

## **An Examination of the Inter-Organizational Structure in the Animal Health and Nutrition Bioscience Network**

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### **Abstract**

*There has been an increased interest in economic network functionality within the last fifteen years, but relatively few empirical studies examining the inter organizational exchanges in animal health and nutrition industries. Using a network of 174 organizations in a defined geographical space in the middle sections of two U.S. Midwestern states: Kansas and Missouri, we extend such research on inter-organizational networks. The purpose of this paper is to measure the extent of the linkages and the systematic complexity of this economic network. We are able to carefully describe the network and assess its capacity to generate knowledge. The findings suggest that robust economic networks are increasingly built on the development of socioeconomic network comprised of weak, strong, and reciprocal ties. This study will help facilitate the design of management policies that increase mutual interaction that are bound in space and time and can change with the business and social environment.*

**Keywords:** networks; animal health; bioscience; inter-organizational; linkages

### ***I. General Introduction***

Networks often emerge in response to globalization of markets and the need to access information needed to manage price volatility, to promote economic performance through relationships with other firms (Powell 1990; Powell and Smith-Doerr 1994). The economic exchanges between organizations require an in-depth analysis of the intangible social relationships, which helps to describe the tangible transformation of inputs into products (Lundvall, 2004). Since the emergence of network analysis, scholars in the fields of strategic management, sociology, and economics have dedicated much time and effort to investigating how, exactly; networks increase organizational learning, enhance reputation benefits, and provide economic benefits. There has been an increased interest in economic network functionality within the last fifteen years, but relatively few empirical studies examining the inter organizational exchanges in animal health and nutrition industries. An analysis of networks between groups and organizations are less common and will provide insight to the emergence, organization, and “New Competition” found business or industry networks. The lack of empirical studies is likely due to the viewpoint that networks had not been viewed as organizational form, but could be studied using the stereotypical market as sequential exchanges between self-interested individuals motivated purely by profit maximizing opportunities or that networks are alliances or joint ventures among hierarchical firms (Merton 1934, Powell 1990).

This paper will work from the premise suggested by Nohria and Eccles (1992). That is, the structure of any organizational research must be understood and analyzed in terms of the multiple networks of ties and how they are patterned. In doing so, we will study a network of 174 organizations in a defined geographical space in the middle sections of two U.S. Midwestern states: Kansas and Missouri, and extend such research on inter-organizational networks. We study the linkages between research, private, and civic organizations to determine how the network is positioned to take advantage of region’s animal health and nutrition industries.

## ***II. The Central Question***

The central question addressed in this research is, do the actual network interactions that are embedded in organizational structure of the Animal Health and Nutrition Corridor has the potential to provide an advantage in accessing new information and resources? The study will use social network analysis to illustrate, measure and examine how ties are distributed — or not distributed— between the individual organizations that constitute the animal health network and how, in turn, the relationships affect access to new information and resources. The purpose of this paper is to examine the extent of the linkages and the systematic complexity of the economic networks. In doing so, we are able to carefully describe the network when assessing its capacity to generate knowledge and innovation.

## ***III. Theoretical Underpinnings***

Network theory converges with organizational economics and strategic management theory on the importance of understanding coordination between vertical and horizontal participants and how decision-making operates within the governance structure. Some economic explanations for the exchange of goods and services are predicated on the decision maker acting rationally to earn more profits. This is an unambiguous prediction because the decision makers' information is limited and often imperfect. The decision maker often will rely on informal trust, familiarity, and friendship to make decisions, which involves participation in reciprocal social networks. Strategic management examines how organizations grow. Strategy is based fundamentally on the development of a unique set of activities that provide a competitive position (Porter 1996), but organizational ties exist because of the challenges related to growth and the inability to act rationally all the time. The study of how a network functions represents a cross-disciplinary approach from the network theorist, strategic management and economics fields. In very basic terms, the diverse network uses organizational ties, which are described as dense versus sparse, or strong versus weak to connect the members throughout the network, through the exchange of information, goods and services.

To understand the diversity of organizations in this network and their potential linkages to one another requires the theoretical perspectives of several organizational theories that deal with multiple exchanges and interactions enforced by informal social networks or the formal institutional rules and third party enforcement of the state. Following the empirical analysis of Zylbersztajn (2004), this study analyzes network functions along two dimensions. The first is a dyadic perspective of a network characterized by many transactions carried out simultaneously. This means conceptualizing the network as a transactions cost minimizing rationale or the evolution in which the use of resources, including knowledge, plays an important role. The second dimension perspective is that of a network within which economic action is embedded. This view, suggested by Mark Granovetter characterizes the organization of economic action as socially situated like other non-economic types of action which cannot be explained by individual motives alone; i.e., it is embedded in ongoing networks of personal relations rather than carried out by atomized actors.

Granovetter based his theory of organization on three classical sociological assumptions: (1) the pursuit of economic goals is normally accompanied by non-economic ones such as sociability, approval, status, and power; (2) economic action (like all action) is socially situated, and cannot be explained by individual motives alone; it is embedded in ongoing networks of personal relations rather than carried out by atomized actors; and (3) economic institutions do not arise automatically in some form made inevitable by external circumstances, but are 'socially constructed' (Granovetter 1992). This study utilizes reciprocity, as well as strong and weak ties, to describe how the organizational relationships within the Animal Health and Nutrition Corridor function to gain access to information and resources. The concept of strong ties is defined as long-time inter-organizational relationships. Burt (1995) discovered that strong ties have a tendency to be redundant sources of information or resources. The cliques in the network identify strong ties. Cliques measure network density by the actual and potential ties in the network.

Also, cliques are an indication of the maximal number of connections. They identify a core group of organizations, which is composed of components with geodesic line segments between all actors in the group. By comparison, weak ties refer to limited investments of time and reciprocity in a relationship. However, weak ties are more important in spreading information and gaining access to resources.

These ties can provide ‘bridges’ between disconnected groups, so a network that relies on the strength of its weakest ties makes more available than would be case with strong ties. Weak ties also are indicators of the number of weak spots and structural holes in the network. Both are measurements of a bridge between organizations in the network. If an organization connected to other organizations by weak ties were removed, then other organizations would become disconnected from the network.

Reciprocity occurs when another actor meets a positive action by one actor with a positive action. Emerson (1976) explains reciprocity as the giving of benefits in return for receiving benefits. The value of reciprocity is its predictability. Constant reciprocity creates high predictability and reduces the uncertainty in an exchange relationship. If another organization returns the favors every time, one can come to expect that the favors will be reciprocated.

### ***3.1. The Unit of Analysis***

The Kansas City Animal Health and Nutrition, hereafter known as the Corridor, represents a concentration of public, private, civic, and research organizations between Columbia, Missouri and Manhattan Kansas (a stretch of 245 miles along Interstate 70) engaged in commercializing products for agriculture and companion animals. The area is known to have over 174 organizations, including 7 of the 10 largest animal health companies who have established their North American Headquarters in the area. The network includes firms that are directly involved in marketing and selling products, firms indirectly involved in providing services to those firms directly involved in animal health, organizations involved in animal research and organizations designed to facilitate collaboration between the aforementioned organizations. Table 1 shows the organizations that constitute the Corridor.

### ***3.2. The Nature of the Corridor***

Most Western legal systems use contracts as the primary means of formalizing inter-firm exchanges. The body of literature on networks reveals the extents to which inter-firm relationships are formalized are explicitly regulated and safeguarded by contractual provisions is an important dimension of the nature of network exchanges (Stinchcombe 1986). An effective network, however, would help to elevate the reputation and increase the visibility of inter-firm relationships, as well as the individual firms themselves within the Corridor. A number of scholars have argued that if a network possesses considerable legitimacy or status, then the organization within which it operates will derive legitimacy or status. This legitimacy or status may, in turn, can have a number of positive economic benefits for the constituent members of the network (i.e., the individual organizations), ranging from survival to organizational growth to profitability. This elevated status of the Corridor is expected to develop as a result of collaborations and investment opportunities, company relocation, or expansions in the region.

### ***3.3. The Geographical Boundaries***

The Corridor extends through the mid sections Missouri and Kansas. Manhattan, Kansas (home of the Kansas State University School of Veterinary Medicine) and Columbia, Missouri (home of the University of Missouri School of Veterinary Medicine) serve as the Corridor’s West and East boundaries. The literature on industrial theory suggests that imitation and innovation are enhanced when organizations are in close proximity to one another. Proximity also is a key factor in organizing networks. The close proximity between the organizations, which is viewed as an advantage for the region, is not easily duplicated in other parts of the country. In the case of the Corridor, the social, historical and economic advantages are more than spillover benefits. They serve as the primary reason for the existence of the region’s animal health strengths.

### ***3.4. The Corridor as a governance structure***

New Institutional Economics provides insight into the choice of a governance structure that best minimizes the cost of commercializing a good or service. It is clear in the case of the firms that chose to participate in the Corridor that the full range of required skills, including basic research, applied research, clinical testing procedures, manufacturing, marketing and distribution, and knowledge of and experience with the regulatory process, could not be cost effectively managed in a vertically integrated governance structure.

The network within the organizational structure of the Corridor incorporates the value chain within a geographical space that enhances the opportunity to provide the different functions of animal health and science across a number of independent organizations.

### **3.5. The Corridor as an organizational form**

The Corridor cannot be designated as any one of the standard organizational forms recognized by state or federal law such as trusts, sole proprietorships, corporations, partnerships, or limited liability corporations. There are no legal associations between interacting organizations. The interaction between organizations and their association to the region constitutes a “New Competition” characterized by lateral, diagonal and horizontal inter-firm ties. The clusters of organizations are defined in terms of carrying out exchanges along a make-versus-buy continuum. That is, the network’s mode of resource allocation is not carried out through discrete market exchanges like spot transactions or through highly centralized organizations, but through individual organizations engaged in reciprocal, preferential, and mutually supportive action.

## **IV. The Domain Perspective of the Corridor**

In order to develop an appropriate analytical framework with which to study the network structure of the Corridor it is important to differentiate between the different types of organizations from which it is constituted (Thompson 1967; Omta et al. 2001). This means specifying the domains of each organizational type and how network ties between each domain may impact knowledge creation and political advocacy for the entire Corridor as well as each organization itself (Smelser and Swedberg 2005; Håkansson, and Snehota, 2006). In their study, Levine and White (1961) found relationships among organizations in a health agency network, for example, different types of participant organizations have different purposes. The organizations in the Corridor are aligned according to the following domains: (1) the research domain that codifies knowledge; the actor involved in generative principle of knowledge creation and capitalization; (2) the intermediary domain that supports commercialization by asserting its political influence and advancing the civic interest; the actor that guarantees stable interactions and exchanges; (3) the enterprise domain which allocates scarce resources to process, distribute, store and market innovations; the key actor in the locus of production; and (4) the support domain as providers that are not directly involved in the movement of the good or service but support activity. The number of organizations in each domain is shown in Table 2.

### **4.1. Expected Outcomes Predicted by Social Exchange Theory**

Social network analysis proposes that certain structural characteristics of networks will increase the probability of forming organizational ties, which, in turn, increases the flow of resources between organizations. However, these expectations can result in rival hypotheses. This is especially true with respect to the benefits of strong versus weak ties. As noted earlier, especially from Granovetter’s (1973) work, there is a bias in the sociological literature toward the benefits of “weak ties,” insofar as these types of links between individuals or organizations tend to encourage access to new sources of information and other material resources. Weak ties, which are relatively free from the tendency to transitivity, are less structured, thus enabling them to bridge the separate cliques or subgroups, carrying information to all the network’s segments (Hanneman 2010). Organizations with more management and collaboration networks often bridge their structural holes with information. Therefore, we might expect that:

**Hypothesis 1:** Weak Tie organizations with more bridging weak ties to different constituent organizations in the Corridor will have greater access to valuable resources than organizations with fewer bridging weak ties.

At the same time, however, there is equally compelling evidence, especially from the organizational theories taught in business schools that strong tie reciprocal relationships, which by definition are more durable than weak ties, will provide greater access to resources. Borgatti (1994) found that “networks of strong ties are tending to be transitive, while networks of weak ties lack this reciprocal quality, and in some cases even tend to intransitivity...” Strong ties impose greater demands for conformity.

Uzzi’s (1997, 1999) study of business networks points out that economic action benefits from initial increases in relational ties, but suffers when organizations are highly embedded. In short, both individuals and organizations might be expected to gain certain types of resources from those with whom they interact regularly and to whom they provide benefits as well.

The critical caveat here is that if this leads to a too highly dense network then it might become difficult for novel information or other kinds of material resources to be accessed. With this critical caveat in mind, we can state the following two hypotheses:

**Hypothesis 2:** Strong Tie organizations with more ties to other similar organizations in the Corridor will have greater access to valuable resources than organizations with less similar ties.

But, it is also expected that:

**Hypothesis 3:** Organizations within the Corridor that have a mixture of reciprocal strong ties and weak ties will have a greater access to information and resources than organizations that rely solely on strong or weak ties.

## ***V. Research Design***

Both qualitative and quantitative methods were employed to provide a comprehensive understanding of the network relationships with the Corridor and how the structural characteristics of these relationships – i.e., weak versus strong ties, cliques, etc. – benefit organizations in different domains within the Corridor, as well as the performance of the Corridor as a whole.

### ***5.1. Qualitative Observations***

A case study research methodology was used to provide an understanding of the real-life context of the Corridor. From March 17, 2010 to March 20, 2012, 15 semi-structured interviews were conducted with individuals whose organizations either is represented on the Corridor's advisory group or whose organization was located in the Corridor's geographical boundaries. In either case, the organizations are directly involved in animal health and nutrition in the region. The advisory group is made of individuals who hold senior-level positions in their own organizations. They come from organizations that are a part of the enterprise and research domains. The advisory group's role in the Corridor is to ratify and monitor the decisions of the "working group". The working group provides a decision management function for the Corridor. These organizations take a leadership role in the Corridor. The working group is responsible for initiation and implementation of the decisions related to public policy, branding, and technology transfer. The initial questions in the qualitative interviews focused on the origins of the Corridor. The discussion that ensued provided a historical perspective of how the Corridor came into existence. The next set of interviews covered how the Corridor operates today and its strengths and successes as a group. Individuals from the research, intermediary, enterprise, and support domains were interviewed.

### ***5.2. The Quantitative Survey of Corridor Participants***

The sampling frame of the accessible population was obtained from the roster of organizations found on the Animal Health Corridor's website. The organizations in the Enterprise and Support domains make up 84 percent of the organizations in the Corridor. In each organization in the sample we targeted an "informant", whose daily work activities lend itself to a greater likelihood of inter-organizational interactions. This included chief research scientists, design engineers and communications professionals.

Table 3 summarizes the responses and non-responses of the informants by domain.

### ***5.3. Questions to Test the Hypotheses***

Questions were separated into either person-centered or network centered organizations. Person-centered survey questions help to describe the actual relationships and to examine the profile of the individual organizations. The network-centered questions were designed in to allow participants in the survey to indicate subgroups to which they belong. The participants were asked general questions about every organization in the network and then more specific questions from a short list of organizations in the network. The list was developed using stratified sampling frame in which organizations were sampled within each of the organizational domains. Due to the large number of organizations, which make up the Enterprise and Support domains, we opted to select only publicly traded organizations from which we could obtain public information.

This resulted in a total of 23 organizations in the Enterprise and Support Domains. The entire Intermediary and Research Domain containing a combined total of 24 organizations were included in the sampling frame. In addition, the study uses different strategies to construct the network questions.

Because of the sensitive nature of some relationships, questions can invade privacy or disclose information to other people outside of the organization being interviewed (Sudman and Bradburn, 1982). Therefore, the study employs a variety of question formats, which includes hypothetical, factual, and direct questions. Table 4 provides a summary of the question format.

For the data management and preliminary evaluation of the data set, the researchers used Network Genie, and UCINET 6.0. Network Genie is Internet based software used to administer the questionnaire and create the master matrices from the individual survey responses. Network Genie software's primary purpose is to collect network data and export it for analysis. From this software, the master matrix is developed and is exported to the NetDraw and UCINET 6 software programs to map network relationships, to identify the structural properties and generate descriptive statistics of the network. A key functionality of Network Genie is its ability to nest subgroups. Network Genie allowed for a question-after-question approach to narrow each participating organization's network from 174 organizations down to a smaller subgroup of organizations. This feature allowed the participant to make a preliminary list of organizations with which he/she has had relationships and then rank those organizations according to their preferences. The nesting feature allowed respondents to work from subgroup lists, thus saving time because participants did not have to review an entire list for subsequent related questions.

Table 5 provides a binary adjacency matrix that notes the presence of any link between organizations. So, if there are multiple network subgroups, the matrix reveals the presence of ties among any of these items.

UCINET is commonly used software in the network sciences. It provides a means to perform the quantitative and qualitative analysis of social networks. The master matrix is created in network Genie and analyzed in UCINET 6 for strong or weak ties and network visualization. The master matrix reflects the responses and the extent of organizational ties, hypothetical relationships, previous collaborative work, and the existence of strong positive or negative past interactions.

## **VI. Findings**

Figure 1 is an illustration of the inter-organizational connections among the organizations in the Corridor. Each organizational node is identified by its domain and identified by its assigned number of 1-174. Note in Figure 1 that the organizations known as isolates are not included. Isolates are organizations with no connections with any other organizations in the network. The existence of reciprocity in a network suggests that valuable information flows between the constituent organizations. Figure 1 shows some evidence of reciprocity, however, not strong. The reciprocal ties are largely between the organizations primarily in the research, intermediary, and enterprise domains. The support domain has very few reciprocal ties and is likely a result of its goods and services are not specific to the animal health and nutrition industries. The lack of reciprocity and specificity in this area describes the support domain's relationships as transactional or arms-length.

The support domain is more likely to include a higher proportion of isolates than other domains. Though support organizations might have been identified as a provider of a good or service for animal health and nutrition, many of the survey participants in this domain did not acknowledge having relationships within the corridor. Also, some support organizations are not exclusively involved in the animal health and nutrition industries. For example, a human resource organization or a legal firm might have resources dedicated to other industries. This suggests why there is proportionately large number of isolates and fewer reciprocal relations in the support domain.

Tables 5 through 9 describe the structural characteristics of the Corridor network. Table 5 gives a summary of the number of outbound and inbound ties between the domains in the Corridor for each organizational type. Outbound ties represent all the connections originating from an organization to all other organizations network. Inbound ties represent all the ties that come into that organization from other organizations in the network. Tables 6 through 9 provide us with a profile of the weak and strong ties within the network as a whole. These data also provide us with insights into structural holes, cutpoints, and network density. Overall, the finding shows that there are more weak ties in the Corridor than either strong or reciprocal ties. There are differences in the nature of ties involving the different domains. The intermediary domain contains proportionately more weak ties than other domains. Organizations in this domain provide more bridging weak ties to different constituent organizations in the Corridor, which increases the likelihood of their having greater access to valuable resources than organizations. Table 6 summarizes the distribution of weak ties between the organizational domains.

The findings are consistent with the general role of intermediary organizations. The nature of the intermediary domain is to advance the interest of the whole network. As measurements of weak ties in the network, the study found more structural holes, cohesion associated with the intermediary domain. Cutpoints represent an organization that connects other organizations in the network. If it were removed, then the other organizations would become disconnected. Figure 2 shows a subgroup of organizations in different domains and their cutpoints.

The organizations with the Corridor are sparsely connected. Several cohesion measurements, such as the number of directed ties, the diameter of its network, and ability for organizations to broker information validate the sparse nature of the Corridor. However, these measurements are stronger when applied across the domain in the network (See Table 7). These results lend support to the first hypothesis organizations with more bridging weak ties to different constituent organizations in the Corridor will have greater access to valuable resources than organizations with fewer bridging weak ties. The second hypothesis suggests that organizations with more strong ties to other similar organizations in the Corridor will have greater access to resources. Table 8 summarizes the tests of strong ties. It includes the number of cliques and exact matches or the same relationships by domain. These tests do not provide support for the second hypothesis. Overall, the Corridor network contains low levels of overall strong ties between similar types of organizations. This study expected to find strong ties proportionately higher between organizations in the research and enterprise domains. This is because the creation and the commercialization of knowledge is a primary function for the organizations in both domains. The researcher expanded the test to a 2-clique measurement, which can be characterized as friend-of-a-friend tie, revealed several cliques existed which increases the likelihood of reciprocal relationships. The outcome is not accepted.

The third hypothesis suggested that organizations within the Corridor that have a mixture of reciprocal strong ties and reciprocal weak ties will have a greater access to information and resources than organizations that rely solely on strong or weak ties. Considering the nature of the Corridor, we might expect that reciprocal relationships play a significant role in the Corridor. However, the measures of reciprocity in the network were insignificant. Information and resources are not being shared with any degree of consistency across and within the domains of the Corridor. The intermediary domain showed more evidence of reciprocal relationships while other domains showed very little. These results appear to not conform to the third outcome. According to the traditional models, networks have many reciprocal relationships. Very little quantitative evidence of reciprocity exists in the Corridor (See Table 9). A total of 11 organizations were found to have relations characterized as being reciprocal. Five of the organizations were from the enterprise domain.

The evidence from the study does support claims of weak ties needed to distribute the new information and resources with the network. However, there was a lack of evidence of strong and reciprocal ties needed to provide stability and the flow of confidential information throughout the network.

## ***VII. Discussion and Implications of Findings***

The impact of the social relations between organizations and the potential advantage they have is consistent with the empirical findings from the study of economic actions and social structure in the labor market. Granovetter (1973) proposes a concept of “strength of weak ties”, which constitutes a bridge to parts of the social system that is otherwise disconnected. This view implicitly assumes that each of the individuals or organizations that are connected to one another by weak ties already possess strong ties, which would be consistent with a view of hierarchy within a firm. Management policies intended to increase mutual interactions are important to knowledge intensive networks. Codified knowledge is partly supported through socioeconomic ties between both private and public organizations. Both management policies and codified knowledge helps overcome the instability of personal ties by identifying the economic benefits to the network. The implications of the findings presented above are that: (a) intermediary organizations hold key weak tie bridging functions with respect to the provision of information and resources; (b) support organizations are largely peripheral, with support organizations making up a large portion of isolated organizations in the network, and (c) while enterprise organizations do hold some key structural positions they do not hold nearly the same influence as intermediate organizations; and (d) research focused organizations are fixed in the network structure in clusters and have similar ties to other organizations.

The larger issue addressed in this study is how do geographically defined networks that contain a mix of private, public and not for profit organizations actually behave in practice?

The concept of an animal health and nutrition network intuitively makes sense. Within a well-defined and easily accessed geographical area there are a variety of organizations with different resources that could potentially assist one another and, at the same time, improve the business and tax revenue environment for the region in which it operates. Our findings do show that there are network linkages between various organizations that make up the Corridor and that for some of them, especially the intermediary organizational type, there appear to be real benefits from participating in the Corridor. At the same time, however, there are a very large number of isolates that do not seem to be connected to any other organizations within the geographical region served by the Corridor. This would suggest, that there are some important questions that need to be addressed by the board that operates the Corridor, not the least of which is, what are the current incentives for members of the Corridor to connect with one another and are there any strategies for identifying and implementing incentives that bring more value to Corridor members and to the Corridor as whole?

Another important question to be asked, is do the kinds of network ties (or lack of ties) between organizations within the Corridor exist in other geographically based private, public, non-profit networks and, if so, how are they affected by the types of goods or services involved versus the strategies with which organizing committees have designed them?

The U.S. government has a long history of supporting private sector research and development (R & D). The economic justification for government R & D support is clear. Primarily because of knowledge spillovers, profit-maximizing firms invest less than the socially optimal level of R & D. This system for supporting R & D worked well when national security concerns generated sufficient support for funding. Even though city planning has been working on urban development plans to update Kansas City's longstanding reputation as a center for agriculture and livestock, the animal health corridor actually helps the public embrace its heritage. It is a heritage that has amassed skills, resources, and know-how for the animal health industry. Public support in the form of research credits can be used to decrease the cost of doing research to a firm by giving tax credits for a portion of its R&D expenditures.

Finally, we need to mention some directions for future research on inter-firm networks. Our analysis revealed a large number of cutpoints in the Corridor network. Cutpoints are fertile grounds trading partners to undertake opportunistic behavior. Based on the discriminating alignment hypothesis postulated by Oliver Williamson (1998), an organization will choose the governance structure which best economizes its transaction costs. Therefore, a high proportion of cutpoints in the network could lead to the increasing the likelihood of vertical integration in the network. In addition, these findings open doors for assessing what potential effects organizational ties have on creating specific skills, and specific knowledge between the organizations that make up the Corridor.



VIII. Tables

**Table 1. Types of organizations in the Corridor by domain**

Research	Intermediary	Enterprise	Support
<ul style="list-style-type: none"> <li>• University of Missouri</li> <li>• Kansas State University</li> <li>• Stower's Institute</li> <li>• KC Area Life Sciences</li> <li>• University of Kansas</li> <li>• Midwest Research Institute</li> </ul>	<ul style="list-style-type: none"> <li>• KC Chamber of Commerce</li> <li>• KC Area Development Council</li> <li>• Kansas Bioscience Authority</li> <li>• Trade Associations</li> <li>• KC Area Life Sciences</li> </ul>	<ul style="list-style-type: none"> <li>• Product Manufacturers</li> <li>• Animal Nutrition Companies</li> <li>• Distribution Companies</li> </ul>	<ul style="list-style-type: none"> <li>• Equipment Companies</li> <li>• Financial Services and Banking</li> <li>• Publishing Companies</li> <li>• Ag Insurance Companies</li> <li>• Communications</li> <li>• Human Resources</li> </ul>

**Table 2. Number of Organizations within each Domain in the Corridor**

Number of Organizations in the Support Domain	Number of Organizations in the Intermediary Domain	Number of Organizations in the Research Domain	Number of Organization in the Enterprise Domain	Total # of Organizations
110	18	10	36	174

**Table 3. Survey Response by Domain**

	Total Number of Organizations Sampled by Domain	Number of Organizations to Respond	Number of Organizations That Did Not Respond
Support	8	3	5
Intermediary	14	8	6
Research	10	5	5
Enterprise	15	5	10
Total	47	21	26

**Table 4. Question Format**

Question Strategy	Question
Factual	The number of times something has happened in the exchange relationship.
Hypothetical	Very descriptive questions related the exchange relationship to prevent recall errors.
Direct	A question asks explicitly with whom they have relations. The type of relationship one organization has with another. Mentions the nature of the relationship in the question.

**Table 5. Inbound and Outbound Ties**

Domain (# of firms in the network)	Number of Outbound Ties	Number of Inbound Ties	Total Number of Ties
Enterprise (36)	88	132	220
Intermediary (17)	110	101	211
Research (10)	89	72	161
Support (110)	71	150	221

**Table 6. Weak Tie Test Summary by Domain**

	Enterprise	Support	Intermediary	Research
Cutpoints	<b>13</b>	<b>19</b>	<b>33</b>	<b>5</b>
Density	16%	19%	29%	12%
Structural Holes	47	76	76	13

**Table 7. Cohesive Measurements**

	Enterprise	Support	Intermediary	Research
Diameter	67	75.9	92.11	78.03
Broker	0	0	1.25	.090
Directed Ties	6	2.5	10.6	8.9

**Table 8. Strong Tie Test Summary by Domain**

	Enterprise	Support	Intermediary	Research
2-Clique	9	30	14	3
Exact Matches	0	3	3	0

**Table 9. Reciprocal Tie Test Summary by Domain**

	Enterprise	Support	Intermediary	Research
Reciprocity	5	2	3	3

IX. Figures

Figure 1: Corridor Inter Organizational Connections.

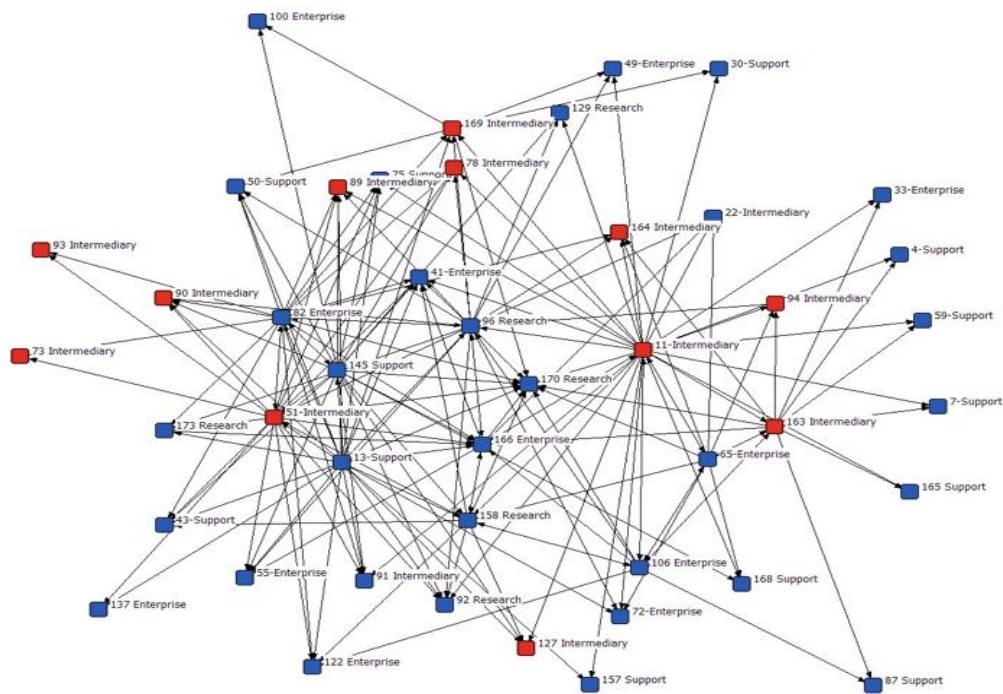
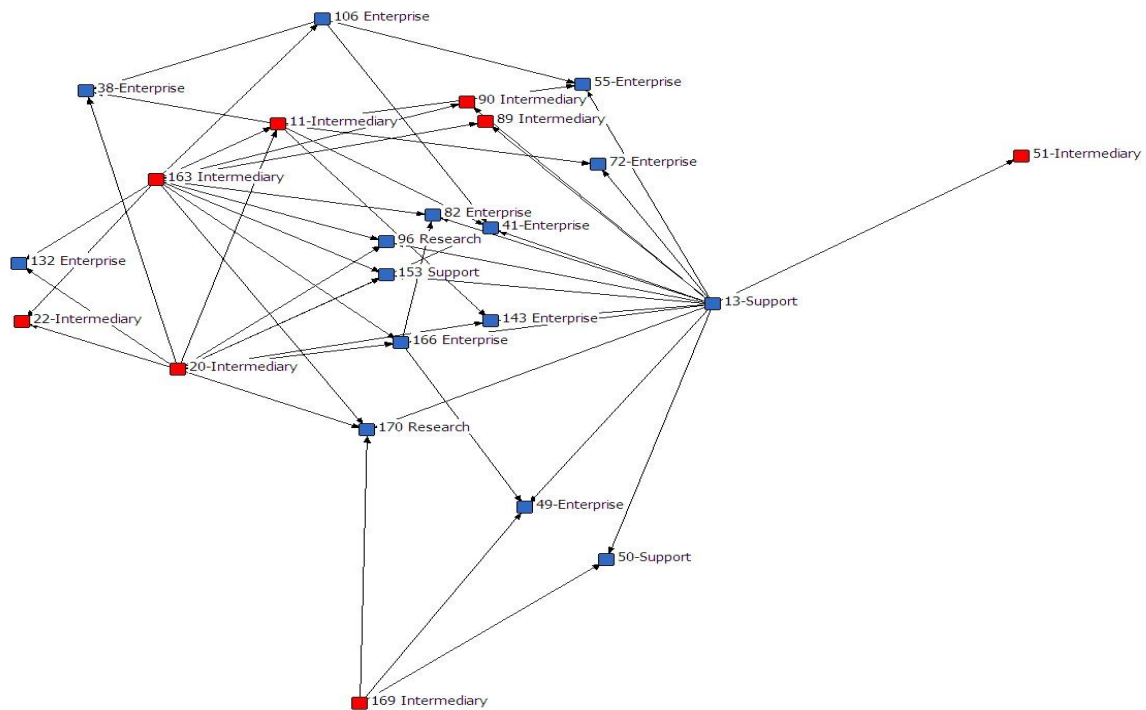


Figure 2: Intermediary Domain Cutpoints



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