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Social Network Analysis

By Neil Reid and Bruce W. Smith

ITS USE IN LOCAL ECONOMIC DEVELOPMENT

Social Network Analysis (SNA) is a tool that can be used to better understand the nature and structure of economic development networks. Using the example of the Toledo, Ohio MSA, **this article uses SNA to examine collaboration networks** within the economic development practitioner community. The SNA identified a core of 31 persons from 11 organizations who are most central to the local collaboration network. Also, the findings indicate an emerging, yet important, role is being played by the local university in local economic development efforts. At the same time, there is room for improvement in inter-county collaboration within the MSA.

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INTRODUCTION

Economic development in U.S. metropolitan areas is often fragmented along both jurisdictional and institutional lines. It is not unusual for a metropolitan area to have a number of agencies that have economic development as part of their mission. It is also not unusual to find overlap in the services provided and geographical areas serviced by these various agencies.

Fragmented economic development systems possess a number of inherent dangers. Duplication of efforts, unwillingness to share ideas and information, hesitation to collaborate on development opportunities, and jurisdictional and institutional territoriality are just a few of the potential pitfalls of fragmentation. Since the majority of economic development agencies are publicly funded, another problem caused by fragmentation is tax-payer dollars not being utilized in their most efficient and effective fashion.

The challenges associated with fragmentation are exacerbated by the need for economic development agents to be seen as effective in the eyes of those who elect them, appoint them, or hire them. Self preservation may be prioritized above regional growth.

The negative effects of fragmentation can be ameliorated to some extent if those who work for a metropolitan area's economic development agencies do communicate with each other on a regular basis, do share ideas with each other, and do collaborate on projects and initiatives. This leads to the question of how to measure the extent of collaboration that does occur within a fragmented economic development environment. In this article, we use the Toledo MSA to demonstrate that Social Network Analysis (SNA) is a potentially useful tool for measuring the nature and extent of collaboration among economic development practitioners within a metropolitan area.

Toledo, Ohio, has over 30 agencies that claim economic development as part of their mission.

Given the current economic circumstances and the fiscal challenges facing many municipalities, understanding networks of collaboration is particularly relevant. Cross-institutional and cross-jurisdictional collaboration, when done strategically, can reduce duplication of efforts, be the catalyst for new and innovative economic development initiatives, and provide taxpayers with better value for their tax dollar.

We briefly describe networks and why they are important to the process of economic development and then we describe the method of Social Network Analysis (SNA) and some of the key characteristics of networks that SNA measures. We illustrate the use of SNA by analyzing the example of the economic development collaboration network in Toledo. Finally, we discuss the implications of the SNA results and how these might be used in guiding policy making.

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The University of Toledo has become a major player in northwest Ohio's economic development efforts during the last decade.

WHAT ARE NETWORKS AND WHY ARE THEY IMPORTANT?

Networks are composed of people and/or organizations that are connected with each other through the exchange of information, ideas, business transactions, and knowledge. Within the context of economic development, networks are typically composed of people who have responsibility for advancing the economic development of a particular geographic region (e.g. neighborhood, city, or a metropolitan statistical area).

Recent work in local economic development has stressed the need for network building at the local, regional, national, and global levels (see for example Malecki 2002). Glückler (2007, 631) characterized networks, which facilitate economic growth, as the "architecture through which productive resources, social values and economic interests circulate."

Networks are important because they are the framework through which people interact with each other and, as a result of these interactions, economic development occurs. Most economic development projects require that people collaborate to seal the deal and turn possibility into reality. For example, when the city of Toledo, Ohio, learned in the summer of 1997 that it had successfully retained its Jeep assembly plant, it was the culmination of months of collaboration among members of the 39-member "Project Jeep" team as well as dozens of other community stakeholders (Gatrell and Reid 2002). While headline-making successes such as Toledo's effort to keep a major employer are important, it is the day-to-day interactions among economic development practitioners that create the relationships and build the trust that are critical to developing a culture of collaborative economic development.

Mature, well-developed, and efficiently functioning networks are also indicative of what is termed "institutional thickness". Institutional thickness refers to the set of local conditions that are an asset to local economies in an era of increased global competition. Within the context of local economic development, institutional thickness has four key components (Coulson and Ferrario 2007, 593). These are:

1. The existence of a variety of economic development agencies, such as chambers of commerce, universities, business service organizations, and local and regional governments.
2. High levels of interaction among local economic development agencies, including information exchange and collaboration.
3. A common vision and shared priorities for the development of the region.
4. Structures of power and/or patterns of coalition which 'minimize sectionalism'.

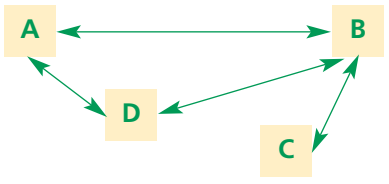
Because networks and their associated interactions are often invisible in the sense that they do not exist on a formal organizational chart, identifying and analyzing interactions, such as collaboration, is often challenging. At the same time, if high levels of interaction and collaboration within a network context are important ingredients of a region's economic development efforts, it becomes critical that we have a method to measure the nature and structure of collaboration within a region's network of economic development practitioners. SNA provides such a method.

SOCIAL NETWORK ANALYSIS

Social Network Analysis is a tool that can be used to analyze the structure of inter-personal relationships within a group of individuals. These relationships, taken collectively, constitute a network. SNA treats individuals as nodes and the relationship between individuals as linkages. The simple network illustrated in Figure 1 comprises four individuals (A, B, C, and D). The arrows connecting the individuals are linkages and represent some type of inter-personal interaction. While individual C does not interact with A and D, he/she is part of the network through his/her relationship with B.

FIGURE 1

Simple Hypothetical Network



Various network metrics have been developed which enable one to compare the structures of different networks. In the remainder of this section, we describe the key network characteristics that are relevant to networks of economic development practitioners.

Centrality

Centrality measures a person's position in the network. A person with high centrality is well connected to other people in the network and therefore has better access to information, resources, and influence than people with lower centrality. There are different dimensions of the concept of centrality in a network. For example, DeSantis (2006, 33-34) refers to "Bridgers". These people "have real power, the source of which is a "personal reach" that stretches across every imaginable boundary and into every corner of a given community." SNA researchers have developed mathematical measures of centrality, such as degrees, betweenness, and closeness.

Based on the purpose of this work and the characteristics of the network, we selected "degrees" as the most appropriate metric for measuring centrality. Degrees is the number of ties that a person has to other people in the network. Since the number of connections will be influenced by the size of the network, degrees is standardized by network size so it ranges from 0 (no connections) to 1 (connected to everyone in the network). More specifically, we use degrees-in centrality because it measures the number of times a person is mentioned by others in the network and therefore eliminates the bias of self-reporting. In Figure 1, node B has the highest degrees-in centrality and node C has the lowest.

Density

An important network characteristic is density. Density can be measured by calculating the actual number of connections within a network as a percentage of the maximum number of potential connections (de Nooy et al 2005). In our hypothetical network (Figure 1), if everyone was connected to everyone else the total number of connections would be 6 and the density would be 100 percent. As A and D are not connected to C, the actual number of connections is 4. This network, therefore, has a density of 66.6 percent (4 of 6 possible connections).

High density networks are desirable. The higher the density the more rapidly information will circulate between network members. Again, referring back to our hypothetical network (Figure 1), for information to pass from A to C it must pass through individual B. On the other hand, if A and B had a direct connection the information could pass directly, and presumably more quickly, between these individuals.

A high density network is also more durable. If individuals were to leave the network (e.g. due to retirement or relocation), then a high density network should be able to survive their removal and continue to function in an efficient and effective manner. All networks have their limits, however, and the more people that leave the more susceptible a network is to breakdown.

Spatiality

Spatiality refers to the geography of a network. The geography of an individual's collaboration network is important. If economic developers within a region are committed to a regional approach to economic development, this should manifest itself in cross-jurisdictional collaboration. Moreover, in the US, state policies can strongly impact local economic development. As one example, the cost of incentives frequently is partially borne by the state. Thus one would expect to observe collaboration among local economic development officials and state officials.

COLLABORATION IN ECONOMIC DEVELOPMENT FROM AN SNA PERSPECTIVE

In this section, we describe the results of our illustrative SNA of the economic development network in the Toledo Metropolitan Area (hereafter referred to as Toledo) (Figure 2). First, some context on the economic development system in Toledo will be provided, followed by a description of the methods of data collection. Finally, the insights into collaboration among economic development practitioners that can be gleaned from the SNA will be discussed.

Toledo MSA Economic Development

Economic development efforts in the Toledo MSA are fragmented. The responsibility for economic development is vested in a large number of organizations. Information compiled by the University of Toledo's Urban Affairs Center identified over 30 entities (public and private) that claimed to perform some type of economic development function in the city of Toledo or Lucas County alone.

A consultant, hired to help Toledo streamline its economic development efforts, noted the gaps, overlaps, and confusion caused by such a plethora of economic development entities: "Toledo has an extensive number of agencies and other entities that list economic development as part of their mission and work program. However, the consensus of our extensive economic development interviews confirms our own analysis that there is no organizational strategy to assign and allocate

FIGURE 2. Toledo, Ohio MSA

each economic development function into a lead agency with roles of all participating agencies defined and agreed to. The result is inefficiency and under-performance" (Hammer, Siler, George Associates 2004, ii).

Despite the consultant's findings, Toledo's economic development landscape remains fragmented, five years after the study. While there are a large number of economic development entities in the Toledo area, there are a small number of organizations that serve all or large segments of the MSA. For example, the Regional Growth Partnership serves the entire metro area and beyond. The Toledo-Lucas County Port Authority operates throughout Lucas County, as does the Toledo Regional Chamber of Commerce. Similarly, some counties have economic development agencies which serve the entire county.

The University of Toledo's commitment to economic development is reflected in its newly dedicated Scott Park Campus for Energy and Innovation.

Data Collection

The first step in data collection was to compile a list of individuals engaged in economic development activities, including chambers of commerce, economic development agencies, and universities as well as elected officials (e.g. county commissioners) who were either directly or indirectly involved in economic development. The list included 81 individuals, each of whom received a survey.

The 81 people were listed on the survey. Each individual was asked to indicate which of the other 80 people they had collaborated with on an economic development project within the last 12 months. They could also add names of other people (not on the list) with whom they had also collaborated. A total of 59 people responded to the survey, providing a response rate of 70 percent. The 59 respondents added the names of 115 additional people with whom they had collaborated on economic development projects. Thus, a total of 174 different nodes (people) resulted from the survey.

In effect, this becomes a snowball type of sample because one can then send the questionnaire to those persons listed by respondents who were not on the initial roster. The results reported in this article are based on the responses received from the original list of respondents. Snowball sampling has limitations because it is not a random sample (Frank 2005). Also one could argue that the network structure identified may be inherent in the sample itself. However, it provides a practical method of data collection when an extensive sampling frame is not available.

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Once collected, the data were analyzed using software called InFlow 3.1 (Orgnet.com). There is a wide variety of SNA software. We utilized InFlow because the creator lived a few hours drive from us in Cleveland, Ohio, and we were, therefore, able to receive face-to-face training from him and to consult with him when questions arose concerning either SNA in general or the software in particular. He is also a nationally recognized expert in social network analysis.

SNA Results

One insight provided by the SNA is identification of the people and agencies that are most central to the region's economic development network. Using degrees-in centrality scores for individuals, one can identify various groupings of the most central people in the network.

GLOSSARY OF KEY TERMS

Social Network Analysis – Social Network Analysis provides a quantitative and graphical description of the relationships or interactions among a defined group of people or organizations.

Node – A person or organization within a network.

Linkage – A linkage or interaction between nodes in a network. A linkage could be information flows, business transaction, or kinship ties.

Network – Networks are composed of people and/or organizations that are linked with each other through the exchange of information, ideas, business transactions, and knowledge.

Centrality – A measure of a node's position in a network.

Density – A measure generated by calculating the actual number of connections within a network as a percentage of the maximum number of potential connections.

E/I Ratio – A measure of the internal or external orientation of a group's interactions.

In this Toledo example, we arbitrarily selected two groups. First, there were 31 individuals who were identified as members of Toledo's economic development core. Core membership was restricted to individuals who had centrality scores more than one standard deviation above the mean centrality score. Second, a super core of individuals was identified. These are individuals whose centrality scores were more than two standard deviations above the mean centrality score.

To maintain the anonymity of individuals, we are not permitted to list specific names. However, we are able to list membership of the core and super core by organization of the individual (Table 1).

An examination of the network's core indicates not only the leading collaborative organizations, but also those organizations that are more peripheral in regional collaboration for economic development. For example, the core of Toledo's economic development network comprises 31 individuals, representing 11 agencies. The relatively large number of agencies represented in the core is indicative of a high level of institutional thickness (Coulson and Ferrario 2007).

However, absent from the core are any representatives from two of the MSA's four counties, Fulton and Ottawa counties, which is potentially a cause for concern from the perspective of regional collaboration. This result suggests a cross-county approach to economic development is only occurring on a limited basis.

Moreover, only one representative of the private sector (First Energy Corporation) and one representative of the state of Ohio (Ohio Department of Development) are included in the core. This suggests limited engagement by the private sector and the state in regional economic development efforts.

It is noteworthy that the University of Toledo, with six individuals, has the largest representation in the core, indicating that the university is a major collaborator in the region's economic development efforts. This is a positive finding as there is considerable evidence that a strong university partner should be a cornerstone of any region's economic development initiatives (Smilor et al 2007).

This result could, in part, be attributable to the fact that the university is a much larger organization than any of the other local organizations. Nonetheless, in recent years, one goal of the University of Toledo has been to become a more active partner in the region's economic development efforts.

TABLE 1
Toledo's Economic Development Collaborators: Core and Super Core

Organization	Function	Number of Individuals	
		Core	Super Core
University of Toledo	Education	6	0
City of Toledo	City government	4	1
Toledo-Lucas County Port Authority	Management and coordination of city and county transportation assets	4	1
Regional Growth Partnership	Regional economic development	4	3
Toledo Regional Chamber of Commerce	Business networking and advocacy	4	2
Lucas County Commissioners	County government	3	0
Lucas County Improvement Corporation	County economic development	2	2
First Energy Corporation	Energy provider	1	1
Local Initiatives Support Corporation	Community development	1	0
Ohio Department of Development	State economic development	1	1
Wood County Economic Development Commission	County economic development	1	0
	TOTAL	31	11

Much of the credit for the university's high standing among the local economic development community can be attributed to Professor Daniel Johnson who was president of the university between 2001 and 2006. Under his leadership, the University of Toledo successfully undertook a number of initiatives that elevated the university's commitment to and role as a partner in local economic development.

President Johnson's commitment to the university being a major player in local economic development has been embraced and continued by his successor, President Lloyd Jacobs. Strong leadership at the presidential level coincided with encouragement from the state of Ohio for universities to forgo their historical insularity and contribute to the local economic development efforts.

Examination of the super core network (defined as individuals with a centrality score of at least two standard deviations above the mean) is also enlightening (Table 1). The super core comprises 11 individuals, representing seven agencies – City of Toledo,

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Very often when ad hoc regional organizations to promote economic development are formed, the membership is drawn heavily from the perceived leadership in the region. While the inclusion of such individuals makes sense, one should not overlook those persons lower in the organizational hierarchy who are key players in the collaboration network. One value of the SNA is that it objectively identifies such persons.

Toledo-Lucas County Port Authority, Regional Growth Partnership, Toledo Regional Chamber of Commerce, Lucas County Improvement Corporation, First Energy Corporation, and Ohio Department of Development. These organizations have long been involved in economic development efforts in the region and they have comparatively large service areas. Absent from the super core, interestingly, is the University of Toledo. Despite being the most highly represented in the core network, it is completely missing from the super core network.

The absence of university personnel from the super core can be explained by the fact that the university is a relatively new player in the northwest Ohio economic development game. It will take time for university economic development practitioners to demonstrate the value that the university can bring to the region's economic development efforts and to build relationships and develop trust with non-university development personnel.

Also absent from the super core are Lucas County Commissioners, the Local Initiatives Support Corporation, and Wood County Economic Development Commission.

An examination of the people in the centrality core, who cannot be named due to issues of confidentiality, indicates those persons who play a key role in the collaboration network of the region. It is notable that over 50 percent of those persons do not occupy positions of authority, such as director or CEO of their agency.

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Whereas degrees-in centrality measures the position of persons within the network, the cohesiveness of the economic development collaboration network is indicated by its density. Table 2 shows that the density of the super core network is very high (63 percent), and the core network density is somewhat lower at 44 percent.

TABLE 2. Network Density

Network	Nodes	Links	Density
Whole Network	174	1225	4%
Core	31	812	44%
Super Core	11	110	63%

In contrast, the density of the whole network is substantially lower (4 percent).

This differential in densities has various implications. As one example, information will move more quickly through the super core and core networks than through the whole network. Also the overall network is less cohesive. In general, these densities suggest that the Toledo economic development network is somewhat fragmented, with a relatively small number of individuals engaged in collaborative projects. The majority are somewhat marginalized from the collaborative process.

One source of fragmentation in the network is its spatiality. As noted in the discussion of the centrality core, no one from Fulton or Ottawa Counties is in the core. Additional insights into the geography of the network were obtained by the use of E/I ratios to examine cross-jurisdictional collaboration. The E/I ratio measures the extent to which a group of individuals are internally or externally oriented in their interactions.

E/I ratios range from -1 to 1. A group that is completely internally focused (i.e. all their interactions are with other members of their group) would have an E/I ratio of -1. In contrast, a group whose interactions are completely externally focused (i.e. all their interactions are with members of other groups) would have an E/I ratio of 1. An E/I ratio of 0 would indicate a group whose interactions are evenly divided between its own members and members external to the group.

The groups can be defined by whatever variable makes sense in the research project. For example, one could examine interactions internal and external to an organization. In this article, we use counties to define the groups.

Table 3 shows E/I ratios for the four counties that comprise the Toledo MSA. Two of the four counties (Fulton and Lucas) have high negative E/I ratios. This indicates a strong internal orientation and suggests that the majority of collaborative projects undertaken by economic development practitioners in Lucas and Fulton

TABLE 3. Inter-county Collaboration within the Toledo MSA

County	E/I Ratio
Fulton	-0.80
Lucas	-0.86
Ottawa	0.00
Wood	-0.15

County respectively are not occurring with colleagues who are located in other counties of the MSA. The other two counties (Wood and Ottawa) have E/I ratios that indicate a more balanced collaboration pattern. In both of these counties, economic development practitioners are more engaged in inter-county collaborative projects than their colleagues in either Fulton or Lucas County. Overall, the fact that three of the four E/I ratios are negative indicates that there is not a strong commitment to inter-county collaboration within the Toledo MSA.

Another aspect of spatiality is the extent of collaboration between northwest Ohio economic development people and economic development people working for the Ohio Department of Development, which is the state economic development organization. Less than three percent of the interactions are between northwest Ohio economic development officials and Ohio Department of Development personnel, with most of those interactions being with the local representative of the Ohio Department of Development.

DISCUSSION AND POLICY IMPLICATIONS

The purpose of this article is to demonstrate the utility of SNA in analyzing collaboration within an economic development network. Measures of centrality, density, and spatiality are diagnostic tools for assessing the characteristics of a network and identifying strengths and weakness.

In the example of the Toledo economic development network, one strength is a core of organizations with high levels of degrees-in centrality. The number of organizations in the core is indicative of a high level of institutional thickness, as is the large number of linkages resulting from the information exchange and collaboration among the core group. Moreover, the density of this core network generated by those linkages provides for the rapid diffusion of information among its members. The fact that the University of Toledo is so heavily engaged as a collaborative partner in economic development in the Toledo region is positive, given the studies that have emphasized the contributions of universities to regional economic development.

Weaknesses in the Toledo example can be identified. The most evident weakness is the lack of cross-jurisdictional or regional interactions. For example, in the core, only two out of the 11 organizations are located outside Lucas County. Also the E/I ratios indicate low levels of inter-county collaboration within the MSA. Another potential problem is the minimal involvement of private sector businesses and state development officials in the core.

In general, SNA provides a lens through which to view a local economic development network. In the Toledo example, we focused on intra-metropolitan collaboration, but one could focus on other aspects of economic development networks which may be important in a particular locale, such as private-public partnerships or soft versus hard networks.

SNA results can also impact policy in a region. As mentioned previously, one can use the results when creating the membership of cross-jurisdictional organizations. If one finds gaps in the local network, then it may be necessary to do network weaving. Network weaving is the process of strategically connecting people with common interests or goals and who can assist each other.

A weaver assumes a leadership role, encouraging linkages among people so that information begins to flow across the structural hole. This makes the economic development network more effective and cohesive in order to achieve specified policy objectives, be it regional collaboration or some other goal.

In the case of northwest Ohio, a network weaver might be assigned the task of encouraging and facilitating more inter-county collaborations. Krebs and Holley (2006) provide an extensive discussion of the theory and practice of network weaving used at the Appalachian Center for Economic Networks, a regional economic development organization in Athens, Ohio. The authors are using SNA results from another survey to do network weaving in a greenhouse cluster in northwest Ohio (Reid et al 2007).

Social Network Analysis is a tool that can be applied in any geographic region that wants to better understand the nature and structure of its network of economic development practitioners. It is particularly valuable because it brings objectivity to the process of identifying critical individuals within an economic development network, especially since it does not favor those with positional power (e.g. chamber presidents).

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It provides insights into networks which can not be obtained simply by interviewing those with positional power. However, SNA does not indicate the nature of social relations among persons in the network. If such information is needed, the SNA must be supplemented with interviews.

In general, Social Network Analysis is most useful when used as a diagnostic tool. The results of an SNA can indicate corrective actions (network weaving) that can be taken to address weaknesses highlighted by the analysis.

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