Social Network Analysis and Systems Change

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Abstract

The paper provides a methodological discussion of how the sociometric method of network analysis can provide a robust analytic technique for understanding complex human systems. Framed within Churchman's notion of "sweeping in" approaches from various disciplines, applications of social network analysis are discussed in terms of their usefulness in systems planning and redesign. The authors argue that this method provides a means for understanding systems from their own points of view. In other words, the method provides the actors within a system a rigorous construct by which they can define their interrelationships. Once the system is mapped, positions of influence and strength can be determined as points for initiating intervention and diffusing innovation. This provides both an effective and efficient avenue for systems change.

The discussion begins with an overview of how systems methodology evolves, drawing in rigorous scientific methods (Churchman's "sweep-in" process). The parallel development of sociometry as a means for understanding complex social systems is then presented. The intellectual goals of the sociometry are tied to the pragmatic goals of systems science. The notion of "authenticity" is then discussed in terms of the role of who defines the system. The role of the participative methods in creating understanding and ownership is explored. Network analysis is presented as a systems approach that brings structure to the analytic phase of systems redesign. In Ackoff's terminology, it provides another way to "formulate the mess." A detailed overview of the mechanics of network analysis is then provided. The tools for information gathering and the computer-based analytic tools required are discussed at length. Actual socio-grams of complex systems developed by the authors are used as examples.

The paper concludes with a discussion of application. This includes how the method can be used within a single organization and within communities of organizations. It also addresses how the tool can be used to foster organizational learning, factors contributing to efficient intervention, and means for charting systems development over time.

Introduction

For the purposes of this paper, the authors would like to pose this definition of network: it is a system characterized by complex interconnections between its parts. The study of networks is viewed as the study of complex systems that emphasizes the complex relationships that bind the elements together. It addresses the nature of the relationships within a system, not the nature of the elements.

Network concepts and methods have been widely applied in every "hard" scientific domain, from basic research in physics, biology and chemistry, to the applied spectrum of engineering disciplines and medicine. The mathematics of network analysis has been widely used to model and simulate physical, biological and mechanical complexity.

This framework has also been widely used to study social interactions in behavioral fields including anthropology, sociology, history, social psychology, political science, human geography, and communications. Network analysis is currently the focus of increasing study and application throughout the field of management. It is this approach, network analysis as it can be applied to social systems, that is the focus of this paper.

While network concepts and methods have been widely used to describe social systems, they have not been as widely utilized as practical tools for systems change. It is the authors' intention to demonstrate that network analysis can be a powerful tool in the context of participative planning and design efforts. In the hard sciences, network tools moved from the laboratory to medical and engineering applications. Likewise, the use of network methods in the social sciences can shift toward application.

We begin with a discussion of the systems context for embracing social network analysis as a method. Here the notion of "sweeping in," a pragmatic approach to the development of methodology, plays a central role. This is followed by an overview of the evolution of social network analysis. The detail here is important, because it provides insights into how sociometrics can provide an analysis of a complex system from its members' point of view. The third portion of the discussion argues that participation always considered a key element in successful systems planning and design is usually omitted from the initial analytic phase of the process. And, finally, the case is made that social network analysis provides a method to develop highly significant participation to the analytic portion of planning, thereby strengthening the overall process.

"Sweeping In": The Logic of Methods in Systems Thinking

Defined simply, "methodology" is the logic of methods. Those of us working in the social sciences seem to spend a significant amount of time assuring the precision of our methods, but give little thought to why we use a particular approach or combination of approaches to a specific problem or issue. The methods we apply to the study of social systems should, or course, be rigorous. However, they should also be coherent and provide a sound basis for judging the appropriate aspects of the particular system we want to learn about. In other words, our choice of methods provides the intellectual context in which we understand a given system.

The "sweep-in" process in systems thinking is key to the development of our current, and often contentious, multi-faceted systems methodology. The roots of significant streams of systems thought can be traced to William James, the nineteenth

century American pragmatic philosopher. He maintained that the choices a scientist makes in carrying out his research have a permanent effect on the results of his inquiry (James, 1890). The methods we chose and our view of those methods influence how we understand a social system. Each method we bring to a problem and colored by our own perspective, provides but one possible way of seeing or approaching the truth. Multiple methods and points of view are needed to approach the "truth." As Churchman points out (1968) the more relevant knowledge we bring to an issue or situation, the more we "sweep in, " the richer and deeper our understanding of that situation, and the closer we approach the truth.

Social network analysis represents an approach that is being "swept in" to the family of systems research methods. If provides another rigorous set of methods by which we can understand complex social interrelationships. Historically the methods were developed in parallel with systems theory. Simultaneous development of compatible approaches is common. Scientists and scholars work in isolation and on similar problems. The first step in the "sweep-in" process is to break down these barriers by understanding what exactly social network analysis is and how it evolved.

Social Network Analysis: Evolution and Intent

Network analysis derives its theoretical roots from anthropology, sociology and social psychology. Jacob Moreno (1934) is credited with laying the foundation of what is now generally conceived as network analysis. His development of the sociometric method of group analysis provided the first empirical measure of group-level communication and subgroup formation. The results of this analysis are presented in a

sociogram (Figure 1), which supplies an illustration of the patterns of communication that exist in a social system.

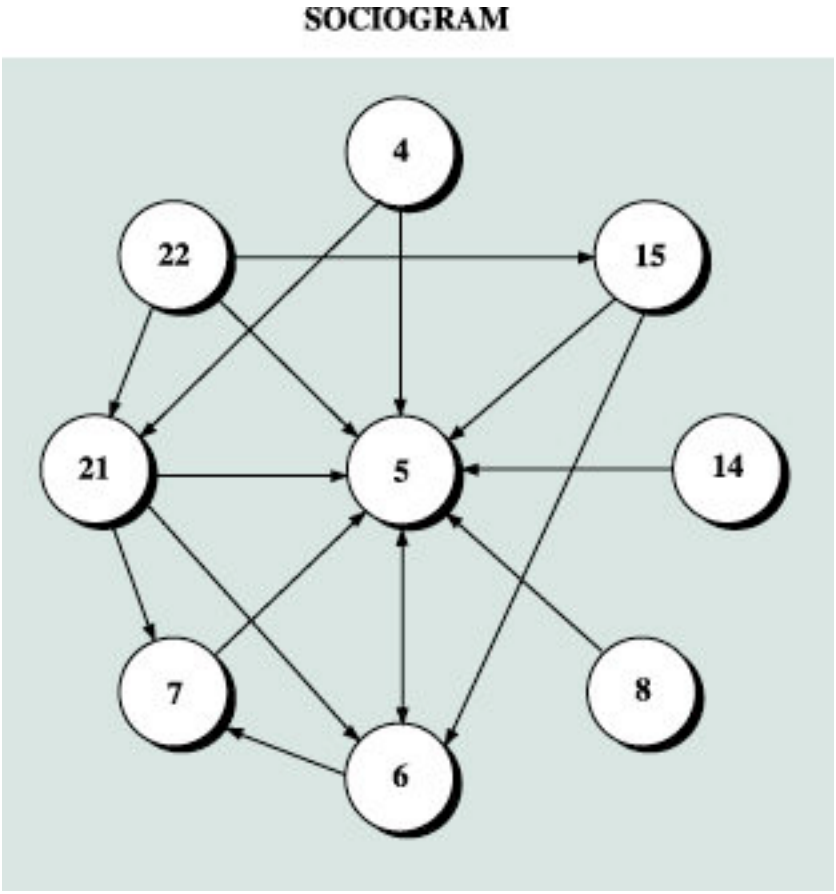

Figure 1.

Illustrates a network of elements. Circles indicate elements, while lines indicate perceived relationships between the various elements. In this sociogram, element number 5 receives communications from all the other elements, but communicates only with element number 6.

Moreno's pioneering work in this area involved an examination of the social relationships existing among individuals who were members of subcultures separated from mainstream society. Most of Moreno's propositions and studies of sociometric analysis is included in his 1934 book Who Shall Survive. However, the methodology

utilized by Moreno was cumbersome and difficult to understand (Treadwell and Leach, 1987). As a result, sociometric network analysis suffered a decline in usage until the mid 1950's.

One influential study that contributed to the resurgence of interest in this technique was Bott's (1957) investigation of family life and domestic practices. Bott studied 20 families in London and set out to explain the effects that class and geographic location had on the allocation of household tasks between the husband and wife. She discovered that an individual's position in his/her social network acted as a convening variable between geographic location and class. This finding suggested that network variables can potentially have a significant effect on human behavior.

While the principles of sociometry are still widely used in social network analysis, the last three decades have seen a shift from an emphasis on social distance or cohesion, to one that emphasizes structural position in the network, independent of the links between two actors in the social system (Burt, 1992). This change is reflected in the wave of network theorizing as reflected beginning with the works of White, Boorman and Breiger (1976) and Granovetter (1973) and the current and increasing number of applications of network analysis in the organizational and management literature (DiMaggio, 1986; Burt, 1992).

Defining the Network: Position, Relationships and Structural Patterns

For our purposes, it is the notion of network "position" that is key. It enables the observer to understand the structure of the overall system from the actors' points of view (Powell, 1990). Sociometric methods map systems by portraying how the collectivity

views the positions individuals occupy. It is not an aggregate of individuals defining their own positions within the system, based on certain categories of relationships. For example, when defining a network based on "influence," one does not ask "whom do you most influence," but "who most influences you?" The result is a more reliable portrayal of the relationships constituting the whole.

Common types of network relationships that can be mapped sociometrically include:

1. **Product/Service** - Systems are connected by virtue of providing a similar product or service

2. **Market Proximity** - Systems are connected by virtue of sharing the same market.

3. **Geographic Proximity** - Systems are connected by sharing a geographic location.

4. **Shared Board Members** - Systems are connected by having the same individuals serving as board members within their governance structures.

5. **Shared Employees/Human Resources** - Systems are connected by sharing employees or employing individuals who previously worked in another part of the system in the network.

6. **Technological Diffusion** - Systems are connected by using the same technologies.

7. **Alliances** - Systems are connected through strategic or operational alliances or partnerships..

8. **Functional Overlap** - Systems are connected by serving a similar function or purpose in the broader environment.

9. **Union Involvement** – Systems are connected through the presence of the same trade unions.

10. **Sources of Investment/Funding** - Systems are connected by utilization of the same sources of investment or funding.

11. **Connection to Private/Government/Nonprofit Organizations** - Systems are connected by having tie to the same organizations in the private sector, government or non-profit sector.

12. **Influence** - Systems are connected to those who act as a source of influence.

13. **Expertise/Information** - Systems are connected by sharing the same information or sources of expertise.

While the above reflect categories of elements that describe network relationship, the following variables reflect elements of network structure and position that have been found to impact system effectiveness:

1. **Network Density** - The degree to which the network is comprised of highly interconnected systems or elements. This variable indicates the degree of autonomy or independence present for members of a given network.

2. **Network Centrality** - The degree to which an element or system is embedded in a complex series of inter-system ties. Centralized components may be either highly influential or inert depending on the criteria for the relationship. For example, highly centralized organizations tend to be more innovative and less creative than non-centralized organizations.

3. **Subgroup Formation** - Cliques of structurally similar elements or systems. Structurally similar components tend to share information, personnel, managerial procedures and resources. As a result, they tend to produce products that are similar in scope and success. It is not uncommon for subgroups to be isolated from the dominant network, but able to achieve the benefits of network membership on a more localized level.

4. **Degree of reciprocity** - The degree to which the criteria for system connectivity is one or two way. For example, a funding source may be connected with an organization in a one-way (non-reciprocal) relationship or two organizations may be connected through a joint venture in a two-way (reciprocal) relationship.

If we look at these network measures, it becomes clear that they hold enormous potential for supporting the initial systems analysis in systems change processes. They enable us to engage the members of the system in a structured and rigorous mapping of key relationships. The types of relationships we uncover through that process provide a critical insights into positions of influence, patterns of communication, concentrations of resources, and other dimensions that can support systems change or impeded it during later implementation phases of the change.

Systems Thinking in Application: Planning

Planning activities resulting in creative systems design and change, are a primary way that systems thinking shapes the world. Systemic participative approaches to planning are, for the most part, very clear on the role that stakeholders play in the design or redesign process. For example, Ackoff (1970) stresses that the idealized design

process in interactive planning enhances creativity, builds consensus and assures commitment to implementation through participation of those affected. Emery and Purser (1996) stress that the convening of stakeholders and guided discussion is key to the success of their search conference methodology. One can view this inclusive approach as another example of the sweep-in process at work. Diverse points of view of parties with standing are necessary to approach a "truthful" collective understanding of the situation.

It has largely been the role of the external planning "expert" to guide the initial systems analysis, often labeled environmental assessment, in the planning process. The assumption is that the expert has tools and techniques that can help those being planned for see their situations in novel ways. Various analytic methods can surface relationships and potential points for systems interventions that might otherwise go unnoticed or underappreciated because the members of the system are simply too close to the situation.

It has also been the role of the external "expert" to guide the implementation of the plan. It is assumed that once there is agreement on the goals or purposes of the system, means planning becomes largely technical. Changes in operations, monitoring and control are dictated by the overall future design.

The key issue here is that participation of those who have ownership of the system is fragmented. It is the authors' contention that continuous and consistent participation in a structured way from initial analysis, through design and implementation provides a more authentic and productive relationship between the participants, the system being planned for and the external expert group.

If a sociometric analysis is carried out to provide a baseline analysis of the system it also provides a roadmap for future systems change efforts. The system itself identifies possible routes for social intervention such as communications channels, shared decision-makers, and existing partnerships or alliances. The roadmap can be reviewed by the participating members to enhance learning about the overall set of relationships and potential of the system for enhancement. Likewise, as systems change is implemented sociometric analysis provides a way to track changes and deviations from what is anticipated.

Conclusion

By sweeping in social network analysis from the realm of empirical social science research and into the world of management practice, planning for human systems can be significantly enhanced. Sociometric methods provide a way to enhance participation in the planning process that is both rigorous and useful. Stakeholder involvement thereby become more meaningful from initial analysis throughout implementation.

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