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Social Network Analysis as a Driver of Continuous Improvement: A Case Study

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ABSTRACT

Social network analysis (SNA) is a research method that, when applied to improvement science, can help leaders understand the strength of relationships within their organization. The COVID-19 pandemic has had a lasting impact on organizational norms, and it has interrupted relationship building efforts. This paper documents a case study of the Kentucky Department of Education (KDE), which deployed SNA techniques to strategically identify areas of growth within its network and design intentional, targeted solutions to improve the network health. As organizations emerge from the pandemic environment and begin to plan continuous improvement efforts, they would be well served to examine the impact of the pandemic on their level of connectedness. The broader impact and generalizability of the case study as well as considerations for replication are also discussed.

Keywords**:** social network analysis, Kentucky, continuous improvement, COVID-19, instructional coaches

As workplaces across the globe begin to reboot their strategic planning and continuous improvement efforts following the global COVID-19 pandemic, they would be well served to consider the impact of the pandemic on their organization's culture and social structures. Social network analysis (SNA) can be combined with the principles of improvement science to yield meaningful information for leaders seeking to examine and strengthen their working networks following the pandemic.

SNA is a scientific method of observing and quantifying the relationships between individuals within a network. The development of SNA is often credited to Jacob Moreno's work in the 1930s (Alba, 1982; Borgatti & Ofem, 2010), but interest into mapping the relationships between individuals within school settings dates to the early 1900s (Almack, 1992; Bott, 1928; Freeman, 1996; Hagman, 1933; Wellman, 1926). Modern notions of SNA evolved from these early efforts as social scientists began to apply matrix algebra and graph theory to create formalized concepts, such as groups, cliques, and social circles, that could be objectively measured (Borgatti & Ofem, 2010).

Social network theory suggests that what happens to a group of actors is a result of the structure of connections among them (Borgatti et al., 2018). This structure of connections represents their network: the people with whom they share some form of relationship. Social network analysists deploy a variety of techniques, including statistical calculations and data visualizations, to understand the strength of relationships between individuals and take note of various anomalies within a network (Borgatti et al., 2018). These visualized connections create a literal *web of relationships* with patterns and structures that can be used to understand the overall network and the leaders and agents acting within it (Borgatti & Ofem, 2010).

Similarly, *improvement science*, frequently referred to as *continuous improvement within the context of education* or *quality improvement within the context of industry*, helps analysts understand the underlying nature of a phenomenon and how the various parts of a system impact one another (Park et al., 2013). The work of improvement science is frequently performed by groups called *networked improvement communities*, in which networks of individuals are intentionally created to study a problem of practice and test solutions (Bryk et al., 2015).

During the COVID-19-induced lockdown period, people across the world reported increased feelings of distress—particularly feelings of loneliness, isolation, depression, and anxiety (Hwang et al., 2020; Matos et al., 2021; Pancani et al., 2021; Pietrabissa & Simpson, 2020; Santini et al., 2020; Xiong et al., 2022). While this phenomenon has been observed in

the general population, it has also been found to exist specifically within the workforce and has largely contributed to the rapid change in organizational support structures (Adisa et al., 2022; Oakman et al., 2020; Varshney, 2021). Interestingly, the transition out of lockdown has likewise created many new mental health challenges for workers, including increases in psychological distress, depression, anxiety, worries, insomnia, and other emotional reactions (Liu et al., 2021).

At the time of this writing, research into the long-term impacts of the pandemic is still in its nascent stage, and a consensus as to whether the COVID-19 lockdowns were helpful or harmful to the workforce has not been reached. Some studies indicate that the lockdowns promoted positive changes in worker physical and mental health (Pelly et al., 2022), with some believing that the psychological profile of each worker, as well as that of their manager, may be a leading indicator of the impacts of lockdowns on each individual (Adisa et al., 2022; Michinov et al., 2022). Regardless of which side the study is situated, it is well documented that the COVID-19 lockdown and work-from-home periods dramatically changed the organizational landscape for agencies everywhere.

Within the context of pandemic-era worker isolation, the application of SNA techniques as part of a larger improvement science framework can help leaders understand the impact of the pandemic on their workforce and respond to changes in a way that strengthens the network. But using SNA techniques to understand relationships within a workforce is not new. It has been successfully deployed within both education (Brewer, 2018; Grunspan et al., 2017; Froehlich et al., 2020) and industry (Bento & Garotti, 2019; Bonchi et al., 2011; Grosser et al., 2010) settings. While SNA techniques alone can help leaders understand the health of their network, it is the action, monitoring, and refinement cycles of improvement science that lead to lasting change of the health of an organization (Park et al., 2013). The following sections will explore the KDE's unique problem of practice, its deployment of SNA techniques to measure the problem, and its use of this information to make decisions and launch improvement cycles to strengthen the health of its network.

A CASE STUDY OF THE KENTUCKY DEPARTMENT OF EDUCATION

The case study is a qualitative research design in which the experience of a phenomenon is documented by the researcher (Given, 2008). Within the field of education, case studies are commonly used to help practitioners gain an understanding of theoretical concepts by presenting them in the context of daily practice (Çakmak & Akgün, 2017). It is in that spirit that this case study presents the KDE's deployment of the SNA technique within the context of continuous improvement. This case study serves as an exemplar for leaders of similarly networked teams by demonstrating how the theory of SNA can be applied within a real-world context to inform continuous improvement decisions.

The KDE employs a team of Education Recovery (ER) staff, whose job is to provide intensive support, just-in-time professional learning, and guidance to schools identified as being among the lowest performing schools under the state's accountability system. The ER staff represent a highly networked group of professionals who work together to overcome systemic barriers that have led a school to chronically low performance.

As with institutions across the globe, the usual workflow of the ER staff was disrupted due to the COVID-19 pandemic. Staff transitioned to working in a largely virtual environment and became more isolated as pandemic-related restrictions limited their in-person interaction with school level employees and as in-person staff meetings were replaced with smaller virtual team meetings. Staff also missed opportunities to network in professional and social settings.

As the staff at the KDE began to emerge from the COVID-19 pandemic and re-deploy its usual processes, the leadership team became concerned with anecdotal sentiments of disconnectedness, isolation, and figurative distance being felt by the staff. This was of immediate concern to leadership who knew that staff reassignments would be likely as the organization transitioned out of its pandemic-era protocols. To implement a continuous improvement effort that would thoughtfully and strategically increase the strength of the network, the leadership team deployed an SNA protocol. Based on the literature, the team hypothesized that the protocol would allow them to identify specific areas of the network where relationships could be strengthened or formed.

Procedures

The KDE began the SNA process by defining the boundaries of the network to be studied, which included all staff who engaged in school improvement work on behalf of the KDE—a total of 91 individuals at the time. Subdivisions of the network were also defined: the total network includes staff divided among five regions and four primary role groups. A survey was created that asked each member of the network to identify which members they would consider to be an advisor, a collaborator, and a friend. They were then asked to rate the frequency of their interaction with the other individuals on a range from *daily* to *once per year*.

The survey was administered during an in-person staff meeting. Prior to administering the survey, the theoretical framework of SNA and the goals and objectives of the project were described in detail. The two network members who were not in attendance that day were contacted by the researcher to discuss the project and given the survey via email, leading to a 100% survey response rate. Staff were given the opportunity to opt-out of the data collection, but none chose to do so. Additionally, both the data analyst and the leadership team made public commitments to protect the confidentiality of the data collection and to refrain from using information collected by the survey to inform staffing, hiring, or placement decisions.

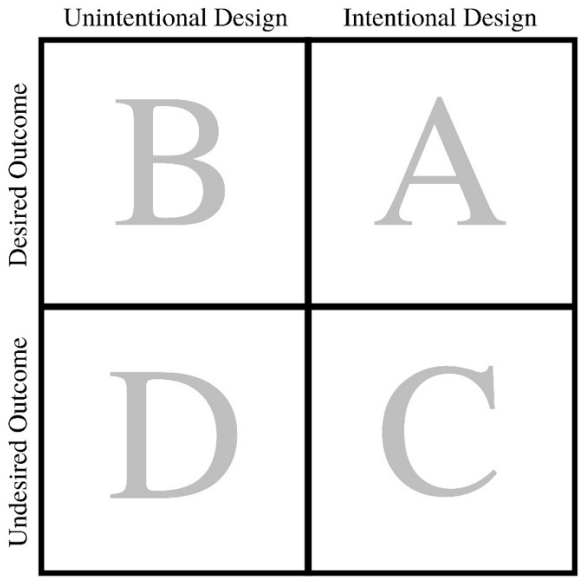
Once the data was received, it was analyzed using the igraph package in the R statistical computing environment (Csardi & Nepusz, 2006; R Core Team, 2022). Tables of summary statistics and sociograms were created to study various subdivisions of the network. Statistical outputs included the network size, number of connections within the network, density of the network, average path length within the network, network transitivity, and number of cliques. Two sociograms were created for the whole network and for each regional group: one using a random output layout that demonstrated centrality and a second using a circular layout that better visualized network density for the lay viewer. Gender and role were also examined as additional metrics that allowed the team to understand the nature of relationships across regional lines. Before information was shared with the team at large, the analyst removed all names or other identifying markers to protect the anonymity of participants.

Interpretation Protocol

As SNA is a highly personal and occasionally vulnerable analytic technique (Daly, 2019), the leadership team designed an interpretation protocol to facilitate an unemotional review of the data. As staff reviewed the summary statistics and sociograms produced by the analysis, they were discouraged from categorizing phenomenon as "good or bad" or as "strengths and weaknesses." Rather, staff were instructed to document phenomenon on the quadrant matrix displayed in Figure 1. Staff placed phenomenon that produced a desired outcome as the result of an intentional system design decision in Quadrant A, while Quadrant D housed phenomenon that represented an undesired outcome that was created through an unintentional system design feature.

Figure 1

Design and Outcome Quadrants



This method of interpreting the data allowed the team to consider the health of their current system design without the negative emotions that are often created through a critical analysis of one's own systems and processes. Following the data

review, staff compared their quadrant notes and participated in reflection about the current functioning of the system. Items placed in Quadrants C and D were identified for potential action.

Lessons Learned

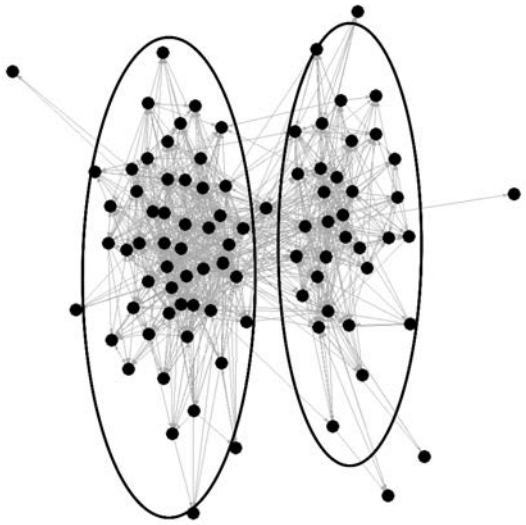
As the team reviewed the analysis, many actionable lessons began to coalesce. As the analysis resulted in more than 100 individual outputs, this paper seeks to document only a handful of illustrative and actionable outcomes.

The network is densely populated and without outliers. This represents a desired outcome of an intentional design decision (Quadrant A) as the structure of the ER staff ensures that every individual is connected to at least one other individual within the network. The team is also highly collaborative, which is a function of the system's overall design as opportunities to collaborate are intentionally built into daily operations. However, it is also clear that the structure has resulted in a rift between two groups: those working in urban areas and those working in rural areas. This represents an undesired outcome of an intentional system design (Quadrant C).

Figure 2 is a sociogram that uses a random layout to display centrality. It represents the entire network population's responses to the question "From whom do you seek advice?" While the network is dense, it contains two clear points of centrality. Deeper analysis demonstrates that the population encircled on the left side of the sociogram are assigned to support urban schools, while the population encircled on the right side of the sociogram are assigned to support schools in rural areas. This is believed to be an artifact of the management structure that governs the ER program as staff serving rural districts are supervised by different leaders than those serving in urban areas.

Figure 2

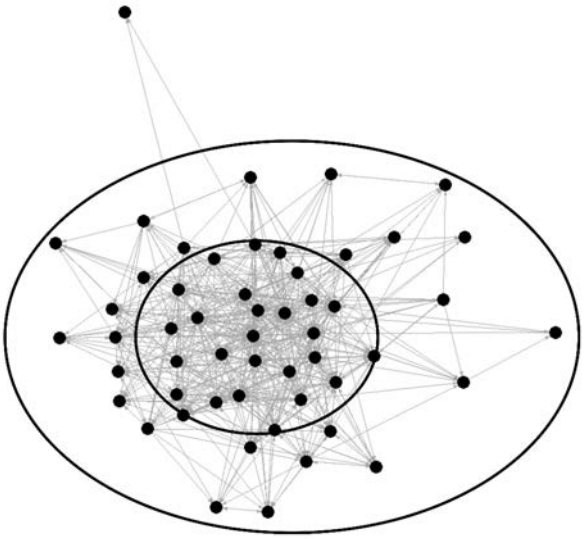
Sociogram of Full Network



As was previously mentioned, a key feature of the analysis is the lack of outliers. This is true across all subgroups—a Quadrant A phenomenon. Upon closer inspection, it is revealed that a subtle barrier exists when incorporating new staff into the fold. Figure 3 presents a sociogram of a subgroup of the larger network. Staff members clustered within the central circle are largely existing staff members with many years of KDE service, while those in the outer circle are largely newly hired staff with less than a year of service. One can see that deliberate attempts have been made to include new staff in the day-to-day operations of the team (Quadrant A), and yet they are not as fully incorporated into the group as leadership would like. As the leadership team was unable to identify intentionally designed barriers that may contribute to this phenomenon, it has been coded as Quadrant D.

Figure 3

Sociogram Showing Existing Staff vs. New Staff



Finally, the statistical analysis of the data revealed that while the group is highly collaborative and friendly, the there is a lower level of internal advice seeking than the leadership team would prefer (Quadrant C). The statistical analysis also revealed one subgroup to be a mathematically perfect network in the areas of collaboration and friendship, a desired outcome that was not intentionally designed (Quadrant B).

Action Taken

Based on lessons learned, the leadership team has undertaken an intentional effort to implement improvement activities that will strengthen the relationships within the network. These efforts have been incorporated into the team's ongoing continuous improvement efforts and strategic plan.

Given that internal advice seeking is lower than desired, the team has sought to create an annotated directory of ER staff that allows staff members to self-identify areas of expertise. As the team discussed the results with staff, it was made clear that some members of the staff didn't know enough about the backgrounds of other staff members to consider them as an advice-seeking partner. Leadership hopes that the development of an annotated staff directory will prompt staff to seek advice from new colleagues across all regions.

As leadership can now see that a divide exists between staff serving in rural and urban areas, they have made a commitment to ensuring that opportunities for cross-regional collaboration are made available on a regular basis. This may take the form of professional learning opportunities, team-building activities during in-person meetings, and an intentional assignment of staff across regions when new supports must be developed. By intentionally mixing team members during staff events, the leadership team hopes that new connections, collaborations, and friendships can form. This will further support their mission to support low-performing schools as staff will be more willing to share the results of their efforts beyond regional boundaries.

Additional efforts will also be made to incorporate new staff into the team more fully. The leadership team already supports a robust onboarding process and the intentional system design that underlies the program ensures that staff are matched with peers for collaborative work. The leadership team is committed to finding new ways to bring newly hired staff into the network at a faster pace. This may include giving new staff opportunities to participate in leadership roles, lead professional learning opportunities, or participating in leadership development courses offered by the KDE.

Finally, the leadership team has made a commitment to the continued monitoring of the health of their network. Efforts to do so include the implementation of an annual SNA procedure, the open and transparent discussion of the results of the

SNA, and the regular collection of staff feedback. This commitment also reflects the approach to continuous improvement and data-driven decision-making that the ER staff support in their daily work. This model-setting is an important element of the work that helps to build trust and cooperation when schools are newly identified as low-performing.

DISCUSSION

The experience of the KDE can inform the continuous improvement work of other organizations. The model documented in this case study represents how an organization and its workflow was impacted by the pandemic as well as how leadership recognized an opportunity to move the organization forward as staff returned to providing support to low-performing schools in the face-to-face setting. The ER staff is structured similarly to other educational organizations who intentionally work together, share resources, and serve as critical friends to support the work of continuous improvement. During the pandemic this group found themselves working in much smaller groups and supporting schools virtually. This was a major change and challenge for the ER staff whose work is built around the factors of trust and building strong relationships that help foster sustainable school improvement.

The design and outcome quadrants (Figure 1) helped frame the discussion for leadership who had long suspected that there was a divide among the group that served the urban area and the groups that served more rural areas across the state. This was not an immediate improvement concern during the pandemic, but as services returned to an in-person format, identifying and remedying division among the network became more important. The SNA and four quadrant discussion helped leadership to quantify the suspected gaps in their network and begin to actively work to improve the health of their system.

These conversations helped guide leadership as they made informed decisions about strengthening the relationships between ER Staff. Strong relationships across the team of ERs are needed to ensure that high quality support is being provided to the lowest performing schools in the Commonwealth.

By quantifying the strength of their network in specific terms, leadership was able to make strategic, but simple changes. Organizing staff by job roles and with other regions rather than allowing staff to sit with their school team opened lines of communication instantly. Conversations and plans are in place to provide upcoming professional learning experiences to cross regional teams to ensure that all regions are being exposed to the same type of high-quality experiences. These simple changes will trigger the development of new relationships due to the structure of the work and the personalities of the ER staff.

Considerations for Replication

While the SNA process described above has led to meaningful insights for the KDE and informed strategic improvement decisions, organizations seeking to replicate this effort should consider contracting with an outside, independent agency to collect the data and complete the analysis. The SNA procedure requires a high level of pre-existing trust and transparency: a feature that already existed at the KDE as is evidenced by both the density of the network and the 100% participation rate. For SNA to be successful, steps must be taken to increase trust and ensure the confidentiality of the process. Team members that are suspicious of the motivations of a leadership team may give inaccurate information or choose to opt-out of the survey all together if the analysis is to be performed by internal staff. As the SNA data collection is not anonymous, participants may experience a high level of personal, professional, and emotional exposure (Daly, 2019). By creating intentional barriers between themselves and the raw data, leadership can signal a commitment to confidentiality.

Additionally, completing an SNA is relatively technical. An organization must have access to a data analyst who is proficient in working in the R statistical computing environment or a similar environment such as Python or UCINET. By working with an external partner, the organization can expand its capacity and gain access to a deeper level of data analysis.

CONCLUSION

The SNA process can be a meaningful addition to the continuous improvement efforts of organizations seeking to strengthen the collaborative relationships between members of their network. When deployed by the KDE, it allowed leadership to identify gaps created by intentional design decisions as well as strengths that resulted from unintentional design. The KDE leadership team was able to implement continuous improvement efforts that targeted these phenomena directly in a way that aligned to its commitment to evidence-based and data-driven decision-making. While the SNA procedure described in this paper was beneficial for the KDE, those seeking to replicate the process would benefit from contracting with an external partner to complete the analysis. Through a carefully crafted SNA procedure, leaders can better understand the way in which

their staff work and nurture more collaborative and responsive teams. School and system leaders should consider partnering with external research organizations to complete this task to improve trust and expand upon existing analytic capacity.

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