EDJ THE IEDC Economic Development Journal

734 15th Street, NW Suite 900 • Washington, DC 20005 Volume 6 / Number 4 / Fall 2007

Critical Steps in the Cluster Building Process

By Neil Reid, Michael C. Carroll, and Bruce W. Smith

THE ART AND SCIENCE OF CLUSTER-BASED ECONOMIC DEVELOPMENT

Economic development efforts organized around the concept of industrial clusters are increasingly popular. One of the challenges facing communities wishing to adopt such a strategy is the lack of a standard methodology that can be implemented once potential cluster industries have been identified. This article provides such a methodology. **The methodology described in this article has been developed as the result of the authors' experience in developing a very successful greenhouse cluster in northwest Ohio.** It is designed to assist any industrial cluster that is in the very early stages of implementation.

critical steps in the

CLUSTER BUILDING PROCESS

By Neil Reid, Michael C. Carroll, and Bruce W. Smith

INTRODUCTION

Hundreds of communities around the world have implemented cluster-based economic development (CBED) programs (Solvell et al. 2003). Products ranging from thoroughbred horses (Akoorie 2000) to Formula One racing cars (Henry and Pinch 2001) are being produced by industries that are part of an industrial cluster. Starting and maintaining an industrial cluster are challenging processes.

In an earlier *Economic Development Journal* article, we examined the challenges in initiating and maintaining a greenhouse industry cluster in northwest Ohio (Reid and Carroll 2006). The northwest Ohio greenhouse cluster was formally launched in January 2005. Since its inception, we have had the opportunity to reflect on the process of starting and managing a successful industrial cluster. In this article, we would like to share these reflections. In particular, we suggest a methodology for moving a cluster from identification to implementation. This methodology outlines a series of steps that are taken *once a particular industry has been identified as a target of cluster-based economic development.*

Numerous methods exist for identifying which industries might be legitimate candidates for a cluster-based economic development strategy. They can be identified through an analysis of industries that currently drive a local economy. Target industries can also emerge from political and industry interests. For example, the impetus for the development of a northwest Ohio greenhouse cluster resulted from strong interest on the part of the local Congresswoman to make the local greenhouse industry more competitive.

Northwest Ohio windmills. The region is in the process of developing an industrial cluster around emerging alternative energy technologies.

Interest on the part of a local industry can also provide the genesis for the development of an industrial cluster. For example, in northwest Ohio, businesses engaged in providing architectural, engineering, and construction services are in the very early stages of developing a cluster-based strategy for their industry.

Previous research has provided methodologies for identifying target industries (Feser et al. 2005, Rey et al. 2005) and has addressed the critical issue of financing (Osama and Popper 2006). However, there have been few attempts at providing a comprehensive and integrated methodology for cluster implementation.

CLUSTER-BASED ECONOMIC DEVELOPMENT

To provide a context for the methodology presented here, it is necessary to understand our con-

Neil Reid is Director of the Urban Affairs Center, University of Toledo, Toledo, OH (neil.reid@utoledo.edu).

Michael C. Carroll is Director of the Center for Regional Development (mcarroll@bgsu,edu) and **Bruce W. Smith** is a Research Fellow at the Center for Regional Development (bsmith4@bgsu.edu), Bowling Green State University, Bowling Green, OH.

THE ART AND SCIENCE OF CLUSTER-BASED ECONOMIC DEVELOPMENT

Economic development efforts organized around the concept of industrial clusters are increasingly popular. One of the challenges facing communities wishing to adopt such a strategy is the lack of a standard methodology that can be implemented once potential cluster industries have been identified. This article provides such a methodology. The methodology described in this article has been developed as the result of the authors' experience in developing a very successful greenhouse cluster in northwest Ohio. It is designed to assist any industrial cluster that is in the very early stages of implementation.

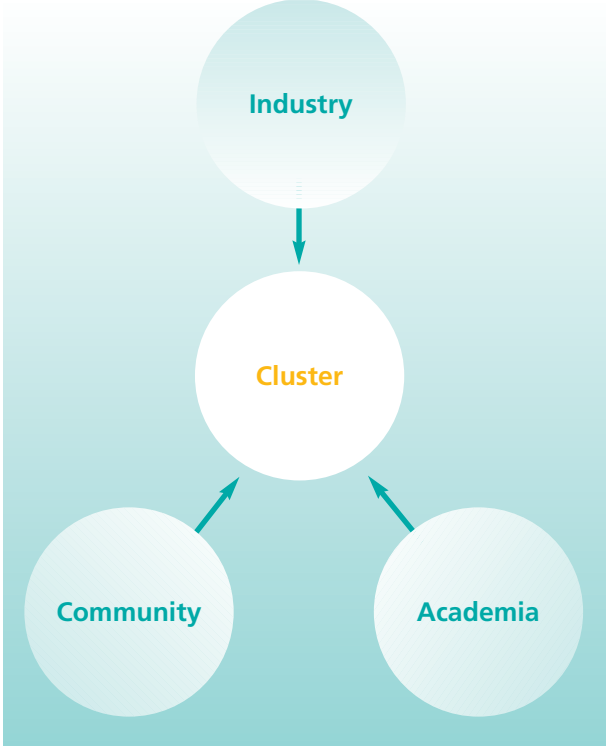
ception of CBED. An industrial cluster comprises a geographic concentration of firms within a particular industry. It extends beyond core firms, however, and includes any other actor or agency in the region who can contribute to the industry's competitive success. A cluster, therefore, should include supplier firms, university researchers, economic development practitioners, consultants, and any other individual or entity from the industry, academia, or the regional community who has skills, expertise, or resources that are of value to the industry (Figure 1).

The key to a successful cluster is collaboration among the members of the cluster. As noted by Porter (1998, 88), "the mere co-location of companies, suppliers, and institutions creates the potential for economic value; it does not necessarily ensure its realization". Similarly, Schmitz (1999, 1628) notes that "external economies are important to growth but are not sufficient to ride out major changes in product or factor markets; that requires joint action".

Joint action is the cornerstone of any successful cluster. Joint action allows members of an industry to collectively address challenges and solve problems that individual firms are incapable of addressing or solving by themselves. There are numerous examples of the advantages of collaboration within the framework of an industrial cluster (see for example Wolverhampton Telford Technology Corridor 2005 and Yorkshire Forward 2007).

If collaboration is paramount to a successful cluster, it follows that identifying the key people is critical. Elsewhere (Reid and Carroll 2006), we have argued that the infrastructure needed to operate a successful cluster be comprised of a Cluster Steering Committee (CSC), Cluster Strategy Team (CST)[1], Program Manager, and Cluster Champion. Selecting the appropriate people to fill these positions is critical to the success of any cluster. The people serving in these positions are the human glue that holds the cluster together. To a large extent, the success or failure of the cluster depends upon their performance in their respective roles. The methodology outlined here can help cluster initiatives to identify the best people to fill these various positions.

Figure 1.
Cluster Partners
Industry, Community, and Academia



GLOSSARY

CBED – Cluster-based Economic Development is a development technique that addresses challenges that may not be solvable by individual firms working in isolation.

CSC – Cluster Steering Committee is the group of people who initiate the process of starting a cluster.

CST – Cluster Strategy Team is the advisory and visioning group that is responsible for the oversight of the cluster.

I/O – Input/Output Analysis is an economic technique that identifies inter- and intra- industry linkages.

MSA – Metropolitan Statistical Area is a geographic entity consisting of a core urban area of 50,000 or more population and adjacent counties that have a high degree of social and economic integration with the urban core.

NAICS – North American Industrial Classification System provides industrial categories for reporting statistics about business activity in the U.S., Canada, and Mexico.

PCM – Potential Cluster Member is an individual or an organization that has the potential to contribute to the cluster.

PCR – Potential Cluster Regions are areas that potentially can support clustering activity because they contain the necessary concentration of firms in the industry and its associated supply chain.

SNA – Social Network Analysis provides a quantitative (and graphical) measure of the strength of interpersonal relationships within a defined group of people.

SWOT Analysis – Strengths, Weaknesses, Opportunities, Threats is a traditional technique for assessing the competitive environment of a firm or industry.

KEY STEPS IN FORMING A CLUSTER

In this section, we describe the step-by-step methodology that a new cluster initiative utilizes. This methodology should be implemented after a particular industry has been identified as a target for CBED (Figure 2).

A Cluster Steering Committee (CSC) will be responsible for implementing this methodology, after an industry has been identified as a target. The CSC is composed of a group of people in the region (from industry, academia, and/or the community) who have an interest in organizing an industry along the lines of a cluster.[2] Depending upon its genesis, the CSC may be more or less formal in nature. For example, if a local economic development agency is leading the cluster initiative, the CSC may be a formally designated ad hoc committee. Alternatively, the cluster initiative may result from more informal interactions among members of the industry and/or academia. In these cases the CSC might be a self-appointed, more loosely structured, group.

Define the Core Industry

It is critical that the core industry or industries being targeted for CBED be clearly defined at the very start of the cluster development process. Failure to define the core industry or industries at this early stage can result in ambiguity with regard to who should be at the table in the early phases of cluster formation. Later on, the article will describe the methodology used to define the core industry's supply chain.

If the core industry is a mature and established industry within a region, we recommend using the North American Industrial Classification System (NAICS) codes for the purposes of definition (U.S. Census Bureau 2002). Utilizing NAICS codes for defining the core industry is advantageous because one can easily access public data for analytical purposes. For example, in our work with the greenhouse industry in northwest Ohio, we defined the industry according to NAICS code 111422 (floriculture production). The product line covered by this NAICS code was a good match with the output of the northwest greenhouse industry.

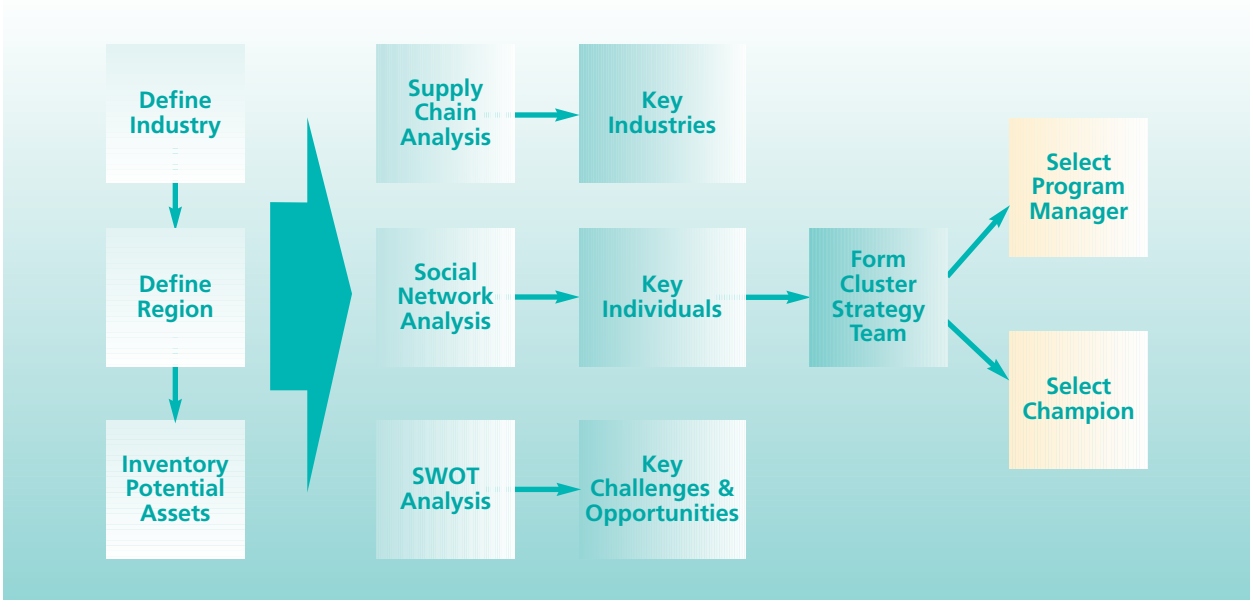
In some cases, NAICS codes may be of limited or no use in defining core industries. Some core industries, for example, are distributed across such a large and diverse number of NAICS codes. When this occurs, NAICS codes are problematic for the purposes of industry definition. The auto parts industry provides an example of such an industry. In a survey of over 300 auto parts manufacturers in Ohio, Rubenstein and Reid (1987) found that the parts manufacturers were distributed across 17 different Standard Industrial Classification (SIC) codes (SIC codes were replaced by NAICS codes in 1997)

It is critical that the core industry or industries being targeted for CBED be clearly defined at the very start of the cluster development process. Failure to define the core industry or industries at this early stage can result in ambiguity with regard to who should be at the table in the early phases of cluster formation.

NAICS codes are also problematic for defining industries that are at the beginning of the industrial life-cycle. Such industries are not of sufficient size to merit their own NAICS code. Where NAICS codes are not useful in defining the industry, it may be necessary to draw upon locally-based experts in the industry to provide definition.

The issue of industry definition is a basic, but necessary, first step in the process of building a successful cluster. It is particularly important if there are limited

Figure 2.
Key Steps in Forming an Industrial Cluster



resources to support cluster development. Concise definition of the core industry or industries permits efficient allocation of limited financial resources. It also facilitates efficient use of human resources by helping to identify who should and who should not be involved in the planning for cluster implementation.

Define the Potential Cluster Region

It is important to define the geographic region within which the potential cluster is going to function. Our strategy is to identify the "spatial footprint" of potential cluster regions (PCR). PCRs are areas that potentially can support clustering activities because they contain the necessary concentration of firms in the industry and its associated supply chain. PCR builds on the notion that spatial concentration is a necessary, but not sufficient, condition underlying CBED policy.

We recognize that a CBED is a network driven economic strategy that stresses collaboration among firms in the core industry, local suppliers, local government, and support institutions such as universities, think tanks, and development agencies. Consequently, a PCR only has the potential to be a cluster due to the co-location criterion. From this perspective, the examination of industry location patterns to delineate PCRs should be the initial step in a CBED, thereby eliminating the likelihood of failed cluster projects due to the lack of critical mass.

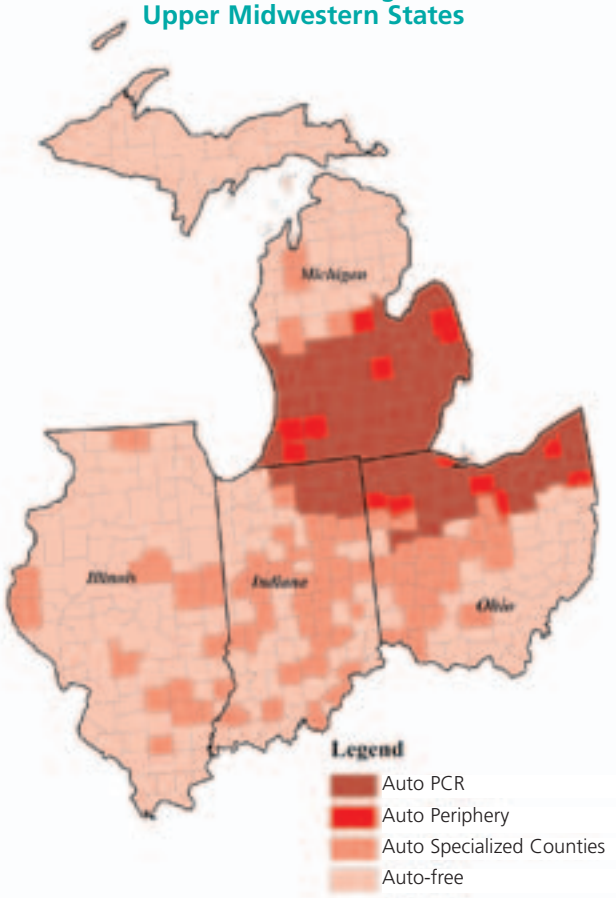
There are two basic approaches to delineating the PCRs. The easiest method is to choose a predefined region. A metropolitan statistical area (MSA), for example, is generally accepted by many analysts as an operational definition of a regional economy (Mayer 2005).

In specific cases, local economic developers may have a broader definition of the regional economy. For example, in northwest Ohio, the regional economy is defined as comprising an 11-county area. This reflects the service area of northwest Ohio's two primary regional economic development agencies - the Regional Growth Partnership (RGP) and the Northwest Ohio Regional Economic Development (NORED) organization. (Regional Growth Partnership, 2007). This definition is geographically larger than the Toledo MSA which comprises only four counties.

Another method of defining the potential cluster region is to derive it empirically using industry data to define the geographic footprint of the industry. Every industry has a unique spatial footprint, which may not conform to predefined regions. Some industrial spatial footprints are localized, encompassing a small number of counties, such as the greenhouse industry, while others are more geographically expansive covering a larger region, such as the auto industry. There are a number of quantitative methodologies relying primarily on census data, which can be used to define the geographic footprint of potential cluster industries (see for example Feser et al 2005, Miller et al 2001).

Our personal preference in defining PCRs is to use a methodology that combines the strengths of location quotients and measures of local spatial autocorrelation, such as Getis-Ord G_i^*. Location quotients measure the degree of industrial specialization within a county compared to the nation. In contrast, G_i^* measures spatial autocorrelation at the local level and it identifies "hot spots", or concentrations in spatial distributions in which counties and their neighbors have similar values of a given phenomena.

Figure 3.
Potential Auto Cluster Regions in Four Upper Midwestern States



A high G_i^* value indicates that high values are clustered near each other, whereas a low G_i^* value is indicative of low values being near each other (Wong and Lee, 2005). In this approach, a potential cluster region has location quotients greater than one and significantly high G_i^* values. Thus a potential cluster region is composed of counties which are more specialized in an industry than is the nation, and its neighbors also contain concentrations of that industry.

Figure 3 illustrates the output that can be produced using our methodology. In Figure 3 the counties identified as "Auto PCR" have the potential to be members of a regional automotive cluster. The geographic reach is extensive for the counties that could be part of an automotive cluster in the states of Illinois, Indiana, Michigan, and Ohio.

In reality, the region identified is probably too geographically large to operate as a single functional cluster. However, the information provided by this analysis could be used by a sub-region within the four-state area

to make an informed decision as to which counties should be part of a sub-regional cluster. For example, if northwest Ohio was interested in pursuing an automotive cluster, the Cluster Steering Committee could use the information provided to identify member counties. Another advantage of this methodology is that it can be applied on a nationwide basis, thus allowing identification of potential competitor regions located elsewhere in the country. The national clusters can be viewed as "geographic benchmarks" for monitoring industry trends.

Inventory Potential Cluster Members

Having defined the cluster industry, it is necessary to compile an inventory of potential cluster members (PCM). A PCM is defined as an individual or an organization that has the potential to contribute to the cluster and who, through that contribution, can provide value to the cluster initiative. PCMs should come from industry, academia, and the community (Figure 1).

In compiling the list of PCMs, expansive thinking and inclusiveness should be guiding principles, since it can always be reduced (or increased) in size at a later date. PCMs will provide the basis for the Social Network Analysis that will be conducted at a later date. The list of PCMs should be compiled by the Cluster Strategy Team, in consultation with regional industrial experts.

Conduct Supply Chain Analysis

The industry definition adopted in the first step of this methodology represents the core industries of the industrial cluster. In the case of the northwest Ohio greenhouse cluster, for example, the core industry comprised greenhouses that produce a variety of floriculture products, including bedding plants and hanging baskets. A cluster comprises much more than just the core industry. It also includes all the downstream suppliers of inputs and upstream customers. Identifying these downstream suppliers and upstream customers is crucial.

We suggest using an input/output (I/O) model to identify forward and backward linkages in the regional economy. One such I/O model, IMPLAN (MIG, Inc. 2004), deconstructs economic activity that results from inter- and intra-industry transactions. It uses a sectoring scheme that divides the regional economy into a 500 by 500 matrix.

Having defined the cluster industry, it is necessary to compile an inventory of potential cluster members (PCM). A PCM is defined as an individual or an organization that has the potential to contribute to the cluster and who, through that contribution, can provide value to the cluster initiative. PCMs should come from industry, academia, and the community.

The entries in the matrix are based on the dollar amount that each industry sells to (and purchases from) other industries in the economy of interest. It measures the amount of final consumption by residents of the region, as well as how much each industry exports from the region. County data are, in turn, aggregated or "rolled-up" to conform to the larger regional economy (Carroll and Smith 2006).

I/O modeling identifies supply chain relationships in the local economy. The model shows the dollar amounts an industry purchases from other businesses in the region. For example, a supply chain analysis of the northwest Ohio automotive industry shows that the local automotive industry purchases over $27 million of locally-produced steel pipes and tubes (Table 1).

The model also shows the percentage of the total demand for a particular input is procured locally and how much is imported from outside the region. Again, using the example of the northwest Ohio automotive industry, the model shows 60 percent of its steel pipes and tubes that are produced within the region. Alternatively, 40 percent of the industry's demand for steel pipes and tubes is being met by firms located outside of the local region (Table 1).

Table 1.
Regional Output and Supply Chain Share for Northwest Ohio Automotive Industry

Supply Industry	Regional Output	Local Supply Chain Share
Steel pipes and tubes	$27,950,014	60%
Blast furnaces and steel mills	$42,925,640	8%
Special dies and tools and accessories	$24,510,412	62%
Paperboard containers and boxes	$24,179,072	57%
Legal services	$23,989,134	38%

Source: Calculations completed by authors.

This information is necessary because it helps to define potential cluster members beyond the core industry, identifies existing relationships among regional production units, and identifies gaps in the local supply chain. For example, only eight percent of the northwest Ohio automotive industry's demand for the output of blast furnaces and steel mills is being met from within the local region. This information can be useful to local economic developers as they identify potential targets for their industrial recruitment efforts. The supply chain analysis permits identification of local industries (by NAICS codes) in the chain.

Specific data on firms within relevant industries that are located within the region can be obtained from business directories. There are a number of such directories that provide firm level information. The *Selectory Business Database* available from Dun and Bradstreet (2007) is a particularly useful directory. This database can be scanned to identify local firms that may become potential

cluster members. This information can be utilized to update the established list of potential cluster members.

Conduct a Social Network Analysis

The foundation of any successful cluster initiative is human relationships. Identifying the people who have the most appropriate relationships is critical. Critical relationships are those which are based on trust and respect.

In his book, *The Tipping Point*, Malcolm Gladwell (2003) identifies three types of key individuals – mavens, connectors, and salesmen. *Connectors* are people who are well connected. They know a lot of people within and beyond their industry. *Mavens* are individuals who have an expansive knowledge base about their particular industry. *Salesmen* are individuals with good persuasion skills.

It should be noted that different authors use varying terminology to describe what Gladwell refers to as connectors, mavens, and salesmen. For example, DeSantis (2006) uses the term *bridger* in place of Gladwell's *connector*. The critical issue is not the terminology. Rather, it is identifying the people who have the connections, knowledge, and inter-personal skills that are basic to the successful development of an industrial cluster.

Identifying key people, as well as relationships among cluster members, can be accomplished with social network analysis (SNA). SNA provides a quantitative measure of the nature and strength of inter-personal relationships within a defined group of people. These relationships are revealed by asking potential cluster members questions about their business-oriented social networks. For example, in the northwest Ohio greenhouse industry we asked all potential cluster members:

During the last 12 months, with regard to your work in the greenhouse industry:

1. Who have you worked with on a project?
2. Who has given you advice or support?
3. Who has given you new ideas?

The data collected from this survey are analyzed using specialized software that allows production of a series of network maps (Figure 4) and summary statistics. In mapping the northwest Ohio greenhouse industry, we used InFlow software. InFlow is a commercially available software that can be purchased as part of a package that includes consultant training in both social network analysis and software use (orgnet.com 2007).

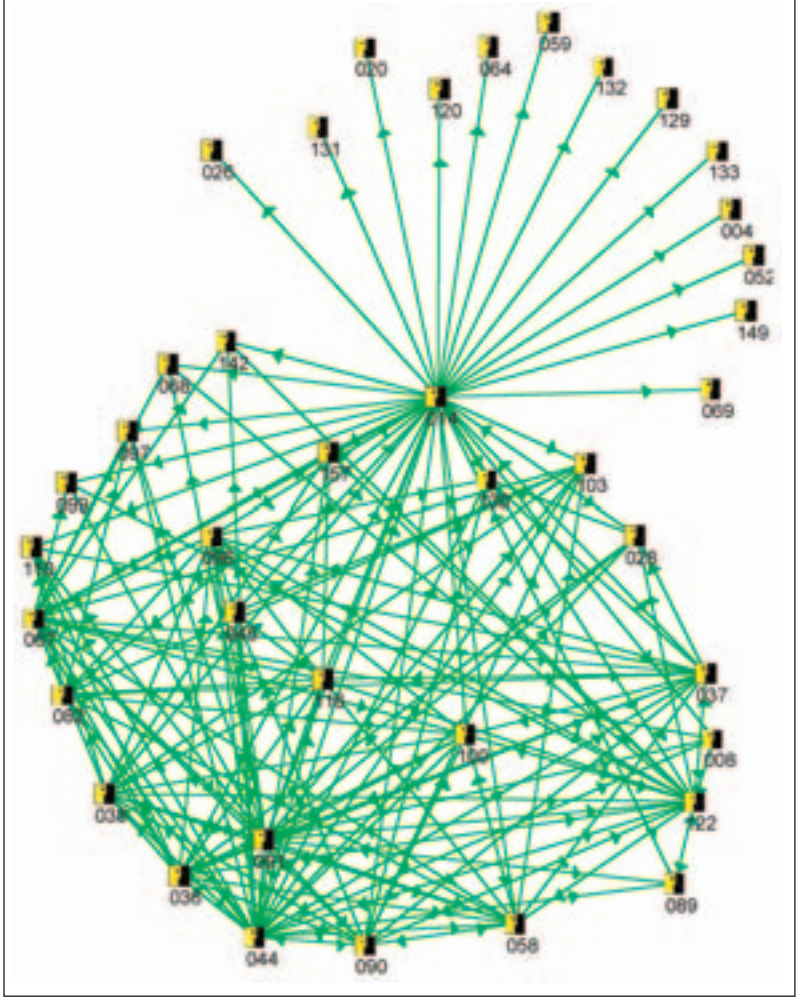
The network maps show the web of relationships that exist among potential cluster members. For example, in the sample network map from the northwest Ohio greenhouse cluster (Figure 4), the person represented as node 014 solely connects 13 people to the group, since those 13 people situated above node 014 in the network map have no other direct connections to the remainder of the cluster members.

Most importantly, the maps allow identification of influential people within the potential cluster. They show the people who members of the potential cluster currently collaborate with and go to for advice, support, and new ideas. These people may not necessarily be the region's *visible* political, social, or economic elite (DeSantis 2006). They are, however, the people who can get things done when it comes to moving the cluster forward and making it successful. They are, according to DeSantis (2006, 34) "the doers whose actual power far exceeds whatever formal authority their societal or even economic status would justify". In other words, they are the mavens and connectors.

The fact that these people may not be visible emphasizes the importance of the social network analysis. Simply talking with the visible leadership in the industry or community may not ferret out key connectors or mavens, but they should emerge through the process of the social network analysis.

Once the cluster is operational, the SNA should be periodically repeated because it is an "x-ray of the inner workings" of the cluster (Cross et al. (2006). It can help diagnose problems stemming from cluster members becoming too isolated or, alternatively, becoming so heavily involved that they do not have time to tend to their own business.

Figure 4.
Sample Network Map from Northwest Ohio Greenhouse Industry



Conduct SWOT Analysis

The next step is to complete a SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis. SWOT analysis has a long history as a strategic planning tool. It is useful with respect to developing an industrial cluster because it can provide focus for the Cluster Strategy Team as it develops action step priorities for the cluster. The results of a sample SWOT analysis are illustrated in Table 2.

The information and data that are necessary to complete the SWOT analysis can be obtained by a variety of methods including surveys, interviews, focus groups, reading trade journals, and conducting quantitative analysis (e.g. shift share analysis). All potential cluster members should be invited to provide their input to the SWOT analysis (US Department of Agriculture 1994).

Select Cluster Strategy Team, Program Manager, and Champion

Having completed the supply chain, social network, and SWOT analyses, the Cluster Strategy Team (CST) can be created from the mavens, connectors, and salesmen identified by the SNA. Ideally, the CST should comprise 10-12 individuals (CLOE 2006), and be representative of industry, academia, and the community.

Representation from all appropriate groups is consistent with the idea of a cluster being a venue for innovations and problem solving as a result of the cross-fertilization of ideas of people from varied points of view. We recommend that 50 percent of the CST comprise individuals from industry, with the remaining 50 percent being divided evenly between academia and the community. Having half of the CST membership from industry ensures that the CST is firmly focused on the needs of the industry.

For a cluster initiative to be successful, it is critical that the needs of the industry be its primary priority. With the CST established, the role of the Cluster Steering Committee (CSC) begins to diminish.

The CST is charged with oversight of the cluster. The first job of the CST is to hire both a Cluster Program Manager and Cluster Champion. We have described both of these positions in detail elsewhere (see Reid and Carroll 2006).

Briefly, the Program Manager is charged with the day to day running of the cluster. This person should understand the process of economic development; be able to communicate effectively with members of industry, academia, and the general community; and have the ability to rally disparate groups of people around the common goal of developing the cluster.

The Champion is the cluster's field agent and spends much of his or her time visiting and talking with cluster members (particularly firms). One of the Champion's major functions is to identify opportunities for collaboration among cluster members and to work with the Program Manager in implementing collaborations.

The Champion should have experience and knowledge of working in the industry and should be someone who is highly respected and trusted by cluster members. The choice of individual to fill the role of Champion should have wide acceptability among members of the cluster.

The ideal Champion should be a salesman, a maven, and a connector. For example, in the early days of the cluster the Champion will be required to sell the advantages of cluster participation to cluster members. As the cluster matures, the Champion will likely interface, as a salesman, with political and community leaders, suppliers, and other key organizations on behalf of the cluster.

Table 2.
SWOT Analysis Results for the Northwest Ohio Greenhouse Industry

STRENGTHS	WEAKNESSES
• Critical mass of growers • Extensive grower experience and knowledge • Passionate and committed growers • Predominantly family-owned and operated • Large regional production capacity • Access to local university, extension and Agricultural Research Service expertise	• Historically, little collaboration between growers • No identifiable market brands • Lack of strategic marketing • Small size of individual growers • Generational nature of business • Heavy reliance on traditional sources of fuel • Old greenhouse buildings • Dated production technology • Limited access to capital
OPPORTUNITIES	**THREATS**
• Increase collaboration with each other • Capitalize on latent market demand • Develop identifiable market brand and improve marketing • Development of niche markets • Alternative energy options available in region • Facility modernization • Adhere to higher quality standards	• Global competition • Price wars with regional competitors • Big Box store purchasing agreements • High and rising utility costs

Implement and Manage the Cluster

With the essential personnel now in place, it is time to implement and manage the cluster. In other words, it is time to move from having a *potential* cluster to having a *functioning* cluster. Again, we have described this process elsewhere (Reid and Carroll 2006).

In brief, the CST should meet monthly. There should be monthly membership meetings that are open to all interested stakeholders. Monthly CST meetings should be held during the week preceding the membership meeting. At these meetings, the agenda for the membership meeting should be established. Both the Program Manager and Champion should attend monthly CST

meetings. On the issue of cluster membership, the CST should decide on the membership rules and also on whether the cluster should have formal status, such as 501(c)3 tax exempt legal status.

It is critical that the newly formed cluster get off to a successful start. The CST should identify some early cluster projects that satisfy two key criteria. First, they should have a high probability of success. Second, they should demonstrate the value of the cluster initiative to cluster members.

CONCLUSIONS

We have outlined in this article a step-by-step methodology for identifying and implementing Cluster Based Economic Development. Creating the human infrastructure is critical to operating a successful cluster initiative. However, some "spadework" is necessary before focusing on the human element. For example, the appropriate geographic region must be delineated and inter-industry relationships examined through a supply chain analysis to capture the key industrial components of the cluster. These steps can be accomplished by academics who have a proclivity for applied research.

In terms of human infrastructure, much of what we have described hinges on finding the right people to fill the positions of Strategy Team members, Program Manager, and Champion. The right people are crucial to the success of any cluster initiative. This is because a successful cluster is predicated on healthy human relationships. This is why Social Network Analysis is such a critical component of this methodology.

Social Network Analysis will contribute to the identification of people with the qualities necessary to be Strategy Team members, Program Manager, or Champion. Equally important, the Social Network Analysis provides empirical evidence of the complex web of social relationships among cluster members. In order to strengthen the cluster, those social relationships must be fostered.

The authors developed the methodology outlined in this article as they went through the process of forming the northwest Ohio greenhouse cluster. The methodology, however, can be applied to any potential industrial cluster. In northwest Ohio, for example, there is interest in applying this methodology to the development of a number of other emerging clusters. These include alternative energy and architecture, construction, and engineering services. The methodology is also being considered as a tool to assist in the development of a greenhouse cluster in southeastern Michigan.

The development of a successful industrial cluster is both an art and a science. Human relationships play a critical role. On the other hand, it is also vital to have a rigorous analysis of available industry data to inform key decisions. The methodology described in this article recognizes the importance of both of these aspects of a successful cluster.

Regardless of the economic strength of an industry in a region, a cluster strategy will fail if critical human relationships are not properly understood and nurtured. This is why social network analysis is such a critical part of the methodology. At the same time, a cluster strategy cannot be successful without precise definition of an industry's economic structure, geographic footprint, challenges to be faced, and opportunities for growth.

The development of a successful industrial cluster is both an art and a science. Human relationships play a critical role. On the other hand, it is also vital to have a rigorous analysis of available industry data to inform key decisions. The methodology described in this article recognizes the importance of both of these aspects of a successful cluster.

The Northwest Ohio greenhouse Cluster Strategy Team: The Cluster Strategy Team provides oversight to the cluster.

ACKNOWLEDGEMENTS

The authors would like to thank Joe Perlaky, Deb Smith, and Sue Wuest for providing photographs for this article. The United States Department of Agriculture funded the development of the greenhouse cluster that is referenced in this article.

ENDNOTES

1 In the case of the northwest Ohio greenhouse cluster the Cluster Strategy Team is known as a Cluster Advisory Board. As a result of our work on the northwest Ohio greenhouse cluster we suggest that the term Cluster Strategy Team be used as this provides a better descriptor of this group's role.

2 In the case of northwest Ohio, the region's two universities, the University of Toledo (UT) and Bowling Green State University (BGSU), are taking the lead in the development of particular industry clusters. In particular, the Urban Affairs Center at UT and the Center for Regional Development at BGSU are leading their institutions' efforts in cluster development.

REFERENCES

Akoorie, M.E.M. (2000). Organizational Clusters in a Resource-based Industry: Empirical Evidence from New Zealand. In Milford B. Green and Rod B. McNaughton (eds.). *Industrial Networks and Proximity*. Burlington, VT: Ashgate, 133-164.

Carroll, M. C. and B.W. Smith. (2006). The Role of GIS in Economic Impact Studies. *Papers of the Applied Geography Conferences*, 29: 400-407.

CLOE. (2006). *Cluster Management Guide – Guidelines for the Development and Management of Cluster Initiatives*. Clusters Linked Over Europe. www.clusterforum.org. Last accessed November 2, 2007.

Cross, R. T Laseter, A. Parker, and G. Velasquez. (2006). Using Social Network Analysis to Improve Communities of Practice. *California Management Review*, 49: 32-60.

DeSantis, M. (2006). Purposeful Networking. *Economic Development Journal*, 5(1): 30-38.

Dun & Bradstreet. (2007). *Selectory Business Database*. Dun & Bradstreet. www.selectory.com. Last accessed November 2, 2007.

Feser, E. Sweeney, S, Renski H (2005).A Descriptive Analysis of Discrete U.S. Industrial Complexes. Journal of Regional Science, 395-419.

Gladwell, M. (2003). *The Tipping Point*. New York: Little, Brown and Company.

Henry, N. and S. Pinch. (2001). Neo-Marshallian Nodes, Institutional Thickness, and Britain's 'Motor Sport Valley': Thick or Thin. Environment and Planning A, 33: 1169-1183.

Mayer, H. (2005). Cluster Monitor. *Economic Development Journal*, 4(4): 40-53.

MIG, Inc. (2004). *IMPLAN User's Guide*. Stillwater, MN: Minnesota IMPAN Group.

Miller P, R. Botham. R. Martin, and B. Moore. (2001). *Business Clusters in the UK: A First Assessment*. Department of Trade and Industry, London

Orgnet.com. (2007). www.orgnet.com. Last accessed November 2, 2007.

Osama, A. and S.W. Popper. (2006). Creating Economic Clusters. *Economic Development Journal*, 5(4): 6-13.

Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, November-December, 77-90.

Rey, S.J., J.C. Duque, O. Smirnov, Y. Kim, and P. Stephens. (2005). Identifying Value-Added Industry Clusters in San Diego County. *Regional Analysis Laboratory Technical Report*: REGAL 050615.

Reid, N. and M.C. Carroll. (2006). Structuring a Successful Greenhouse Cluster in Northwest Ohio. *Economic Development Journal*, 5(4): 42-48.

Rubenstein, J.M. and N. Reid. (1987). Ohio's Motor Vehicle Industry: Industrial Change and Geographical Implications. *Miami Geographical Research Papers*, No. 1, Oxford, Ohio, Department of Geography, Miami University.

Regional Growth Partnership. (2007). www.rgp.org. Last accessed November 2, 2007.

Schmitz, H. (1999). Global competition and local cooperation: Success and failure in the Sinos Valley, Brazil. *World Development*, 27(9): 1627-1650.

Solvell, O., G. Lindqvist, and C. Ketels. (2003). *The Cluster Initiative Greenbook*. Ivory Tower AB: Stockholm.

U.S. Census Bureau. (2002). *North American Industrial Classification System (NAICS)*. U.S. Census Bureau. http://www.census.gov/epcd/www/naics.html. Last accessed November 2, 2007.

U.S. Department of Agriculture. (1994). *Strategic Planning Handbook for Cooperatives*. Rural Business Cooperative Service, Cooperative Information Report 48.

U.S. Department of Commerce. (2003). *State and Local Personal Income, State Annual Estimates, 2003*. Bureau of Economic Analysis. http://www.bea.gov/regional/index.htm#state. Last accessed November 2, 2007.

Wolverhampton Telford Technology Corridor. (2005). Local Companies Collaborate to Fight Low Cost, Overseas Competition. *Cluster Focus Newsletter*, Summer. www.ae-cluster.co.uk. Last accessed November 2, 2007.

Wong D. and J. Lee. (2005) *Statistical Analysis of Geographic Information with ArcView GIS and ArcGIS*. John Wiley & Sons, Inc, Hoboken, NJ

Yorkshire Forward. (2007). Innovative Partnerships Recognized at Awards. *Business Newsletter*, January. www.yorkshireforward.com. Last accessed November 2, 2007.