not have a set carrying capacity in terms of their ability for organizations to engage in exchanges, but rather that the structure of relationships among them and the governance of that structure can act as limiting factors when they are not appropriately addressed. The authors also suggest that the length of the network path through which resources being exchanged must travel should be a key focus in creating a higher carrying capacity for the movement of the resources that communities have. In a study of the relationship between interorganizational network structure and collaborative outcomes in 99 public health collaboratives in the United States, Retrum, Chapman, and Varda (2013) found that density of stakeholder relationships had a stronger impact on collaborative outcomes like trust among stakeholders and resources shared than other network metrics, like centrality and breadth. Their study suggests that denser networks around community issues will be more likely to achieve trust and participants will invest more resources into the work being done. Others modify these results, suggesting that it is important to maintain relationships outside of densely connected stakeholders in the interest of having access to outside resources and ideas (Valente, Chou, & Pentz, 2007).

The literature also suggests that lead organizations in coalitions and other collaborative change efforts play a key role, supporting the networked community change literature's focus on having a stakeholder that organizes the process (Provan, Veazie, Staten, & Teufel-Shone, 2005). Without strong leadership, the process of managing many ties within a network may become overwhelming for participants and they may experience diminishing returns from their participation. Further, the fragmented nature of many change efforts indicates a lack of boundary-spanning stakeholders who can bridge the network, connecting stakeholders who would otherwise not have access to each other (Foster-Fishman, Salem, Allen, & Fahrbach, 2001; Morrissey, Tausig & Lindsey, 1985). Implementing effective leadership structures can take advantage of stakeholders' tendency to have smaller fragmented groups by bridging them and making it easier for information to move between groups.

Small world networks fit well with the study of networked community change efforts due to their similarities in structure. The small, densely connected groups of nodes with sparse ties to each other in small worlds resemble the groups engaging in action learning or action research in networked community change and can help to achieve a similar level of close connection that would come from increasing density without a resultant burden on community members to maintain a large number of ties (Retrum, Chapman, & Varda, 2013). Further, the organizing stakeholders act as an intermediary, shortening the distance between stakeholders in the network, minimizing the number of necessary ties outside of their cluster due to their high degree centrality and strategic connections with each cluster. This supports communities in achieving the short path length for more efficient collaboration suggested by Paarlberg and Varda (2009). Additionally, it allows the change effort to take advantage of both bonding and bridging social capital, using the trust that can develop within small groups and the diversity of ideas and resources that come from having networks that reach farther (Burt, 2005). While the theoretical description of networked community change efforts appears similar to small world networks, little empirical work has examined the extent to which these networks appear in practice or the extent to which they facilitate the process of information sharing.

Advantages and Challenges of Networked Community Change Techniques

Implementing a networked community change effort has the potential to coordinate stakeholders around more effective change efforts by implementing a new structure for building relationships. This structure has the power to increase the efficiency of moving information through the network and to make it possible for stakeholders to focus specifically on the area of the effort that is most relevant to their experience. There are, however, some disadvantages and challenges that can emerge from this approach to structuring stakeholder relationships. Specifically, cracks can form in the network, leaving out some stakeholders or creating a network that does not effectively support stakeholder needs. Further, the process places a great deal of power in the hands of the organizing stakeholder as the manager of the action learning process occurring in the workgroups, which can operate as both a challenge and an advantage in the network.

Sometimes ties within the network can be prohibited or broken, systematically excluding relevant stakeholders from participating in network efforts. These 'cracks' in the network have been split into several categories. Type one cracks occur when a set of structurally equivalent stakeholders does not exist to build needed ties with another group of network stakeholders. Type two cracks occur when some relevant stakeholders do not interact with the rest of the network or when they are very distantly connected to the network. Finally, type three cracks occur when a relationship exists, but the content of the relationship does not adequately serve the needs of the stakeholders (Tausig, 1987; Gillespie & Murty, 1994). These cracks can occur for a number of reasons. For example, in one community, social norms dictated that some participants could not contribute to many parts of a change effort and that the only real avenue for participation was through speaking to a distantly connected researcher (Dworski-Riggs & Langhout, 2010). Stakeholders have also been excluded when relationships with organizing stakeholders do not lead to an expected exchange of information (Evans, Rosen, Kesten, & Moore, 2014). In other cases, ties have been directed in a way that allows participants to receive resources from the network, but not to contribute them, as was the case in a youth evaluation process where the voices of youth were not valued through network contributions (Checkoway, 1998). Network cracks create inefficiency, inhibiting the process of community change and could very easily emerge in small world networks, where the loss of a sparse tie could easily lead to a network crack.

While the potential for cracks to occur in the network represents a disadvantage to using this process, it does attend to some of the issues that have arisen in previous community change efforts using other kinds of structures. Change efforts that have brought all stakeholders to a common table, where each organization has a single vote in making change, can parallel the dynamics of inequality that exist in the larger community. This means that those organizations that are most well-represented at the table have the most control over the direction the work takes (Chavis, 2000). In networked community change efforts, groups with similar interests can focus on the area of an issue that is specific to their interests and the organizer is responsible for ensuring that the voices of each group are heard by the others (HanleyBrown, Kania, & Kramer, 2012).

Using a centralized structure, however, also presents unique challenges. Operating in this way puts a lot of power in the hands of the organizing stakeholder, which means that they must have significant capacity for managing the information that comes in and navigating the process of sending it back out (Evans, Rosen, Kesten, & Moore, 2014). They also must carefully assess historical dynamics of inclusion and exclusion present in the community to ensure that no group's perspective is lost due to biases either held by the organizing stakeholder or by the stakeholders who receive information from them. Further, some efforts have additional outside stakeholders who must be consulted before the network can take an action (FSG, 2013c). Adding additional barriers to the movement of information or the implementation of an action plan can inhibit the added efficiency that would otherwise come with a network structure with an organizer coordinating stakeholders.

The process of shifting stakeholder relationships to create a more centralized structure comes with both advantages and challenges in network functioning. Awareness of network structure and the flow of information and resources among stakeholders over the course of a change effort can provide valuable information to take action to minimize the potential challenges that can arise related to excluding or disadvantaging some network participants. Further, ensuring that the organizing stakeholder has the appropriate capacity to manage their role in the network over time can support successful change efforts. Future studies should examine the extent to which these disadvantages might influence outcomes of a change effort.

Research Questions

In order to further explore the network structures that emerge from networked community change efforts, this study aims to answer three research questions. First, when networked community change efforts operate according to proposed theoretical models, do they yield small-world network structures? This question will be explored by building and examining an agent-based model of tie-building behaviors among stakeholders in a change effort. Second, how do idealized networked community change efforts differ from those in practice? This question will be explored through conducting a qualitative review of articles about networked community change in practice and the challenges associated with it. Finally, given the way networked community change operates in practice, what are the characteristics of the network that it yields? This question will be explored by refining the initial model based on findings from a literature review of the networked community change in practice.

METHOD

The present study employs agent-based models (ABMs) to simulate the interactions among stakeholders participating in networked community change efforts. ABMs provide an effective approach to simplifying complex systems in order to examine their underlying patterns (Epstein, 1999). They are particularly useful when the system of interest would otherwise be difficult to study in the environment in which it occurs naturally, making it an appropriate approach for studying networked community change. Modeling allows for the exploration of many possible scenarios, demonstrating the ways in which a group of people might act given a variety of constraints on their behavior. Such constraints would be difficult to manipulate experimentally in a community setting (Neal & Lawlor, 2015). In the case of networked community change efforts, modeling will illuminate the efficiency of different network structures that emerge when stakeholders follow simple rules for relationship building. In particular, ABMs avoid the challenges associated with getting the large sample size necessary for a study of social networks. Using a simulation, the observer can see all ties within a network and get an accurate measure of network-level variables given the constraints on the model.

ABMs are constructed around a set of underlying assumptions, which will guide the process of model development: (1) agents are autonomous, (2) agents are interdependent, (3) agents follow simple rules, and (4) agents are adaptive and backward looking (Macy & Willer, 2002). To meet the first assumption, agents in a model must act autonomously, without top-down system organization dictating their behavior. Second, agents have the ability to influence others and to be influenced by others. Third, ABMs must employ the simplest set of rules possible that will still create a desired macro pattern of behavior. Finally, agents must be able to adapt both at the individual and population level. Some examples of adaptation include, learning, imitation, and evolutionary selection. In the current model, this means that participants will build relationships of their own volition, they will make choices based on information available to them about potential members of the network and will be influenced by their behavior. Additionally, they will act according to simple rules set out in the current frameworks for community change and will adapt to the conditions for network-building available to them as the model iterates.

ABMs are typically developed through several iterations of the modeling cycle. This cycle (as defined in Railsback & Grimm, 2012) begins with the formulation of questions and hypotheses, which will determine the purpose of the modeling project. Next, modelers must make decisions about the structure of the model, identifying relevant characteristics, variables, and entities for the model. This includes making decisions about the kinds of agents to be included in the model and how they will be represented, the parameters that will guide behavior of the agents, and the appropriate time scale for each run of the model. After making the necessary decisions about model structure, modelers move on to the implementation phase in the cycle. Implementation transitions the model from a planned structure into an animated object. Modelers develop computer programs that follow the process defined by the model structure to demonstrate the behavior of interest. The final step in the cycle is analyzing the model. Analyzing the model allows for learning from the behaviors demonstrated by agents when it is run. There are a number of ways to analyze the data generated through ABMs and modelers will need to choose those that are most appropriate for their research questions and hypotheses. The analysis step is also a time when models can be revised and refined, bringing modelers back to the beginning of the cycle, so a more accurate version of the model can be produced.

In the present study, I developed an initial agent-based model to examine the structure of the social network that emerges in networked community change efforts when they are conducted under ideal conditions. Specifically, this model was tested to determine the extent to which a small world network emerged among stakeholders. Next, I conducted a content analysis on articles written about the experience of implementing networked community change efforts to understand the challenges that practitioners encounter when using this approach. I used those challenges to refine the initial model. The refined model demonstrates the extent to which it is possible for a change effort to yield a small world network when challenges are present.

This approach is analogous to the Institute of Medicine's efficacy to effectiveness design within the prevention intervention research cycle. The efficacy to effectiveness design proposes that interventions should first be examined using efficacy trials, where they are implemented under highly controlled, optimum conditions. Next, successful interventions should move to effectiveness trials, where they are examined in real-world settings (Mrazek & Haggerty, 1994). The process of building and testing the initial model resembles the efficacy stage of the IOM model by providing an ideal setting in which to examine the potential for the approach, while the refined model represents the effectiveness stage by introducing real-world challenges into the model.

Researchers often criticize this model because interventions are often unsuccessful when they move from the efficacy to effectiveness trial stage. They argue that the controlled environment of efficacy studies does not take into account the contextual factors that influence intervention success in the real world and that interventions are often unable to move to large-scale implementation (Glasgow, Lichtenstein, & Marcus, 2003). Using an ABM to model the efficacy and effectiveness stages allows for a simple process through which any number of real-world contextual manipulations can be introduced into an ideal model representing an efficacy test. Further, networked community change as an intervention to organize stakeholders in change efforts is already being implemented on a large scale, so simulated efficacy and effectiveness trials can provide additional insight into the difficult to measure outcomes around how these approaches are function. Further, changes can be made to these approaches after examining them in an effectiveness study.

STUDY 1 METHODS

Initial Model

The purpose of the initial model is to determine the extent to which small world networks emerge when stakeholders participate in networked community change efforts as they are described in the literature. The model, developed in the Netlogo programming environment (Wilensky, 1997), consists of a set of agents that interact with each other according to parameters that can influence networks in a community change effort. It is set up in an initialization stage and then runs according to the simple rules set out for agents to follow as they build a social network. (See appendix D for an annotated description of the initial model code).

Agents & model setup. The model contains one type of agent, stakeholders. Stakeholders are the people, organizations, and entities that the process is bringing together to create change. Their objective in the model is to build relationships with similar others. The number of stakeholders remains constant at 100 throughout the simulation. When the model is initialized, it randomly places the population of stakeholders in a simulated environment and randomly assigns each one a value from one to ten representing their interest in the community issue to be addressed. This value can represent any defining characteristic on which they might choose to organize for a networked change effort, including their role in the network surrounding the problem or a particular topical interest related to it. For example, interest values could represent stakeholder interests in a particular aspect of a problem around which they want to work with similar others (e.g., transportation). Alternatively, this value could represent the role that individuals play in the system surrounding the general problem of interest (e.g., parents wanting to connect with other parents around issues relevant to their children). It is outside the scope of this analysis to consider the identities or interests most salient for stakeholders in change effort;

however, the stakeholders use their interest scores to determine who is similar to them when deciding whether or not to form a tie. These values are continuous, so stakeholders do not need an exact match to build a tie, but ideally, stakeholders seek to build ties with others who have numbers as close to their own as possible. Using a numbering system to represent the dimension on which stakeholders build relationships is certainly a simplification upon the complex criteria that individuals consider when building relationships for change efforts; however doing so allows researchers to examine the minimum behavioral requirements to recreate the kind of phenomena that emerges in community settings (Epstein, 1990).

Parameters. The model has two parameters: how strongly stakeholders prefer to connect with similar others based on their interest scores (i.e., homophily) and the organizer's activity level. Homophily represents the relative weight placed on stakeholders' desire to build ties with similar others. Homophily is a beta value in a logistic function (see below) that determines the likelihood of two stakeholders forming a tie. In this function, the difference in stakeholder interest scores determines how similar any two stakeholders are. The organizer's activity level represents the probability that an organizer tie will form. Because the probability of forming an organizer tie is not based on the similarity of the stakeholders being considered for the tie, organizer ties can bridge the network, bringing together diverse groups of stakeholders.

Implementation. During model implementation, two kinds of links are formed: those initiated by stakeholders and those initiated by an organizer. In each model iteration, each stakeholder takes a turn randomly choosing another stakeholder to potentially build a stakeholder-initiated tie with. If the two stakeholders already have a tie, then the stakeholder re-evaluates whether they want to maintain a tie with them. Next, they calculate the probability of building a tie based on their similarity and the value of homophily using the following logistic function:

$$Prob\ (R_{ij(t+1)}) = \frac{\exp\ (\beta_0 + \ \beta_1 Sim_{ij})}{1 + \exp\ (\beta_0 + \ \beta_1 Sim_{ij})}$$

where

$$\beta_{0\,=}\ (ln(1 - \ \beta_1))$$

And

$$Sim_{ij}\ = 10 - |Interest_i - Interest_j|$$

β_0 is the intercept of the equation
β_1 is the weight of similarity, modified by Sim_{ij} which represents the similarity between the two agents
Sim_{iu} determines the similarity of two stakeholders by taking the absolute value of their interest values (the numeric distance between the two stakeholders), then subtracting that number from 10

βSim_{ij} Represents the role of homophily, determined by the degree to which two stakeholders differ in their interest scores and the weight of homophily in determining the probability of a tie. The simulation then chooses a random number between zero and one. If the number is less than the probability that the stakeholders will build a tie, then they will connect. If it is greater than the probability, then they will not connect or, if they had a pre-existing tie, they will lose it.

After each stakeholder takes a turn evaluating a potential tie with another stakeholder, an additional organizer-initiated tie can form. The organizer, unseen in the simulation, randomly chooses two stakeholders and evaluates whether to build a tie between them based on the value of the set organizer activity level. The simulation chooses a random number between zero and one, compares it against the organizer activity value, and builds a tie between the two chosen stakeholders if the random number is less than the organizer activity level.

Outcome variable. The outcome variable for the model is the level of network efficiency, operationalized by the extent to which the model represents a small world. I measure this with the small world quotient, Q. The model captures this variable at three time points, 52, 104, and 156 iterations (congruent with measuring Q at the end of each year for the first three years of a community change effort). The model computes the average path length and clustering coefficient for the stakeholder network, then generates a random graph of the same size and degree to use as a comparison. It then calculates Q using the following equation:

$$Q = \frac{CC_{actual}/CC_{graph}}{APL_{actual}/APL_{graph}}$$

Study 1 Results

The purpose of the first study was to evaluate the extent to which networked community change efforts exhibit the qualities of a small world under ideal conditions. To test the small worldliness of the idealized model, I ran it under a range of ideal conditions. Specifically, I examined a range of values for the weight of homophily from 50 to 100 in increments of 10 and the organizer activity level ranging from .5 to 1 in increments of .1. These values represent the ideal networked community change effort by demonstrating stakeholders acting on the desire to form small groups with similar others as well as an effective organizer, building ties across those groups to facilitate the movement of communication for the effort. I ran the model 50 times for each set of parameters, recording the small world quotient elicited after the first, second, and third years. Runs resulting in a disconnected network were excluded from the analysis, as the small world quotient cannot be computed when disconnected nodes are present.

I first examined the extent to which the model represented a small world at the end of each year of network building. The Q values at the end of year one ranged from 2.21 to 8.38 (M = 4.32, SD = .88), with 100.00% of cases yielding a Q value above the 1.00 cutoff value to be considered a small world. The Q values at the end of year two ranged from 2.72 to 6.74 (M =

4.49, *SD* = .85), with 100.00% of cases above the 1.00 cutoff. At the end of year three, *Q* values ranged from 2.77 to 7.00 (*M* = 4.50, *SD* = .87), with 100.00% of cases equal to or above the 1.00 cutoff. See Appendix J for histograms depicting the distribution of *Q* values across runs. The findings indicate that networks are generally able to achieve small world status within the ideal range of 50 to 100 for homophily and .5 to 1 for the probability of forming organizer ties. In addition, higher levels of organizer activity and homophily tend to yield higher Q-values.

A BRIEF QUALITATIVE INTERLUDE

Methods

While the ideal form of the model represents what the literature on networked community change suggests that stakeholder networks might look like, the unique challenges that arise when change efforts are implemented in a community could also influence the network's structure. In order to explore the role that these challenges play in network formation, I developed a refined model. It was created based on an analysis of written accounts about communities engaging in networked community change efforts in order to examine the ways in which information sharing networks emerging in practice differ from those that emerge according to the idealized format set out in the literature. To assess the challenges that occur in networked community change efforts in practice, I employed a directed content analysis approach to assess a sample of articles about these efforts, applying codes derived from the major steps involved in engaging in networked community change (described in detail below). Content analysis was particularly useful for this type of review because it focuses on the messages included in a text and allows researchers to tease apart key themes emerging from a number of written sources (Patton, 2002). A directed approach is appropriate for coding efforts where pre-existing knowledge of the topic exists and the researcher seeks to expand on current knowledge (Hsieh & Shannon, 2005; see Neal, Neal, Kornbluh, Mills, & Lawlor, in press for an example of this approach in a community psychology context). As there is a body of literature dictating the ideal structure for networked community change efforts, a directed content analysis was more appropriate than a conventional content analysis, where codes emerge from the data.

Sample. The sample of articles used to refine the initial model was collected through a Google Scholar search using the inclusion criteria described below and illustrated in Appendix E.

Publications describing systemic action research were included if they (1) cited Burns (2007), (2) included the phrase “systemic action research”, and (3) included the word “challenge” or “difficulty.” Similarly, publications describing network action research were included if they (1) cited Foth (2006), (2) included the phrase “network action research,” and (3) included the word “challenge” or “difficulty.” Finally, publications about collective impact were included if they (1) cited Kania and Kramer (2011), (2) included the phrase “collective impact,” and included the word “challenge” or “difficulty,” and included the title of one of the following foundational collective impact articles: “Roundtable on Collective Impact,” “Channeling Change: Making Collective Impact Work,” “Understanding the Value of Backbone Organizations in Collective Impact,” “Embracing Emergence: How Collective Impact Addresses Complexity,” or “Collective Insights on Collective Impact.” A reference to a second article was added for collective impact because it has been cited extensively in publications, creating a very large pool of sources, but few describe the actual process of implementing collective impact in a community change initiative. Those articles that describe collective impact’s implementation often include references to multiple collective impact articles.

The pools for the three approaches were combined to form a set of 147 articles and then narrowed by removing all articles that did not include any discussion of a networked community change effort (i.e., those that cited a foundational article, but did not describe a change effort) or that did not include information about the implementation and challenges associated with the approach. This yielded a sample of 33 articles (11 articles about collective impact, 7 articles about network action research, and 15 articles about systemic action research).

Codes. The initial set of codes for the articles were based on the components involved in networked community change outlined above and they were applied to instances where the authors describe challenges or difficulties in the implementation process. These include: the selection of an issue that stakeholders agree upon, the emergence of an organizer, the organizer's behavior and facilitation of the effort, the process of learning among stakeholders, and tie formation during the effort and were translated into the following codes: common issue, organizer selection, facilitation, learning, and tie formation. See appendix F for examples of the coding process with excerpts from two of the articles in the sample. Using the coded content, I will assess the key themes that emerge across them and those that are most frequently represented in the literature will be incorporated into the refined model.

Results

The purpose of the qualitative interlude was to examine the challenges that arise in networked community change efforts, which may create deviations from the ideal model described in the literature. The directed content analysis elicited a number of themes, illuminating the complexity of implementing networked community change efforts; however, there were several that came up consistently across the steps of implementation. They include: organizers being unsuccessful, high stakeholder turnover, stakeholders not following homophily, and stakeholder power dynamics. See appendix G for a summary of these themes with representative quotes.

Unsuccessful organizer. In many cases, networked community change efforts encountered challenges with their organizing stakeholder. These challenges frequently revolved around effectively negotiating their role as a facilitator among participating stakeholders. For example:

"Of the five collective impact conditions, the hub has made the least progress with establishing shared measurement systems. The uncertainty about future staff roles makes it seem unlikely that such complex long-term measurement systems will be devised in the near future, leaving the hub to rely on more developmental measures such as participation rates" (Walton, 2014, p. 153).

Without an organizer to coordinate the process, systems for sharing information among stakeholders cannot effectively form and the network among stakeholders will not facilitate the process. In the condition above, the organizer's lack of success manifests itself through the inability to develop a shared measurement system, aligning the information to move among stakeholders; however, facilitation challenges could occur in any type of facilitation among stakeholders.

Non-homophilous stakeholders. Stakeholders often also failed to organize according to homophily in their efforts. In some cases, this was a function of disorganization and role confusion. When stakeholders were unclear about the roles played by other stakeholders, they could not make decisions about who to prioritize as a partner based on similarity or relevance to their own work.

> "Establishing clear roles for each of the partners will be essential for each of the partners to remain in the collaboration. When asked about roles, a school district participant said, 'We spent two years trying to talk about what each partner's role should be...nothing came of it.' He added, 'I never sensed a backbone from Collective Partners to step in and play hard ball with either one of us. Which, they are giving us money, they are giving them a lot of money... it's an interesting experiment." (42)

While homophily is often described as a naturally occurring feature of social networks, networks constructed around homophily can only form when stakeholders are aware of their features as well as those of their potential alters. In networked community change, the efficiency gained by creating networks with smaller groups of stakeholders may be lost if stakeholders are unable to be intentional in choosing appropriate alters to build ties with.

Stakeholder turnover. Stakeholder turnover represents another challenge in networked community change efforts. Stakeholders are often left efforts due to changes in resources and the movement of individuals in and out of change-focused organizations. In one effort, participants described the challenge associated with having many volunteer staff members who have limited engagement and do not participate in the effort over long periods of time:

> "In the case of community radio in Ghana (and elsewhere), the largely voluntary nature of station staffing means that maintaining the same team of actors for an extended period of time can be challenging. In the context of a capacity building initiative, this can sometimes mean that certain individuals are involved in some elements of the work, but may then miss other key steps. This poses challenges to ensuring a broad-based understanding of an approach within stations. This was the case in one of the three stations involved in this study, and it may have influenced the outcomes that station experienced." (Harvey, 2011, p. 2051)

Turnover can be disruptive to the process of building a change effort, as described above, by making it difficult to build capacity among stakeholders, inhibiting the power of the network to make change. In a networked community change effort, this also means that information might not be able to get through the network to all stakeholders as some may be disconnected due to turnover.

Stakeholder power dynamics. A number of sources discussed power dynamics as a challenge to effectively developing relationships among participating stakeholders. Power dynamics were manifested in efforts by the systematic privileging of some stakeholders over others in the relationship formation stage. This dynamic emerged in one effort where stakeholders from one domain found it difficult to cultivate relationships with others who have traditionally had less power in the system:

> "Additionally, while there were a number of Toledo business leaders engaged in the initiative the involvement of education stakeholders remained more of a challenge. 'I only have one educator on the board, so it's difficult to build the necessary trust to make change. There is still a sense from some educators that the business leaders are trying to fix them,' observed Baker." (Grossman, Lombard, & Fisher, 2013, p. 8)

Each of these challenges may impact network efficiency in networked community change efforts. While efforts implementing networked community change efforts report these challenges in their work, the extent to which they have an impact on their stakeholder networks is still unclear. In order to test each of them, I will operationalize and implement them in a refined model in study 2.

STUDY 2 METHODS

In order to examine the effectiveness of networked community change efforts under real-world conditions, I created a refined model that incorporated the kinds of challenges that occur most frequently in practice. These challenges include: unsuccessful organizers, non-homophilous stakeholders, stakeholder turnover, and stakeholder power dynamics. Each challenge was uniquely represented in the refined model and tested independently as described below. The refined model follows the same process of tie formation and measures the same outcome variable, Q, but, as discussed below, has been modified to incorporate key challenges to networked community change efforts. See Appendix H for a breakdown of the critical challenges faced by networked community change efforts and the operationalization of those challenges in the refined model.

Refined model

Unsuccessful organizer. To model the phenomenon of unsuccessful organizers, I kept the initial model constant and changed the range of probabilities for forming organizer ties to 0 to .5. This represents a change from the ideal range of .6 to 1 used in study 1. These values represent the challenges that arise for the organizer as a facilitator. When they are unable to effectively negotiate relationships among stakeholders their likelihood of forming ties will decrease. In order to test this new range of probabilities, I ran the model, sweeping the refined range as well as the range for stakeholders not following homophily. All other variables were held constant.

Non-homophilous stakeholders. Similar to the unsuccessful organizer modification, I simulated a lack of homophily among stakeholders by restricting the range of possible values for the homophily parameter to include 0 to 50. These values, outside of the ideal range tested in study 1, represent a shift in the extent to which stakeholders place importance on homophily when making ties. In the ideal model, stakeholders followed homophily by placing a high value on building ties with individuals who are similar to them; however, with this lower range of values, they do not. In order to test this new range of parameters, I swept the refined range along with the unsuccessful organizer activity range, keeping all other variables constant.

Stakeholder turnover. I introduced stakeholder turnover into the model by randomly selecting and replacing an existing stakeholder with a new stakeholder with no ties. The probability that this will occur in a given iteration is defined by a new parameter ranging from 0 to 100, where a value of 0 indicates that they will definitely not lose their ties and 100 indicates that they will definitely lose them. This process simulates the possibility that stakeholders will leave the network, losing all of their ties and that new stakeholders may enter the network with no ties. To test the role of stakeholder turnover, I ran the model, sweeping stakeholder turnover probabilities from 0 to 100 in increments of 10 under ideal conditions (homophily set to 100 and organizer activity set to .9). This demonstrates the effects of multiple levels of stakeholder turnover over under the best circumstances yielded by the ideal model.

Stakeholder power dynamics. I modeled stakeholder power dynamics by assigning each agent a power value between 0 and 1. When agents meet to form a potential tie, the less powerful stakeholder's power number is multiplied by the probability of a tie forming. Doing so restricts tie formation for less powerful stakeholders. The refined model contains two potential power distributions: exponential and uniform. The exponential distribution assigns power values randomly with only a few stakeholders having a very high level of power and many stakeholders having lower power levels. The uniform distribution randomly assigns each power value to equal numbers of stakeholders. To test the role of stakeholder power dynamics, I ran the model under ideal conditions (high homophily, high organizer activity) with exponential and uniform power distributions.

Study 2 Results

The purpose of this study was to understand what kinds of networks emerge from a networked community change effort operating under real-world conditions, with a particular focus on network efficiency. In order to understand this, I examined the Q values for the networks yielded by my refined model under a number of real-world conditions.

Unsuccessful organizer & non-homophilous stakeholders. The challenges of having an unsuccessful organizer and non-homophilous stakeholders were examined together by sweeping homophily from 0 to 50 and organizer activity from 0 to .5. (See Appendix L for a heatmap demonstrating these variables at the end of year three, with all values of homophily from 0 to 100 and organizer activity from 0 to 1.) Sweeping these two parameters and examining the resultant Q values indicates that under some circumstances it is possible to achieve a small world, while in others it is not. At the end of year one, Q values ranged from .99 to 3.06 (M = 1.63, SD = .49), with 25.19% of observations below the 1.0 cutoff for being a small world. At the end of year two, Q values ranged from 1.00 to 2.91 (M = 1.65, SD = .50) and no observations fell below the 1.0 small world cutoff. At the end of year three Q values ranged from 1.00 to 2.71 (M = 1.67, SD = .51), with no observations less than the 1.0 cutoff. (See appendix K for histograms with the distribution of Q values for each year). The distribution of Q values looked similar to those from the initial model (bimodal in the first year and trimodal by the end of the third year); however, the Q values were generally lower in the refined model. I conducted an independent samples t-test to compare the Q values at the end of year three in the refined and ideal model. It indicated that the mean value for Q was significantly lower in the refined model (M = 1.67, SD

= .51) than in the ideal model (*M* = 4.55, *SD* = .87), *t*(3041) = 115.61, *p* = .000, with the refined networks achieving approximately one third of the efficiency observed in ideal networks. This demonstrates that while many of the networks in the refined condition are able to generate small worlds, they are significantly less efficient than those in the ideal model.

Stakeholder turnover. I studied stakeholder turnover under ideal conditions for homophily (100) and organizer activity (.9). See Appendix M for plot of the average Q values (with a 95% confidence interval) for each level of stakeholder turnover. This process generated many missing values for Q, with 8,721 of 10,000 (1,000 runs for each value of stakeholder turnover from 10 to 100), model runs generating missing data, indicating that networks with turnover are often disconnected. Missingness increases as turnover increases, indicating that higher turnover is a precursor to disconnected networks. In the cases where the network is connected, there is a trend toward the higher Q values seen in ideal networks, indicating that turnover primarily changes the connectedness of the network, rather than the Q values.

Stakeholder power dynamics. I examined power under ideal conditions for homophily (100) and organizer activity (.9), running the model 10,000 times for each type of power distribution: exponential and uniform. Of the 10,000 runs for an exponential distribution, none of the networks were connected, prohibiting the model from calculating a Q value. For the uniform distribution the network was connected for 3.67% of model runs. Those networks that were connected had Q values ranging from 2.56 to 11.84 (*M* = 5.46, *SD* = 1.60), with all connected networks surpassing the 1.0 cutoff to be a small world.

DISCUSSION

Many approaches to networked community change efforts have grown in popularity in recent years (Kania & Kramer, 2011; Foth, 2006; Burns, 2007). While these approaches are being implemented widely in practice, few studies have examined the networks that emerge during networked community change efforts. In order to better understand these networks, I examined the following questions: (1) When networked community change efforts operate according to proposed theoretical models, do they yield small-world network structures? (2) How do idealized networked community change efforts differ from those in practice? (3) Given the way networked community change operates in practice, what are the characteristics of the network that it yields? To address them, I first examined network efficiency under ideal conditions, then examined qualitative accounts of networked community change to understand the challenges that in-practice efforts encounter, and finally, I developed a refined model to test the networks that emerge in practice relative to the ideal. The results demonstrate marked differences in efficiency in the initial and refined models, with important implications for moving forward the science of networked community change efforts.

Under ideal conditions, the networked community change process described in theoretical literature does elicit the efficient stakeholder networks for sharing information in the process of change. This is apparent from the number of models that reached the cutoff point to be a small world. Overall, the initial model suggests that the underlying network building processes in networked community change are an efficient way of bringing stakeholders together for a community change effort. The qualitative analysis of accounts of networked community change efforts in practice demonstrated a several key themes about challenges that arise during the change effort. These themes included issues with non-homophilous stakeholders, an unsuccessful organizing stakeholder, stakeholder turnover, and power dynamics among stakeholders. These challenges suggest that efforts must deviate from the ideal approach described in the literature during implementation. To further understand the challenges described in the qualitative analysis, I operationalized them and created a refined model to test them. The refined model demonstrated that networks do not always achieve small world status and frequently become disconnected. Often, when they do achieve small world status, they are less efficient than they would be under ideal conditions.

Implications & Recommendations

Study one's findings demonstrate the promising nature of networked community change efforts. Under ideal circumstances, this approach could help create very efficient structures for communicating among members of a change effort. These findings suggest that this approach to change could prove to be very useful for increasing efficiency in community change efforts; however, findings from the qualitative analysis and study two provide critical information that communities will need to consider in order to successfully implement networked community change efforts.

The challenges described in the qualitative analysis mirror issues that have been described in other places as a feature of collaborative community change efforts (Chavis, 2001; Dworski-Riggs & Langhout, 2011). Further, the literature on networked community change indicates that networked community change approaches are, in part, a reaction to the kinds of problems that emerged in the qualitative analysis (Foster-Fishman & Watson, 2011; Foth, 2006; Burns, 2011; Kania & Kramer, 2011). For example, Foth (2006) explains, "Instead of one-to-many and many-to-many 'broadcast-style' information exchange media, network action research harnesses informal peer-to-peer channels that provide amore private, intimate and ethnographic way of communicating with community members (210).” Given that participants using these approaches report challenges related to power dynamics and turnover, the ability to use this method to address these problems using peer-to-peer channels is not likely to occur. Further, Kania and Kramer (2013) suggest that “When supported by an effective backbone and shared measurement system, the cascading levels of collaboration creates a high degree of transparency among all organizations and levels involved in the work.” Without the effective support of the backbone organization (organizing stakeholder), change efforts may still encounter challenges in connecting other stakeholders to create an efficient network, where information flows to all members. Further, networks with power dynamics and turnover limiting participation among some stakeholders will not be able to achieve the transparency suggested in Kania and Kramer’s (2013) Collective Impact model.

While every community has a unique context, these problems can manifest themselves similarly across contexts and throw the process off track and they should consider the nature of the problems that are most likely to occur in their particular change effort. Programming these problems into the refined model and simulating them provided some critical insights into the way these problems can manifest themselves in practice and the unique ways in which each of them can shift network efficiency. The findings suggest that each of the challenges elicited in the qualitative analysis are problematic for efforts in different ways. Low homophily and organizer activity demonstrate that, when encountered in tandem, the stakeholder network can fall below the cutoff for a small world network, indicating that the network becomes very inefficient. In addition, networks with low homophily and low organizer activity are significantly less efficient than those with high homophily and high organizer activity.

Change efforts with stakeholders experiencing these problems might have the ability to efficiently share information, but the burden of maintaining such a minimally efficient network could slow an effort's progress or place an unnecessary burden on stakeholders, which could lead to burnout or turnover. One way stakeholders can address or potentially prevent this problem is by carefully selecting an appropriate organizer for the effort and monitoring their success as a connector within the network. The organizer is able to build bridges among diverse groups of stakeholders, which can allow them to have a sparser, more efficient network; however this will not work if the organizer is unable to build ties. Thus, stakeholders should consider the extent to which the organizer has qualities that facilitate their ability to build ties, like trust among stakeholders, knowledge of where and how various stakeholders are doing change-related work, and knowing which stakeholders will be able to effectively work together. Provan and Kenis (2007)'s work on network governance may prove useful as stakeholders consider who would be the most appropriate organizer for their effort). Further, the organizer has power as a facilitator to support participants in thinking through how they think about homophily within the context of the change effort. Stakeholders can then implement strategies for relationship-building that reflect a common understanding of the relevant dimensions of homophily.

Power dynamics also represented a unique type of problem for networked community change efforts. Both exponential and uniform power distributions created networks where some proportion of the stakeholders were disconnected, indicating that some people or organizations are getting left out of change efforts. The proportion of disconnected networks for both of the unequal power distributions was so high that I could not conduct any meaningful analysis comparing their efficiency with the networks generated in from the ideal model. For efforts that are hoping to be more inclusive in their work, power distributions will make this challenging. It is important to note that stakeholders will generally want to set boundaries around the population of stakeholders who are relevant participants in an effort. However, when power dynamics are at play, a subset of stakeholders within the relevant population for the effort will be left out of the network. Given the frequency with which stakeholders are left out of the network, efforts with unequal power distributions will have difficulty consistently maintaining their connectedness and ensuring that all voices are able to reach all parts of the network.

To address the impact of power dynamics, stakeholders participating in a change effort can consider the history of stakeholder engagement in their particular context to understand more clearly whose perspectives have been historically been left out. Further, collaborating with stakeholders who have been marginalized in efforts in the past might elicit new ways that they would prefer to be engaged with the network or particular stakeholders that they would be comfortable working with. Then, the organizer can take intentional steps to ensure the network supports integration of those stakeholders.

Stakeholder turnover also creates challenges for networked community change efforts. When networks experience low turnover levels, they can still maintain a connected network with high efficiency. However, when stakeholder turnover is more common, the network will almost always be disconnected. Similar efforts where inclusivity represents an important value, creating a plan for handling stakeholder turnover can help create circumstances where the network will be connected. This might include having a plan for orienting and integrating new stakeholders into the effort or addressing underlying issues that lead stakeholders to lead the effort. Stakeholders should give special attention to thinking about the process by which new stakeholders become connected to the existing network. If they are not connected to homophilous others, and to the organizer, they might not become well-integrated in to the network and this could decrease the effectiveness of other efforts toward increasing homophily and organizer activity.

While the networked community change approach has been met with much enthusiasm in the practice community, there are plenty of opportunities for challenges to arise that might decrease the efficiency of the stakeholder network. Stakeholders in each effort should carefully consider the extent to which each of the challenges presented here might influence their work and consider interventions to address them. While the analysis presented in study two examines each of these challenges separately, it is certainly possible that change efforts will encounter multiple challenges in their work. As a result, it will be important to plan preventative measures to address these potential issues and to consider interventions that will address challenges in tandem.

Limitations

This study has several key limitations, including the challenges associated with using models to represent complex human behavior, the approach to measuring the network efficiency, the approach to qualitative analysis and the focus on networks, rather than other aspects of change efforts. Models are always a flawed representation of reality; however, they can be tools for meaningful learning. In these studies, the models were simplifications of real-world phenomena and as such they did not include all potential contextual factors that may be at play in a networked community change effort. Individual efforts may have additional unique factors contributing to their success or failure. Additionally, they may deviate from the networked community change literature in their interpretation and implementation of the process. As there are not publicly available manuals for any of these approaches, implementation may vary substantially from one community to another. Collecting network data directly from stakeholders engaging in change efforts would have alleviated this limitation; however, it would also create new challenges associated with collecting complete network data and make it difficult to manipulate the networks' parameters for analysis.

Further, this model represents only one piece of the much larger landscape of activities happening in networked community change efforts. It was outside the scope of this work to explore deeply the processes through which stakeholders generate useful information to share through their networks (for example, through Kania & Kramer (2011)'s shared measurement) or the ways in which stakeholders use information they have learned from participating in the network to take action around the problem of interest. An efficient network will not support change outcomes if the stakeholders are not working towards the network's goals.

In addition, the use of Uzzi and Spiro's (2005) small world quotient as a measure of network efficiency is limited. This measure does not allow for comparison with networks of differing sizes or average degrees (Telesford, Joyce, Hayasaka, Burdette, & Laurenti, 2001). The measure is appropriate in this case because the networks being analyzed are all the same size; however the small world index or ω use standardized values for measuring the extent to which a network is a small world and allow for comparison across networks of different sizes. These two options are significantly more computationally intensive to calculate and it was outside the capacity of this study to examine them in addition to measuring the small world quotient. Using Q as the outcome variable is also limiting because it cannot be calculated in cases where the network is disconnected. This means that if there are any stakeholders without ties in a network, the data for the network is considered missing. It is difficult to measure the extent to which a disconnected network represents a problem in this case because the simulation does not measure how long each stakeholder is connected or disconnected from the network or if there are particular types of stakeholders who are disconnected more frequently than others. For example, there may be a short period of time in which one stakeholder is disconnected from an effort due to a challenge like employee turnover, but they become reconnected relatively quickly. In that case, turnover may not be as substantial a problem as it might be if there are stakeholders who never become connected to the network and remain disconnected for the duration of the change effort. Without data to illuminate these differences, next steps for addressing disconnectedness are somewhat limited.

My approach to qualitative data analysis was also limited in its ability to demonstrate the full extent of the challenges that emerge in networked community change efforts. The published accounts I analyzed consisted primarily of snapshots of networked community change efforts at one time point. These do not necessarily demonstrate the emergence and disappearance of challenges that might happen over the course of a change effort. Further, my analysis did not consider the co-occurring challenges in an effort. Instead, I examined each challenge individually, which may have left out key interaction effects when multiple challenges were present. Different types of data may be more appropriate to gather information about the challenges that emerge in these efforts over time, like interviews or focus groups with participants. Further, many efforts employ developmental evaluation (Patton, 2011) as a tool for understanding success in networked community change efforts, as this evaluation approach looks at data about effort functioning over time. That data can provide a more accurate view of the emergence, disappearance, and co-occurrence of problems over the course of a change effort.

Future Directions

There are a number of future directions in which the study of networked community change efforts can be expanded. In particular, future efforts can examine networks in practice to understand their efficiency and study other aspects of networked community change efforts that influence their success. First, collecting data from stakeholder groups as they engage in change efforts can further demonstrate the network dynamics seen here. Additionally, examining these multiple efforts using networked community change approaches can demonstrate the unique ways that context and stakeholder interpretation of networked community change theories influence an effort's outcomes.

Further, comparing findings with multiple measures to understand network efficiency will provide more insight into the extent to which the network structures emerging in these kinds of efforts are efficient. This could include using other measures for small worlds as described in Telesford, Joyce, Hayasaka, Burdette, & Laurenti (2001) or using alternative approaches to measure efficiency. Using multiple measures of small worlds will allow researchers to compare across networks of differing sizes and degrees. Other approaches to understanding network efficiency might include qualitative interviewing with participants to understand their perceptions of efficiency during networked community change efforts and non-networked community change efforts or using or examining the actual information flow among participants by examining dissemination processes. This kind of data can also illuminate Paarlberg and Varda (2009)'s work on carrying capacities in community stakeholder networks to determine the extent to which carrying capacities influence the functioning of networked community change efforts as well as network interventions that can address them.

Additionally, examining the other aspects of networked community change efforts in greater detail can demonstrate the role these factors play in conjunction with efficient networks to achieve change goals. These might include a focus on the process of coming to consensus about a common agenda for stakeholders to address, building a shared measurement process to follow-up on stakeholder successes throughout the process, and governance processes used by the organizing stakeholder. Understanding the process through which stakeholders come to consensus on their goals and set a common agenda can also serve as a boundary-setting process, where some stakeholders are included or excluded based on how the larger group frames the problem and agenda. Further research about this can help determine who participates as a stakeholder in these efforts and who is excluded from them. Understanding measurement processes can demonstrate how efforts track their success over time and using the measurements can be compared with change strategies to determine which strategies have a high impact. Assessing the processes through which organizers govern the change process can elicit more detailed information about the ways in which they are able to influence network participation and performance.

Conclusions

Overall, the findings from the study indicate that networked community change efforts demonstrate promise in theory as a process for creating efficient networks, but look somewhat different in practice. Under some circumstances the networks that emerge continue to be efficient, but lose a great deal of the efficiency that stakeholders enjoy under ideal conditions. Stakeholders implementing networked community change efforts should consider the role these problems might play in their unique contexts and develop further interventions to address them. Future research can illuminate the best processes for attaining the ideal circumstances described here and the processes through which change efforts can intervene when they experience challenges in their work.

APPENDICES

APPENDIX A – Table 1

Table 1. Approaches to Networked Community Change

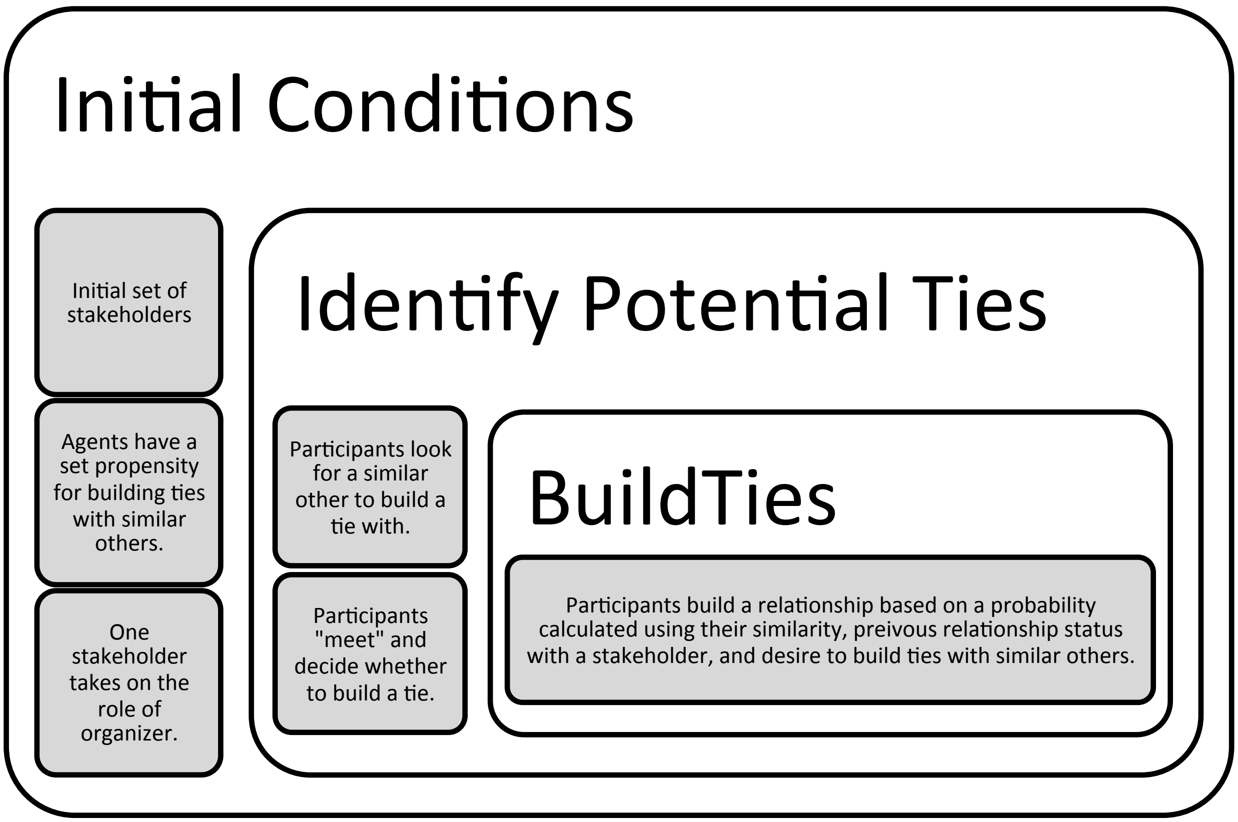
Approach:	**Initial Conditions**	**Facilitator**	**Information Sharing process**	**Network Structure**
Collective Impact (Kania & Kramer, 2011)	Must have an influential champion (backbone organization), adequate financial resources, a common agenda, and a sense of urgency for change (Hanleybrown, Kania, & Kramer, 2012)	A backbone organization manages the change process.	A Common agenda ensures that all players are in agreement about central issues. In practice participants break up into small groups to exchange information.	The backbone organization is central within the network; many instances of CI in split stakeholders into smaller groups around particular issues of interest.
Networked Action Research (Foth, 2006)	There are existing networks of stakeholders, but they are not meaningfully connected to each other for a collective change effort. Networks can also be developed through the promotion of interest groups, bringing participants together around common issues.	An AR facilitator connects previously disconnected groups of stakeholders and guides them through the action research cycle.	Stakeholder groups each work on the same problem from their shared perspective, with the facilitator guiding the process and bringing together learning from each group.	The pre-existing small groups of similar stakeholders are connected to each other through the action research facilitator.

Table 1 (cont'd)

Systemic Action Research (Burns, 2007)	Stakeholders need to agree about the problem of interest.	A facilitator brings stakeholders together, synthesizes information, and supports action.	Groups engage in independent inquiry and provide information to the facilitator.	Participants are split up into multiple independent strands of inquiry involving a group of similar stakeholders that come together through a common facilitator.
ABLe Change (Foster-Fishman & Watson, 2011)	Agree on a common issue, scan the system to collect information surrounding the issue, develop a common agenda for the work.	Facilitators manage action learning process, data, and bringing appropriate perspectives to the table.	A common agenda ensures that all players are in agreement about central issues within smaller groups.	The facilitator connects smaller groups of structurally equivalent stakeholders in the network.
Strategic Doing (Morrison, 2010)	Unspecified	Can be multiple stakeholders acting as convener, connector, guide, or strategist	No common agenda; instead, a set of common questions: What could we do together? What should we do together? What will we do together? When we will get back together?	The convener brings stakeholders and their pre-existing ties together to engage in learning and information sharing.

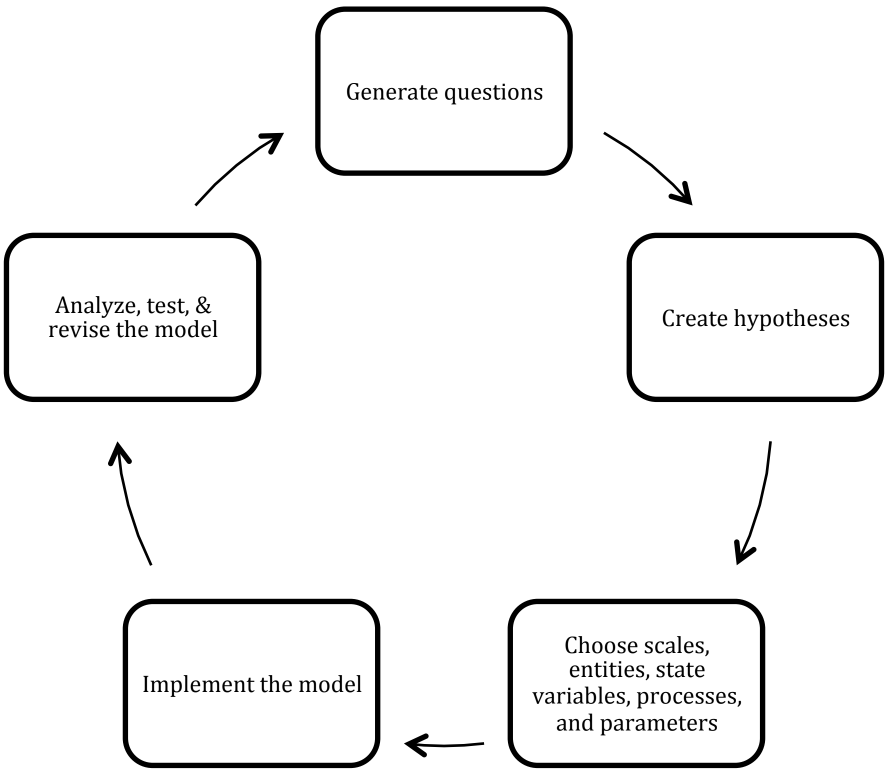
APPENDIX B – Figure 1

Figure 1. Development of a Networked Community Change Effort



APPENDIX C – Figure 2

Figure 2. Modeling Cycle as Outlined in Railsback & Grimm (2012)



APPENDIX D – Table 2

Table 2. Annotated Initial Model Code

Netlogo Code	*Annotations*
extensions [nw]	Ask NetLogo to load the network extension package, making network calculations easier to compute
undirected-link-breed [alls all] undirected-link-breed [rands rand]	Ask NetLogo to create two types of ties: Alls represent the ties among stakeholders in the model Rands represent the random graph ties the model compares against the generated stakeholder network for small world computations

turtles-own [
  my-issue
  partner-prob
  alpha
  ]
	Create variables that each agent will have:
	
	my-issue - what issue the turtle is interested in
	
	partner-prob - the probability of developing a partnership with another turtle
	
	alpha - an important number for calculating logistic regression

Table 2 (cont'd)

globals [current-density small-world-quotient apl-partner apl-random cc-partner cc-random cc-year1 cc-year2 cc-year3 rcc-year1 rcc-year2 rcc-year3 apl-year1 apl-year2 apl-year3 rapl-year1 rapl-year2 rapl-year3 density-year1 density-year2 density-year3]	Create a set of global variables for the whole program: Current-density – track network density as the model runs small-world-quotient – the ratio of the CC and pl random graph comparisons apl-partner – average path length of the all network apl-random – average path length of the random network cc-partner – clustering coefficient of the all network cc-random – clustering coefficient of the random network cc-ratio – ratio of random and partner cc apl-ratio – ratio of random and partner apl swq-year1 – the small world quotient after 52 iterations of the model swq-year2 – the small world quotient after 104 iterations of the model swq-year3 – the small world quotient after 156 iterations of the model density-year1 – the density of the all network after 52 iterations of the model density-year2 – the density of the all network after 104 iterations of the model density-year3 – the density of the all network after 156 iterations of the model

Table 2 (cont'd)

to setup	Create a submodel called setup. This is where the environment for the simulation is initialized.
Ca	Clears anything in the environment that remains from the previous model run
make-turtles	Call the make-turtles submodel to populate the simulated environment
ask patches [set pcolor 38]	Sets the background of the environment to a color that will make it easy to see all of the turtle colors
if spring-layout = true[repeat 500 [layout-spring turtles alls 0.5 15 15]]	Layout the turtles so the network is more visually appealing
reset-ticks	Set the number of model iterations to zero
end	end the submodel
to make-turtles	Create a submodel for making the stakeholders in the simulation
ask n-of population patches [sprout 1]	Create the number of agents that were specified by the user
ask turtles [set size 4 set shape "person" set my-issue ((random 9) + 1) set color scale-color green my-issue 1 10]	Give the agents some characteristics: - make their size large enough that they are easy to see - give them a shape that makes them look like a person - assign them an issue number between 1 and 10 - assign them a color that represents their issue number
end	End the submodel
to go	Create the go submodel to have the agents meet each other, build ties, and calculate network metrics
meet	Call the meet submodel described below
organizer	Call the organizer submodel described below

Table 2 (cont'd)

stats	Call the stats submodel described below

if ticks = 52
 [set cc-year1 cc-partner
  set rcc-year1 cc-random
  set apl-year1 apl-partner
  set rapl-year1 apl-random
  set density-year1 current-density]
	Keep track of the stats needed to make network computations for year one

if ticks = 104
 [set cc-year2 cc-partner
  set rcc-year2 cc-random
  set apl-year2 apl-partner
  set rapl-year2 apl-random
  set density-year2 current-density]
	Keep track of the stats needed to make network computations for year one

if ticks = 156
 [set cc-year3 cc-partner
  set rcc-year3 cc-random
  set apl-year3 apl-partner
  set rapl-year3 apl-random
  set density-year3 current-density]
	Keep track of the stats needed to make network computations for year one

tick	Update the number of iterations of the model
if spring-layout = true [repeat 500 [layout-spring turtles alls 0.5 15 15]]	Layout the turtles so the network is more visually appealing
End	End the submodel
to meet	Create the meet submodel where turtles meet each other and have the opportunity to form ties based on the weights of the parameters
ask turtles [let alter one-of other turtles let issue-diff abs(my-issue – [my-issue] of alter)	Ask each turtle, one by one, to choose another turtle, then calculate the difference between their interests in the issue being addressed
if all-neighbor? Alter [ask all-with alter [die]]	Check to see if the turtle they have chosen is someone they currently have a tie with. If yes, then the tie will disappear and they will re-evaluate their relationship with that stakeholder
let pmax 100	pmax is the upper limit for the probability of a tie. The turtles have, at best, a 50/50 chance of building a tie with another turtle on a given iteration.
Set alpha (ln((pmax / 100) / (1 – (pmax / 100))) – preference-for-similarity)	Calculate alpha, the intercept for the logistic function

Table 2 (cont'd)

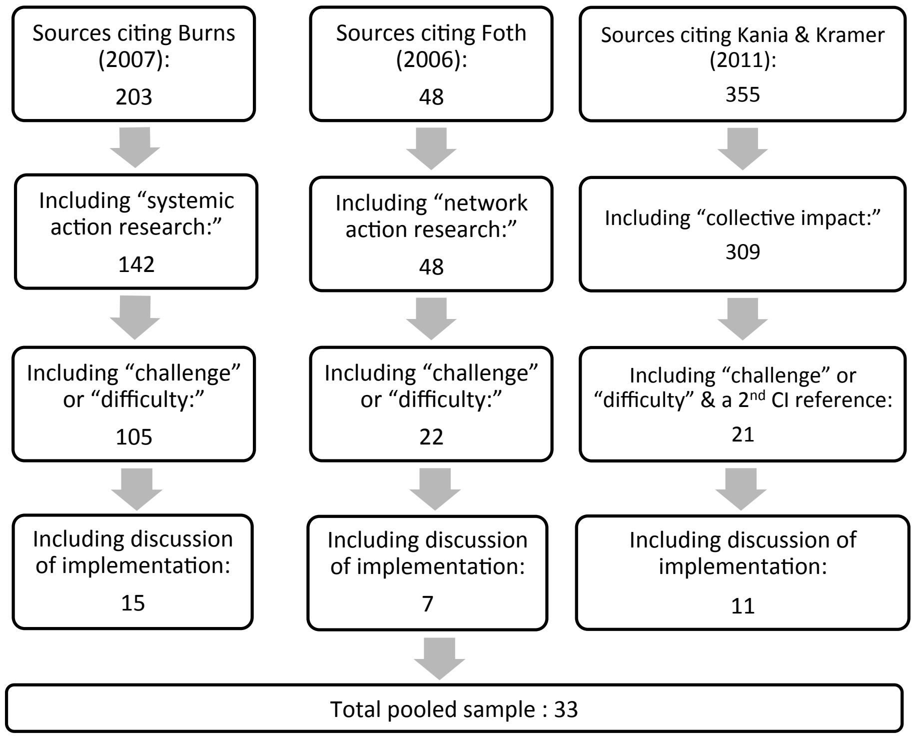
set partner-prob exp (alpha + (preference-for-similarity * ((10 – issue-diff) / 10))) / (1 + exp(alpha + (preference-for-similarity * ((10 – issue-diff) / 10))))	Calculate the entire logistic function to determine the probability of a tie forming.
If (((random 99 + 1) / 100) < partner-prob) [create-all-with alter [set color green]]]	Choose a random number between one and one hundred, if it's less than the calculated probability of a partnership, then create a tie between them. Make the tie green.
End	End the submodel
to organizer	Create a submodel that makes makes organizer ties among stakeholders
if (random 999 + 1) / 1000 < organizer-activity [ask one-of turtles [create-all-with one-of other turtles [set color blue]]]	Choose a random number between 1 and 1000, if it's less than the value of the organizer-activity parameter, create a tie between two random stakeholders, make the tie blue
end	End the submodel
to stats	Create a submodel to calculate necessary statistics for network computations
If ticks = 52 OR ticks = 104 OR ticks = 156	If the model has reached the end of the first, second, or third year of the change effort, then do the calculations in the submodel calculate the density of the network
[set current-density (count alls) / ((population ^ 2 – population) / 2)	Calculate the density of the network
nw:set-context turtles alls	The following computations should use the alls network
set apl-partner nw:mean-path-length	The apl-partner variable should represent the average path length of the alls network
set cc-partner mean [nw:clustering-coefficient] of turtles	The cc-partner variable should represent the average clustering coefficient of the alls network
while [count rands < count alls]	Use a look to create a random network to use as a comparison to the alls network. While there are fewer random ties than all ties, keep running the loop to make new ties
[ask n-of 1 turtles [let alter one-of other turtles create-rand-with alter[hide-link]]]	Ask two random turtles to create a random link on each iteration of the loop until it reaches the end case
nw:set-context turtles rands	The following computations should use the rands network
set apl-random nw:mean-path-length	The apl-random variable should represent the average path length of the rands network

Table 2 (cont'd)

set cc-random mean [nw:clustering-coefficient] of turtles	The cc-random variable should represent the average clustering coefficient of the rands network
ifelse (apl-partner = 0 OR apl-partner = false OR apl-random = 0 OR apl-random = false) [set small-world-quotient 0]	If the network is disconnected, set the small world quotient to zero
[set small-world-quotient ((cc-partner / cc-random) / (apl-partner / apl-random))]	If the network is not disconnected, calculate the small world quotient
ask rands [die]]	Reset the rands network so it can be recreated for the next set of computations
end	End the submodel

APPENDIX E – Figure 3

Figure 3. Sources Included in the Sample



APPENDIX F – Table 3

Table 3. Coding System and Examples

Codes	Definitions	Examples
Common issue	Stakeholders come to some agreement about the issue that they plan to address in their efforts	"The elementary school principals and myself had what we thought we needed and I think the former school coordinator understood that, but Collective Partners were pushing her to do things that we don't need to be done." (2) "Because conversations about expectations, common goals, and shared measurements are not being communicated to the staff members, organizations are losing faith in others' ability to deliver quality services to students." (2)
Organizer Selection	An organizer emerges to manage stakeholder engagement in the effort	"One core issue with Collective Partners being the backbone organization is that the main liaison position, the school coordinator, for the organization remained unfilled for most of the year." (2)

Table 3 (cont'd)

Facilitation	An organizer acts as a facilitator, within and between groups of stakeholders, bringing other stakeholders into the effort where appropriate	"Parzen had begun to make initial inroads with the San Diego community, but the future remained less than certain. According to Cafferty, 'Tad has elevated the dialog around business and education relationships, and it has garnered a level of interest and support I haven't seen in a while.' Others, including Parzen himself, voiced more caution with the progress. 'On a scale of 1 to 10, I think we are at a 4 on mobilizing the business involvement,' he said. Marten agreed, 'Getting the business community involved in supporting City Heights has proved challenging.'" (1) "Interviews with other participants revealed that there is a disconnect between services offered by the backbone organization and what was needed within the community." (2)
Learning	Participants form sub-groups to engage in research, learning, & action	"However, we realized a major challenge would be the acquisition of strong benchmark-level analytical capabilities." (1) "Both program directors and after school teachers reported that they little contact and few conversations with people outside their own organization. Many reported that the programs offered by the district run more parallel to the Mission Ministries programs rather than collectively interacting." (2)

Table 3 (cont'd)

Tie Formation	Members of the effort engage in relationship formation over time	"There is still a sense from some educators that the business leaders are trying to fix them." (1) "The contrast of having an underperforming, predominately African-America student population, and an older, white male composition on the Aspire board mirrored some of the community issues." (1) "While it does not seem that the struggle is over power, data indicate that the qualifications of the partners and trust in their decision-making is contributing to a lack of cooperation between organizations." (2)

1. Grossman, A.S., Lombard, A. & Fisher, N. (2014). StriveTogether: Reinventing the local education ecosystem, Harvard Business School Case Study.
2. Yeates, K.R. (2014). Joining forces: The challenges of multi-organizational collaboration (Masters Thesis) Retrieved from: Google Scholar.

APPENDIX G – Table 4

Table 4. Qualitative Themes and Representative Quotes

Theme	*Representative Quote*
Unsuccessful organizer	"Of the five collective impact conditions, the hub has made the least progress with establishing shared measurement systems. The uncertainty about future staff roles makes it seem unlikely that such complex long-term measurement systems will be devised in the near future, leaving the hub to rely on more developmental measures such as participation rates" (Walton, 2014, p. 153).
Stakeholder Turnover	"In the case of community radio in Ghana (and elsewhere), the largely voluntary nature of station staffing means that maintaining the same team of actors for an extended period of time can be challenging. In the context of a capacity building initiative, this can sometimes mean that certain individuals are involved in some elements of the work, but may then miss other key steps. This poses challenges to ensuring a broad-based understanding of an approach within stations. This was the case in one of the three stations involved in this study, and it may have influenced the outcomes that station experienced." (Harvey, 2011, p. 2051)
Stakeholders don't have clear roles to organize around (not following homophily)	"Establishing clear roles for each of the partners will be essential for each of the partners to remain in the collaboration. When asked about roles, a school district participant said, 'We spent two years trying to talk about what each partner's role should be...nothing came of it.' He added, 'I never sensed a backbone from Collective Partners to step in and play hard ball with either one of us. Which, they are giving us money, they are giving them a lot of money... it's an interesting experiment." (42)
Table 4 (cont'd)	
Stakeholder power dynamics	"Additionally, while there were a number of

	Toledo business leaders engaged in the initiative the involvement of education stakeholders remained more of a challenge. 'I only have one educator on the board, so it's difficult to build the necessary trust to make change. There is still a sense from some educators that the business leaders are trying to fix them,' observed Baker." (Grossman, Lombard, & Fisher, 2013, p. 8)

APPENDIX H – Table 5

Table 5. Operationalization of Qualitative Themes in the Refined Model

Theme	Operationalization in Refined Model
Unsuccessful organizer	The organizer has a low probability (less than .5) of building a tie during each iteration of the model
Stakeholders not following homophily	Stakeholders have low values for homophily
Stakeholder Turnover	Stakeholders randomly disappear from the network and are replaced with new, unconnected stakeholders
Stakeholder power dynamics	Each stakeholder has a power value between 0 and 1, multiplied by their probability of building a tie

APPENDIX I – Table 6

Table 6. Annotated Refined Model Code

extensions [nw]	Ask NetLogo to load the network extension package, making network calculations easier to compute
undirected-link-breed [alls all] undirected-link-breed [rands rand]	Ask NetLogo to create two types of ties: Alls represent the ties among stakeholders in the model Rands represent the random graph ties the model compares against the generated stakeholder network for small world computations
turtles-own [my-issue partner-prob alpha power]	Create variables that each agent will have: my-issue - what issue the turtle is interested in partner-prob - the probability of developing a partnership with another turtle alpha - an important number for calculating logistic regression power – the extent to which a turtle is a desirable partner, not accounting for their issue number

Table 6 (cont‘d)

globals [
  current-density ; track network density as the model runs
  clustering-coefficient ; the clustering coefficient of the network; this is the average of clustering coefficients of all turtles
  total-links ; total number of partner links in the network
  num-disconnected-pairs ; number of turtles that could be connected but aren't
  altercolor; what color is alter
  mycolor ; what color am I
  organizer-links ; keeps track of the number of organizer-links the model creates on an iteration
  small-world-quotient ; the ratio of the cc and pl random graph comparisons
  apl-partner ;average path length of the all network
  apl-random ; average path length of the random network
  cc-partner ; clustering coefficient of the partner network
  cc-random ;clustering coefficient of the random network
	Create a set of global variables for the whole program:
	
	Current-density – track network density as the model runs
	
	small-world-quotient – the ratio of the CC and pl random graph comparisons
	
	apl-partner – average path length of the all network
	
	apl-random – average path length of the random network
	
	cc-partner – clustering coefficient of the all network
	
	cc-random – clustering coefficient of the random network
	
	cc-ratio – ratio of random and partner cc
	
	apl-ratio – ratio of random and partner apl

Table 6 Cont'd

cc-year1
  cc-year2
  cc-year3
  rcc-year1
  rcc-year2
  rcc-year3
  apl-year1
  apl-year2
  apl-year3
  rapl-year1
  rapl-year2
  rapl-year3
  swq-start ; small world quotient after set-up
  swq-year1 ; small world quotient after 52 iterations of the model
  swq-year2 ; small world quotient after 104 iterations of the model
  swq-year3 ; small world quotient after 156 iterations of the model
  density-year1 ; density after 52 iterations of the model
  density-year2 ; density after 104 iterations of the model
  density-year3 ; density after 156 iterations of the model
  max-power
  meet-power
  current-turtle
  ]
	swq-year1 – the small world quotient after 52 iterations of the model
	
	swq-year2 – the small world quotient after 104 iterations of the model
	
	swq-year3 – the small world quotient after 156 iterations of the model
	
	density-year1 – the density of the all network after 52 iterations of the model
	
	density-year2 – the density of the all network after 104 iterations of the model
	
	density-year3 – the density of the all network after 156 iterations of the model
	
	max-power – the highest power level that any turtle has after power is initially distributed
	
	meet-power – when two turtles meet, this variable contains the power level of the least powerful alter
	
	current-turtle – a variable to count up from 0, going through the number of turtles in the environment to assess which has the highest power level

to setup	Create a submodel called setup. This is where the environment for the simulation is initialized.
Ca	Clears anything in the environment that remains from the previous model run
make-turtles	Call the make-turtles submodel to populate the simulated environment
distribute-power	Call the distribute-power submodel to assign power values to each turtle
calc-max	Call the calc-max submodel to determine which turtle has the highest value for power

Table 6 (cont'd)

Ask turtles [set power power / max-power]	Divides every turtle's power score by the highest power level in the model, ensuring that no turtle has a power level greater than one.
Ask patches [set pcolor 38]	Sets the background of the environment to a color that will make it easy to see all of the turtle colors
if spring-layout = true[repeat 500 [layout-spring turtles alls 0.5 15 15]]	Layout the turtles so the network is more visually appealing
reset-ticks	Set the number of model iterations to zero
end	end the submodel
to make-turtles	Create a submodel for making the stakeholders in the simulation
ask n-of population patches [sprout 1]	Create the number of agents that were specified by the user

ask turtles
[set size 4
  set shape "person"
  set my-issue ((random 9) + 1)
  set color scale-color green my-issue 1 10
  set power 1
 ]
	Give the agents some characteristics:
	- make their size large enough that they are easy to see
	- give them a shape that makes them look like a person
	- assign them an issue number between 1 and 10
	- assign them a color that represents their issue number
	- assign every turtle a power level of 1 to start off

end	End the submodel
to distribute-power	Create a submodel for distributing power values among stakeholders according to a pre-determined type of distribution

Table 6 (cont'd)

ask turtles [if power-distribution = "Equal"[set power 1] if power-distribution = "Exponential"[set power (random-exponential 50 + 1) / 100] ; rescale scores from 0 to 1; divide everything by the largest number if power-distribution = "Uniform" [set power ((random 9) + 1) / 10] set size power + 2]	Ask turtles to set their power values based on the user-selected power distribution type. If the user selects an equal distribution, all turtles have a power value of one. If the user selects an exponential distribution, turtles get assigned a power value according to a random exponential distribution structure. If the user selects a "uniform" distribution, turtles get assigned a power value according to a uniform distribution, where there are equal numbers of turtles with each power value.
To go	Create the go submodel to have the agents meet each other, build ties, and calculate network metrics
meet	Call the meet submodel described below
organizer	Call the organizer submodel described below
stats	Call the stats submodel described below
if ticks = 52 [set cc-year1 cc-partner set rcc-year1 cc-random set apl-year1 apl-partner set rapl-year1 apl-random set density-year1 current-density]	Keep track of the stats needed to make network computations for year one
ask n-of population patches [sprout 1]	Create the number of agents that were specified by the user
ask turtles [set size 4 set shape "person" set my-issue ((random 9) + 1) set color scale-color green my-issue 1 10 set power 1]	Give the agents some characteristics: - make their size large enough that they are easy to see - give them a shape that makes them look like a person - assign them an issue number between 1 and 10 - assign them a color that represents their issue number - assign every turtle a power level of 1 to start off
end	End the submodel
to distribute-power	Create a submodel for distributing power values among stakeholders according to a pre-determined type of distribution

Table 6 (cont'd)

ask turtles [
  if power-distribution = "Equal"[set power 1]
  if power-distribution = "Exponential"[set power (random-exponential 50 + 1) / 100] ; rescale scores from 0 to 1; divide everything by the largest number
  if power-distribution = "Uniform" [set power ((random 9) + 1) / 10]
  set size power + 2
  ]
	Ask turtles to set their power values based on the user-selected power distribution type. If the user selects an equal distribution, all turtles have a power value of one. If the user selects an exponential distribution, turtles get assigned a power value according to a random exponential distribution structure. If the user selects a "uniform" distribution, turtles get assigned a power value according to a uniform distribution, where there are equal numbers of turtles with each power value.

To go	Create the go submodel to have the agents meet each other, build ties, and calculate network metrics
meet	Call the meet submodel described below
organizer	Call the organizer submodel described below
stats	Call the stats submodel described below

if ticks = 52
 [set cc-year1 cc-partner
  set rcc-year1 cc-random
  set apl-year1 apl-partner
  set rapl-year1 apl-random
  set density-year1 current-density]
	Keep track of the stats needed to make network computations for year one

if ticks = 104
 [set cc-year2 cc-partner
  set rcc-year2 cc-random
  set apl-year2 apl-partner
  set rapl-year2 apl-random
  set density-year2 current-density]
	Keep track of the stats needed to make network computations for year one

if ticks = 156
 [set cc-year3 cc-partner
  set rcc-year3 cc-random
  set apl-year3 apl-partner
  set rapl-year3 apl-random
  set density-year3 current-density]
	Keep track of the stats needed to make network computations for year one

tick	Update the number of iterations of the model
if spring-layout = true [repeat 500 [layout-spring turtles alls 0.5 15 15]]	Layout the turtles so the network is more visually appealing
End	End the submodel
to meet	Create the meet submodel where turtles meet each other and have the opportunity to form ties based on the weights of the parameters

Table 6 (cont'd)

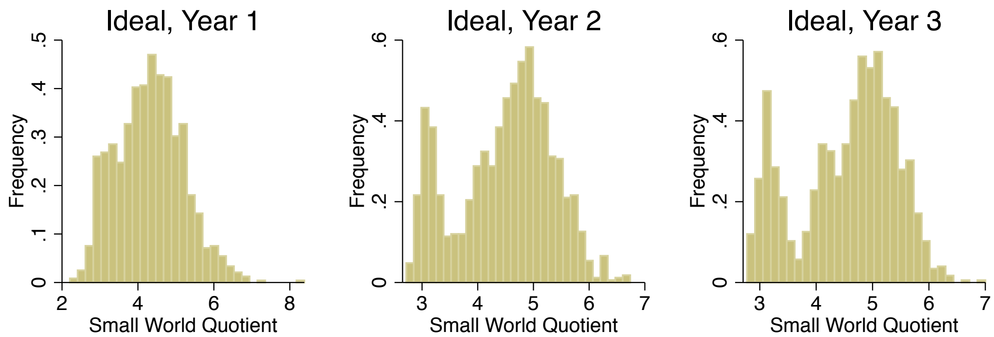
ask turtles [let alter one-of other turtles let issue-diff abs(my-issue – [my-issue] of alter)	Ask each turtle, one by one, to choose another turtle, then calculate the difference between their interests in the issue being addressed
ifelse power <= [power] of alter [set meet-power power] [set meet-power [power] of alter]	Of the two turtles considering a tie, set meet-power to be the value that matches up with the less powerful turtle's power level
if all-neighbor? Alter [ask all-with alter [die]]	Check to see if the turtle they have chosen is someone they currently have a tie with. If yes, then the tie will disappear and they will re-evaluate their relationship with that stakeholder
let pmax 100	pmax is the upper limit for the probability of a tie. The turtles have, at best, a 50/50 chance of building a tie with another turtle on a given iteration.
Set alpha (ln((pmax / 100) / (1 – (pmax / 100))) – preference-for-similarity)	Calculate alpha, the intercept for the logistic function
set partner-prob exp (alpha + (preference-for-similarity * ((10 – issue-diff) / 10))) / (1 + exp(alpha + (preference-for-similarity * ((10 – issue-diff) / 10))))	Calculate the entire logistic function to determine the probability of a tie forming.
if (((random 99 + 1) / 100) < partner-prob * meet-power) [create-all-with alter [set color green]]]	Choose a random number between one and one hundred, if it's less than the calculated probability of a partnership times the meet-power, then create a tie between them. Make the tie green.
end	End the submodel
to turnover	Create a submodel that demonstrates stakeholder turnover in an effort
if (random 999 + 1) / 1000 < stakeholder-turnover [ask n-of 1 turtles [ask my-links [die]]	Choose a random number. If that number is less than the value for stakeholder turnover, kill all of the ties from a randomly selected turtle.
End	End the submodel
to organizerhj	Create a submodel that makes makes organizer ties among stakeholders
if (random 999 + 1) / 1000 < organizer-activity [ask one-of turtles [create-all-with one-of other turtles [set color blue]]]	Choose a random number between 1 and 1000, if it's less than the value of the organizer-activity parameter, create a tie between two random stakeholders, make the tie blue
end	End the submodel
to stats	Create a submodel to calculate necessary statistics for network computations

Table 6 (cont'd)

If ticks = 52 OR ticks = 104 OR ticks = 156	If the model has reached the end of the first, second, or third year of the change effort, then do the calculations in the submodel calculate the density of the network
[set current-density (count alls) / ((population ^ 2 - population) / 2)	Calculate the density of the network
nw:set-context turtles alls	The following computations should use the alls network
set apl-partner nw:mean-path-length	The apl-partner variable should represent the average path length of the alls network
set cc-partner mean [nw:clustering-coefficient] of turtles	The cc-partner variable should represent the average clustering coefficient of the alls network
while [count rands < count alls]	Use a look to create a random network to use as a comparison to the alls network. While there are fewer random ties than all ties, keep running the loop to make new ties
[ask n-of 1 turtles [let alter one-of other turtles create-rand-with alter[hide-link]]]	Ask two random turtles to create a random link on each iteration of the loop until it reaches the end case
nw:set-context turtles rands	The following computations should use the rands network
set apl-random nw:mean-path-length	The apl-random variable should represent the average path length of the rands network
set cc-random mean [nw:clustering-coefficient] of turtles	The cc-random variable should represent the average clustering coefficient of the rands network
ifelse (apl-partner = 0 OR apl-partner = false OR apl-random = 0 OR apl-random = false) [set small-world-quotient 0]	If the network is disconnected, set the small world quotient to zero
[set small-world-quotient ((cc-partner / cc-random) / (apl-partner / apl-random))]	If the network is not disconnected, calculate the small world quotient
ask rands [die]]	Reset the rands network so it can be recreated for the next set of computations
end	End the submodel

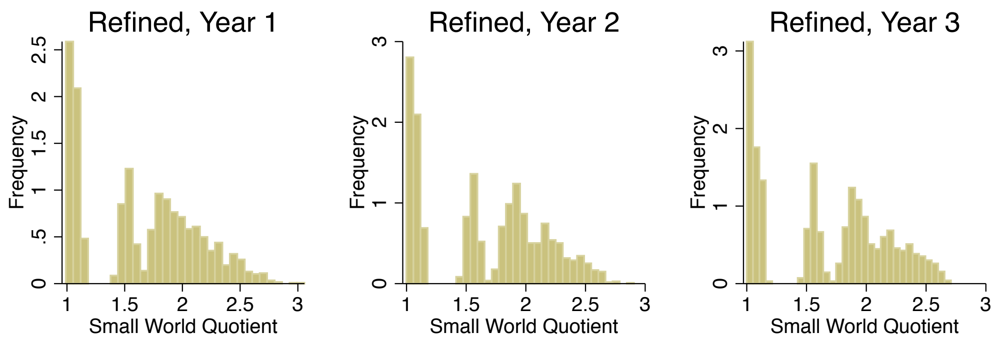
APPENDIX J – Figure 4

Figure 4. Histograms of Q-values for the Ideal Model



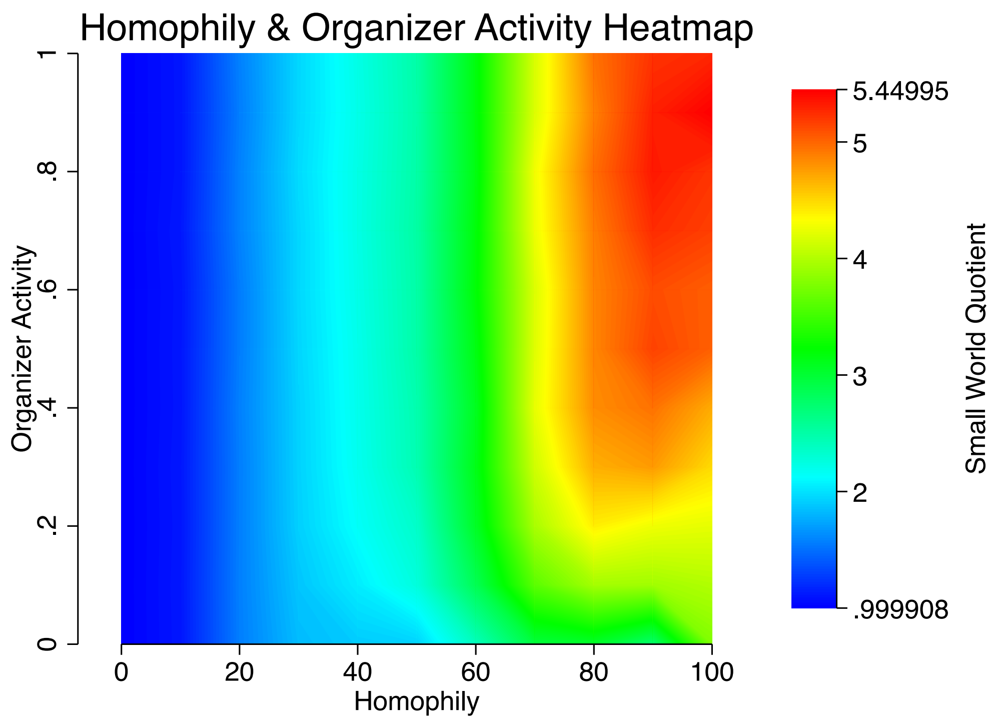
APPENDIX K – Figure 5

Figure 5. Histograms of Q-Values for the Refined Model



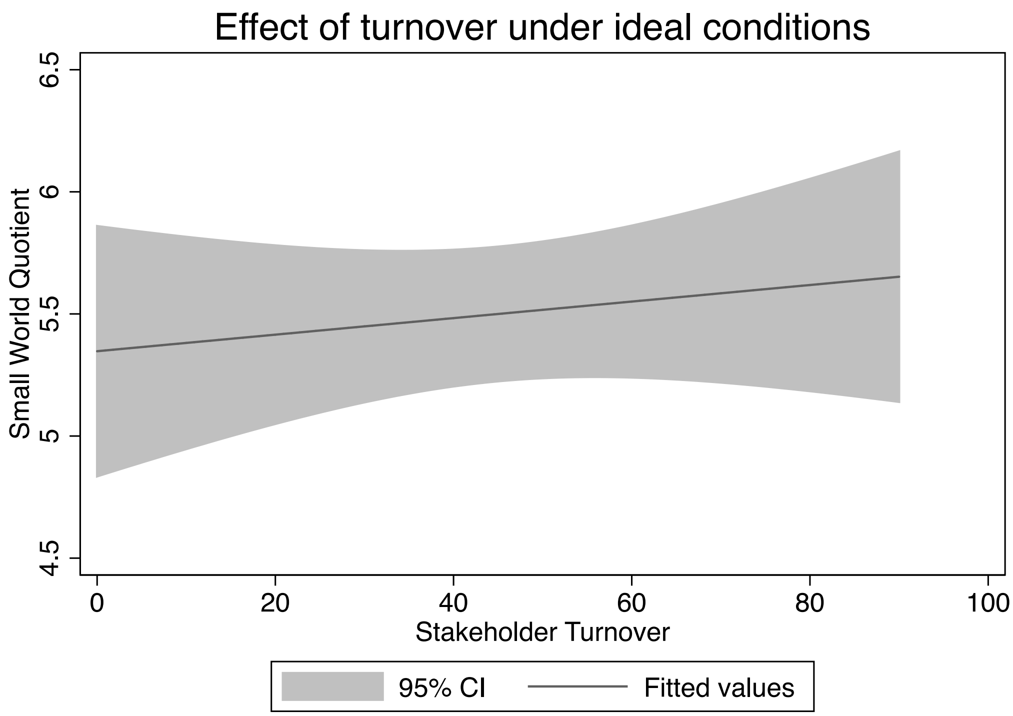
APPENDIX L – Figure 6

Figure 6. Heatmap of Homophily and Organizer Activity



APPENDIX M – Figure 7

Figure 7. Stakeholder Turnover Graph



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