

A Case Study of a Bio-Science Network: The Kansas City Animal Health and Nutrition  
Corridor.

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## **ABSTRACT**

The research combines network theory with aspects of social network analysis to identify and explicate the strong and weak ties in bioscience network. Data was gathered from personal interviews and a survey of 22 organizations to explore the economic interactions within a network of public, private and civic organizations engaged in commercializing animal health and nutrition products. The analysis shows that the patterns of relations follow a functional logic. That is, weak ties are more dominant in a network where access to knowledge and resources are important. These findings are consistent with previous network theory research from Mark Granovetter's strength of weak tie hypothesis that economic action is embedded in ongoing social ties.

## **CHAPTER 1: DISSERTATION OUTLINE**

The dissertation follows an outline, which is graphically illustrated Figure 1.1. The study proceeds as follows. The first part covers Chapters 1-4. It introduces the research question, provides a theoretical review of network theory and concepts, and discusses how networks function to create a potential advantage. Chapter 1 elaborates on networks in bioscience. For the purposes of this study, a structuralist view is concerned with how organizations, as a whole, function within a network rather than how individuals within these organizational networks function. This chapter also includes the purpose, significance and motivation for this study. Chapter 2 provides a theoretical view of scholarly field of economic sociology, which studies the tangible and intangible aspects of economic exchanges. Insights from this scholarly field provide the foundation to study social exchange theory. This chapter introduces the unit of analysis— the Kansas City Animal Health Corridor—and it defines its nature in terms of its plan of action, organizational form or structure, types of organizational ties, and its primary network activities. In this section the organizations are segmented into domains. Domains are the primary activities of an organization and will serve to define the region according to its primary business interests. Chapter 3 conceptualizes and defines the network by establishing a theoretical framework to study the tangible and intangible transactions and exchanges that occur within discreet networks. Here the the study introduces strong ties and weak ties as the primary concepts to describe the informal linkages between trading partners. Also, the chapter operationalizes strong and weak ties by defining the tests used

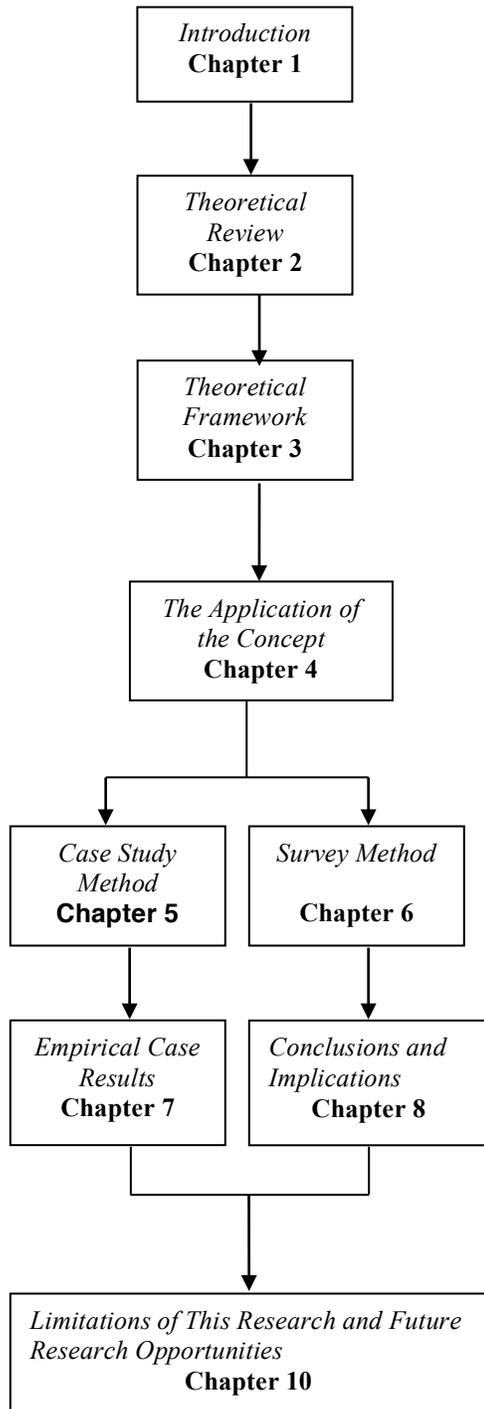
to explain the linkages in the network. In Chapter 4, the network concepts are applied and the expected outcomes are presented.

In Chapters 5 and 6, the research presents the methods and research design used in the study. In doing so, it links the data to the theoretical framework for purpose of interpreting the findings. The chapters also establish the logic for using a case study method and survey method. I discuss separately how each method is insufficient by itself but together provides a more complete picture of how the network functions. These two methods provide an opportunity to study the network in two parts. One part helps to explain how the Kansas City Animal Health Corridor functions as one entity. The other part focuses on the individual parts of the network (civic, profit, non-profit and governmental organizations) and the ties that connect them. The study examines if and how the 173 organizations are connected. Here,

Chapter 5 discusses the theoretical framework and its application of exploratory and qualitative (case study) methods to directly observe in a real-life context and in Chapter 6, the study uses a descriptive and quantitative (survey) method to operationalize the concepts and measure how network actors view their connections. Both chapter 5 and 6 includes the procedures for data collection and instrumentation to measure variables in terms of the validity and reliability of the procedures.

Chapter 7 discusses the empirical results from the tools used to evaluate the network performance. Chapter 8 draws conclusions from the outcomes and the implications of how networks function. In Chapter 9, the study discusses the limitations of the study and the opportunities for future research.

Each chapter in this study adds to the understanding of how the network structure functions influences the access to information and resources.



**Figure 1.1: Dissertation Outline**

## 1.1 General Introduction

In response to globalization of markets and access to information to manage market supply and price volatility, networks in bioscience have emerged to promote economic performance through relationships with other firms (Powell 1990; Powell and Smith-Doerr 1994). Understanding the functionality requires an in-depth analysis of the intangible social relationships and 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, provide economic benefits, and facilitate the management of resource dependencies.

Despite the increased interest in network functionality within the last fifteen years, few empirical studies on the role of inter-firm networks exist (Powell et al., 1996; Kastle et al. 2009). This research aims to address this lack of reliable data by analyzing a network in the animal health and nutrition industries. This network is organized similar to the “New Competition” industries in computers and biotechnology seen in regional districts like Route 128 in Massachusetts, the Silicon Valley in California or the textile district of Prato, Italy. The inter-firm lateral and horizontal linkages characterize the network’s relations with suppliers, customers, and even competitors. The “New Competition” is seen of semi-autonomous organizations (Miles & Snow, 1986), organized with “new” features such as flat hierarchy, empowered workers, self-governing teams, heavy use of temporary structures (e.g., project teams, task forces), lateral communication, knowledge-based, etc. (van Alstyne 1997; Birkinshaw & Hagstrom,

2000) all align to the same collective goal. This is in contrast to the “Old Competition industries” in which arm’s length competitive relations characterize large hierarchical firms such as automobiles. Eccles (1991), who employs the term network to describe the patterns of ties that exists and are defined by hierarchical reporting relationships, task interdependencies, and information sharing (Bengtsson & Powell 2004). The network is referred to as a particular type of organization contrasted with a hierarchical or market form of organization. Mark Granovetter (1992, 1995) suggests that networks are a collection of firms bound together in some formal and/or informal ways by an intermediate level of binding.

Building on the Powell and Kastle’s findings, the research on networks of organizations is uncommon. 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 motivate purely by profit maximizing opportunities or that networks are alliances or joint ventures among hierarchical firms (Merton 1934, Powell 1990). Instead, the study of organizations, from a network perspective, 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.

Another approach to study networks has been at the individual level in which individuals are taken as nodes of the network (Brass et al. 2004). This approach involves the study of an individual person rather than an organization as a whole. However, an

analysis of networks between groups and organizations are less common and will provide insight to business or industry networks.

In a study of how the actual network functions, social network analysis tools and interview data were used to analyze the ties between the organizations that make up Kanas City Animal Health Corridor. Its findings are consistent with prior research on networks. The network's potential advantage is its ties, which can be conceptualized in generic terms of being strong, weak or reciprocal and are conceived as conduits along which information or resources flow. In doing so, scholars from different scientific fields of economics, sociology and business management help our understanding of how the network of organizational ties "New Competition" functions.

### **1.1.2 Purpose**

This study's purpose is to determine if the actual network interactions and its set of organizational ties have 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 organizations in the network. Networks share some interests with organizational economics and strategic management theories regarding the coordination of activities between vertically and horizontally structured organizations. 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, imperfect or evolving. The decision maker favors intangibles — ideas, information and relationships—to make decisions, which involve the work of network theory. Also, strategic management examines how

organizations grow. Industrial economic theory suggests that strategy is based fundamentally on a unique competitive position (Porter 1996). Here organizational ties exist because of the challenges related to growth and the inability to act rationally all the time. The network 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 and sparse, or strong and weak to connect the population throughout the network, and exchange goods and services.

### **1.1.3 The Research Question**

Network organizations offer a higher degree of differentiation compared to more traditional organizations. There is often a difference in the objectives, the cognitive and emotional orientations, and the organizational profiles of the constituent organizations in the network. Considering this degree of differentiation, how does a diverse network inter-firm relationships function? For instance, do the constituent organizations connect (or do not connect) within a geographical area, where, it is assumed that there are potential advantages in building relationships (social networks) with one another? Or do the relational ties between similar organizations provide a better chance of influencing the flow of information and resources? So, how does this network function?

### **1.2 Significance and Motivation for the Study**

This study is significant because the general lack of empirical studies on networks that explain the interaction between the constituent organizations in the network. In the purest sense, networks require an exchange and the nature of that exchange must be greater afterward than it was before the exchanged occurred. Many researchers are motivated to

understand the formal and informal factors that impact the exchange of goods and services. It examines how the network is structured — in terms of its informal interactions and organizational affiliations — to access valuable information and resources. The network's potential advantage is its ties, which can be conceptualized in generic terms of being strong, weak, or reciprocal. It is conceivable that differing and inconsistent expectations among multiple constituent organizations could lead to increased suspicion behavior that their organization's interests are receiving less attention within the network (Whyte 1949; Kahn et al. 1964; Spekman 1979; Van Sell Brief, and Schuler 1981). However, the literature does not explicitly point out the interactions between civic, research, and for-profit collaborations.

This study shares an interest in the function and performance of an organization similar to the organizational economics and strategic management literature. However, the boundaries of network theory are much broader and the independent variables of interest — relational ties— are with all relevant stakeholders in its business ecosystem. The theory identifies gaps or opportunities within a network and may provide insight into the configuration and implementation of new and more efficient organizational strategies. Ultimately, the contribution and motivation for this study provides a novel framework to study networks made of industrial, civic, and academic organizations directly and indirectly involved in the commercialization of goods and services. The diversity of the Kansas City Animal Health Corridor, which represents more than 173 organizations, theoretically presents a major source of coordination costs. Teece (1986) found when different firm controls resources, it is considered a predictor of network formation.

### **1.2.1 Contributions to the Literature**

The study's contributions to sociology and organizational economics are unique on two fronts. From the theoretical view it creates its logic on how networks function from the analytical perspective of social network theory. First, to some economists the number of separate but interdependent firms requires coordination of its activities. A large amount of coordination is a predictor of the relative presence and consistency of a central staff in networks (Phillips 1960). Asymmetry in the resources controlled by different organizations, including information, is a predictor of formal organizational arrangements like contracts or by-laws. In addition, the application of social network theory and empirical research is used to analyze the network structure at a certain time, and the positions of the individual organizations within a network. Based on this, the study borrows heavily from a social scientific perspective rooted in economic sociology. Second, it represents the intangible to explain the social network in the animal health and nutrition industries, which is responsible for the advantages gained from being connected or linked to other organizations.

This study uses network theory and social network analysis to make contributions to the literature on networks, organizational economics, and business management scholarship. It will inform how a business strategy formation involves the monitoring, interpretation, anticipation of the changing agribusiness environment and it focuses on the optimizing the linkages between the organizations and its surroundings (Porter 1985; King et al. 2010). Understanding how to compete in a sector is a key challenge for agribusiness leaders. The study of relational ties between organizations in the network may provide valuable insight for “New Competition” organizations to reach their goals.

### **1.2.2 Motivation**

The volume of social network research in management has increased radically in recent years across many disciplines. Network research is part of a general shift, beginning the second half of the 20th century, away from individualist, essentialist and atomistic explanations toward more relational, contextual and systemic understandings often studied in exchange theory to analyze these quasi-economic relationships (Brass, et al., 2004).

At a 2010, Kansas City Agribusiness Council meeting members discussed an effort undertaken by a group of public, private, and research organizations. The intent of these organizations was as to leverage the animal health and nutrition expertise to create jobs in the area, and to attract capital to spur innovation needed to address the health and nutrition needs of companion and agriculture animals. According to the findings of many network researchers, the emergence of the social structure allows networked organizations to engage in reciprocal, preferential, and mutually supportive actions to create an advantage (Barney and Hansen 1994; Smelser and Swedberg 2005). For instance, a leader in the bioscience community regarded the U.S. Government's decision to relocate the National BioAgro Defense Facility to the Manhattan, Kansas as "game changing" and further indicated the influx of information and resources would benefit the entire region. The potential for repetitive market relations and the linking of social and business relationships provided the underlying embedded logic to study how the Kansas City Animal Health Corridor function. For example, the literature on networks are generally function to increase learning (Powell 1990, 1996, Uzzi 1997), increase status or the reputation for all constituent organizations (Oliver 1991, 1992, Polodny 1993,

Polodny and Phillips 1996), increase the economic benefits of lowering transactions costs (Williamson 1991) or to reduce uncertainty for the network.

Understanding how organizations in a network's structure interact and respond to another organization's decisions has been studied in a wide range of scholarly fields. What each organization does affects one or more of the other organization at least some of the time. This creates complexity and makes outcomes difficult to predict. One would need to follow organizational economics, economic sociology, organizational studies, as well as interdisciplinary work on subjects like competition, cooperation, and embeddedness to keep abreast with these developments. The Kansas City Animal Health Corridor, hereafter known as the Corridor or region provides an opportunity to study exchanges that are based on formal and informal interaction.

## CHAPTER 2: THEORETICAL REVIEW

The first chapter starts with an overview of the purpose and the motivation of this study. This chapter begins by discussing the network in terms of its formal and informal approaches to exchanging goods and services. Next, this chapter defines the network, discusses network performance, provides more detail about the unit of analysis, and conceptualizes how the network operates. The explanation of this theoretical model includes a discussion of the nature of the Corridor, that is to infer what it is established to do.

The chapter concludes with a review of the how to categorize the organizations that make up this diverse network. The Corridor is made of a number of separate but interdependent organizations. This section provides a conceptual description of the Corridor by means of categorizing each organization by its primary function. The degree of diversity in the network leads to a domain perspective needed to narrow and define the type of organizations in the network.

When discussing the ties among the individual organizations, the study utilizes Mark Granovetter's influential 'strength-of-weak ties' thesis, which maintain that weak ties are often more important. Granovetter's (1973,1995) influential 'strength-of weak-ties' thesis maintains that weak ties are often more important in spreading information or resources than strong ties because they tend to serve as bridges between otherwise disconnected social groups; strong ties lead to less efficient transmission processes because a large number of actors in the strong tie network also know each other.

## **2.1 The Formal and Informal Perspectives of Networks**

Two scholarly fields, in particular new institutional economics and economic sociology provide formal and informal analytical tools to study how networks exchange goods and services. New institutional economics views an exchange of goods and services as a chain of tangible activities configured to achieve an efficient network (Beamon 1998a; Simsci-Levi, Kaminsky, and Simsci-Levi 2008). The primary focus is placed on ex ante contracting and ex post bargaining activities to reduce cost (Williamson 1991a, 1996). Transactions are made of formal and discrete exchanges, which often rely on the tangible workings of law, organization, institution and administrative fiat to transform inputs into products. The exchange theory in sociology brings a quasi-economic analysis and uses tools to analyze the relationship between the transacting parties (Tichy et al. 1979; Walker et al. 1997; Uzzi 1997). Sociology's view of an exchange suggests that more intangible resources are responsible. It focuses on the relationship between two actors. The actor exchanges are often simultaneous, parallel and are not characterized by subordinate relationships with other organizations (Podolny and Page 1998).

## **2.2 Network Performance**

When analyzing network performance with formal and informal ties, the network can be a set of tangible exchanges where a buyer and a seller exchange a good or a service. The network performance can also be seen as a set of intangible factors often influences the decision on whether to exchange goods or services. The tangible exchanges can create patents, trademarks, product and process technology, and trade secrets, while the intangible exchanges develop trust, competencies, skills, and personal relationships. The

emergence of the social structure allows some network theorist to measure performance in terms of the reciprocal, preferential, and mutually supportive actions between organizations (Barney 1994; Smelser and Swedberg 2005). There is a distinct difference between the informal and the formal exchange. The informal exchanges which are based on simultaneous and parallel exchanges and the formal exchanges, which are based on administrative fiat to transform inputs into products (Jones et al. 1997). In this study, the organizations involved in animal health and nutrition are considered a network and the social structure of that network creates a potential advantage. The ties within the network impact the flow of information and resources in both informal and formal ways. The way in which the Corridor is configured will impact how the organizations coordinate the flow of information and resources with the other constituent organizations in the network. The coordination of activities is represented by the evolution of agribusiness research with macro-analytical perspectives, which began with the Davis and Goldberg (1957) commodity systems approach (CSA) of “Getting the system right.” The CSA approach entailed coordination and harmony within the agrifood system. The coordination evolved into getting the network performance right (Chaddad and Cook 2000). This accelerated the inter-industry and intra-industry collaboration in a growing agrifood chain with its complex objective functions, as seen by organizations with biogenetic technologies. “There is a growing awareness of the potential for a multidisciplinary approach to a complex set of challenges observed in the agro-industrialization process” (Chaddad and Cook 2000). This case study provides insight into the relational ties that impact the performance of the organizations directly and indirectly involved in the commercialization of bioscience innovations in the animal health industry.

### **2.2.1 The Unit of Analysis**

The Corridor has been established as a national epicenter of animal health and nutrition. The region has been rewarded the trifecta of major government biotechnology resource facilities, including the National Bio and Agro-defense Facility's (NBAF) biodefense laboratory, Animal Disease Research Laboratory, and a center of excellence on zoonotic animal diseases. These advantages are added to the other resources already dedicated to animal health and nutrition in the region including three of the five largest pet foods companies in the world and top-tier veterinary schools. The complexity of bioscience initiatives is, in part, a result of a collective effort of entities collaborating to commercialize animal health products.

Geographically, the Corridor extends through the middle part of Missouri and Kansas. Manhattan, Kansas and Columbia, Missouri serve as the Corridor's east and west boundaries (Figure 2.1). The Corridor is a concentration of private, civic, and research organizations involved in commercializing animal health products for agriculture and companion animals. The region was significant in animal health and nutrition even before it became known as the Corridor. Its history includes the agricultural markets that date back to the Kansas City Stockyards, which was established in 1871. In 2009, the area received its official designation under United States House of Representatives and United States Senate resolutions as the Animal Health Corridor. The organizations that make up the Corridor are involved in a number of primary activities including R&D, manufacturing, and distribution. The revenue earned from animal medicines ranges from experimental to the prevention of animal diseases.

The Corridor represents an interdependent and complex group of organizations with varying degrees of inter-organizational linkages. The organizations in the Corridor are interdependent in that all organizations determine the extent by which they exchange with any or all of the other organizations. Also, the Corridor is complex in terms of its multiple connections. This means that one organization could have ties with a number of different organizations in the network. This web of interactions provides a potentially advantageous opportunity to exchange information, goods, and services. Miller and Jablin (1991) found the structure of the network influences how organizations are affected by changes.

### **2.2.2 The Nature of the Animal Health Corridor**

The Kansas City Animal Health Corridor began as an initiative between public and private institutions in the region. Its goal was to maximize the animal health assets in the region. Goal attainment required connecting the government and research sectors and engaging organizations that were competing in and supporting the animal health and nutrition industry. The network organizations are loosely organized and interdependent. How the network is organized is especially valuable when it comes to explaining the coordination and dissemination of salient and trusted information that is often transmitted between trading organizations. Most Western law systems use contracts as the primary means of formalizing inter-firm exchanges. The body of literature on networks reveals the extent 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 (Stinchcomb 1985).

The literature on industrial theory suggests that imitation and innovation are a result of organizations being in close proximity to one another. Proximity 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, but they may serve as the primary reason for the existence of the region's animal health strengths.

After conducting 15 interviews, reviewing websites and archival materials, it is clear that the Corridor is attempting to connect all the stakeholders in animal health including veterinary schools, companies, state governments and venture capitalists. These stakeholders represent a diverse grouping of organizations that can be studied as a whole network or by the subgroups that make up the network. A successful network would help to elevate the reputation and increase the visibility of the Corridor. A number of scholars have argued that a network organizational form, possesses considerable legitimacy or status, and then may derive legitimacy or status through the affiliation. This legitimacy or status may in turn have a number of positive economic benefits for the actor, 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 ([kcanimalhealthcorridor.com](http://kcanimalhealthcorridor.com)). The resulting effects are the potential benefits for the constituent organizations and the region as a whole.

## **2.3 Defining the Network**

In this section, the study defines the Corridor in physical and functional terms. Organizations within the Corridor work together across markets and across industries. They have the ability to leverage their key resources to increase the economies of scale and scope. These inter-organizational relationships were previously not possible due to high co-ordination costs (Clemons and Row, 1992). Increased coordinating cost tends to lead to specialization among organizations, leading to increasing interdependence, flattening of hierarchies and the development of inter-firm structures for co-operation and decision-making. Podolny and Page (1998) define a network form of organization as any collection of actors ( $N > 2$ ) that pursue repeated, enduring exchange relations with one another and, at the same time, lack a legitimate organizational authority to arbitrate and resolve disputes that may arise during the exchange.

### **2.3.1 A Geographical Definition**

The Corridor can be defined in geographical terms as a concentration of organizations in parts of Missouri and Kansas involved in animal health and nutrition, or operationally as the number of organizations that have taken a leadership role to provide marketing support, assists in technology transfer, and to address public/political concerns for the region as a whole. Both the geographical and operational definitions are important, as one definition does not completely explain the size or the functions of the activities taking place within the Corridor. This study approaches the Corridor as all of the organizations listed on the Corridor's website at the time the survey instrument was being developed.

Without the involvement of the civic, research and for-profit organizations the initiative would likely not have developed or would have developed differently.

However, networks are most common where participants have some kind of common background. In this case we consider geography, similar professional activities, cultural, historical, and institutional context to explain their common background.

### **2.3.2 A Value Chain Definition**

Another way of defining the network is through its value chain. The value chain distinguishes between the primary and activities (those involved with the transformation of inputs and interface with the customer) and the support activities. Porter (1985) generic value chain identifies a few broadly defined activities that are separated to provide a more detailed identification of the networks activities. By exploring different activities, and most importantly, the linkages between them it is possible to gain a sense of a network's main capabilities.

In addition to defining the network by its value chain, New Institutional Economics provides greater insight into the choice of a governance structure that best minimizes the cost of commercializing a good or service. It became clear that the full range of required skills, for example, basic research, applied research, clinical testing procedures, manufacturing, marketing and distribution, and knowledge of and experience with the regulatory process, could not be cost effective in a vertically integrated governance structure. Instead the empirical evidence of a network is the value chain is spread across the region. The network functions to gather some advantage it would not garner if it acted completely independent of others. For instance, the basic science and applied research skills needed to create new products were based in universities, research institutes, and dedicated biotech firms (Powell, Smith-Doerr, 1994; Zucker, Darby, and Brewer, 1994; Powell, 1996b). A functional definition includes processes in which inputs are

transformed into goods and services and the types of organizations involved. The network as a value chain provides a definition that separates the important functions across a number of independent organizations.

### **2.3.3 An Organizational Form Definition**

The Corridor is not 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 to infer, 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.

### **2.4 The Impetus for The Corridor’s Emergence**

As discussed earlier in this chapter, the area’s animal bioscience roots can be traced back to Kansas City’s historical strength in agricultural markets and the stockyards that were established in 1871. The renewed interest in the cultural and regional competitive advantage helps this concentration of organizations to collaborate and create opportunities that would further establish the region as a national leader in animal health and nutrition research, innovation, and production.

### **2.4.1 Financial Support**

The idea of the Corridor began after the James “Jim” E. Stowers Jr., the founder of American Century Investments, and his wife Virginia G. Stowers, who dedicated their personal fortune to improving human health through basic research. The Stower’s Family of Kansas City donated \$500 million to start its biomedical research organization that conducts basic research on genes and proteins that control fundamental processes in living cells to analyze diseases and find keys to their causes, treatment, and prevention. This gift galvanized leaders in industry and government to investigate the other economic opportunities related to bioscience that could be developed in the region. The Stower’s Institute of Medical Research and the bioscience industries of plant, human, and animal sciences help to define the Corridor industrially.

The field of bioscience is known as a set of technologies with the potential to transform various fields--pharmaceuticals, chemicals, agriculture, veterinary science, medicine, and even waste disposal. The animal science segments of bioscience gained initial support from the community after a region investigation reported the positive economic contributions of the bioscience industry to the region as a whole. These historical changes were spearheaded by civic, research, and for profit organizations.

### **2.4.2 Economic and Institutional Embeddedness**

This explanation of the Corridor’s emergence can be explained by the extent of social and institutional embeddedness in the network. The network formation is contingent on the larger social institutions including banks, legal systems, labor markets and political support. While social embeddedness takes into consideration those economic relations

between organizations pre-existing social relationships, the economic benefits that result from access to information are the underlying factors for the emergence of the Corridor

Evidence of economic action in animal health did not begin solely as one organization making decisions based on administrative fiat, but developed as a result of a collaboration of peers in an effort to increase intellectual capital. This development undergirds how it operates today. That is to induce, not any one organization in the Corridor serves in a subordinate role to another. Instead the organizational relationships are characterized by horizontal ties or peer roles. Its motive for existing are similar to the work of Galaskiewicz (1985) which argues the motives for network formation are to acquire resources, reduce uncertainty, enhance legitimacy, and attain collective goals, which are a result of the degree of embeddedness in the network.

The Corridor business system embodies a local institution formed from the region's heritage, carried on through specific relationships and extended by the "New Competition" of different actors and institutions.

## **2.5 A Plan of Action**

Leaders in civic, for-profit, research organizations describe the Corridor as an effort to bring industry and government agencies together to collectively accomplish innovation and research, and to improve on the assets that have already be established in the Kansas City area. The plan for the Corridor has rapidly evolved to include workforce development, the recruitment of other organizations into the region, influence public policy and engagement of the animal health industry with the Corridor.

### **2.5.1 Organizing Animal Health Resources**

A part of the Corridor's strategy for continued growth and development is to provide other organizations not currently associated with the Corridor the resources and functional needs for high tech industries ([kcanimalhealthcorridor.com](http://kcanimalhealthcorridor.com)). However, it is worth noting the exchange of valuable resources and information is not required to take place between the constituent organizations in the region. Network organizations are free to exchange goods, services, or resources with other organizations outside of the network.

The stakeholder approach creates the nature of this complex organizational form. It is a quasi-governance structure that does not rely on the market or a vertical integration to carry out an exchange or transaction. Instead, it relies on the leadership from some organizations to provide connections in the network so that they might collaborate and create opportunities to commercialize animal health products.

### **2.5.2 The Constituent Organizations**

Each organization in the domain was established to meet its own individual goals. Its ongoing existence is based its own ability to create value that attracts resources to sustain its own operation. Specifically, there are organizations whose primary activities include legislative and policy development, technical transfer and collaboration, branding, marketing, and recruitment. Ultimately, the Corridor is not the result of a single organization taking a leadership role but rather a dynamic combination of organizational connections. As pointed out by Powell (1990), the form of a network is highlighted by the following factors: know-how, that is the intellectual capital that has been honed by years of training, education and experience; the demand for speed resulting from the economic logic of capitalizing on the benefits from fast access to information, flexibility,

and responsiveness to changing tastes and preferences; and finally trust is a factor. Trust is the social context to encourage cooperation and solidarity. Networks should be most common in work settings where participants have some kind of common background.

### **2.5.3 A Strategic Priority of the Corridor**

One of the chief strategic priorities of the Corridor is to serve as a conduit for interaction between organizations in the animal health industry. When the number and types of organizations that make up the Corridor are taken into consideration it is likely the certain organizations interact different or do not interact at all. This study emphasizes the significance of all Corridor interactions. That is to generalize, the study emphasizes that when interactions between organizations increase, this increase advances the Corridor as a whole and engages the de facto organizations because they are geographically located in the region. In fact, the 2010-2012 strategic priorities for the Corridor include the engagement of the entire animal health industry with the Corridor.

### **2.6 A Network Market and Hierarchy Approach**

The network represents an organizational form unlike a perfectly competitive market or a hierarchy, which transforms inputs into output within the legal boundaries of the organization. New institutions in the form of a network have developed to handle some of the uncertainties that arise when handling the transfer and acquisition of various forms of knowledge between organizations. However, wrapped up within the network are complex legal, social, and economic variables that complicate the management process. Balancing the competing interests of the public good, reducing the barriers in terms of access to

knowledge, and ensuring the efforts result in socially valuable outcomes in the form of new innovations can be difficult.

The challenges of a network organizational form is to determine where on the continuum between spot market and vertical integration does the network fit. Its position indicates how strong or weak the ties are between the organizations. The following sections summarize the continuum of a theoretical market exchange. For example, in a pure market, relations are not enduring, but episodic, formed only for the purpose of a well-specified transfer of goods and resources and ending after the transfer. In a traditional hierarchy, relations may endure for longer than a brief episode, but a clearly recognized, legitimate authority exists to resolve disputes that arise among actors. However, the following summarization of the continuum of a theoretical market exchange will show the network is neither a pure market nor a vertically integrated organization.

### **2.6.1 Market**

For the exchange conducted in the market, prices tend to convey all the relevant information needed to exchange a good or service. The majority of the organizations in the Corridor are for profit organizations. A market attribute is its fast and simple communication to exchange a good or a service. The basis of the exchange is on long-term contracts that define the terms of the agreement for a long period of time or haggling over the terms of the agreement (mostly prices) for each individual exchange.

### **2.6.2 Hierarchy**

The majority of the organization's transactions are carried out within the organization. That is to induce, that inputs are transformed into outputs within a vertically integrated organization. The basis of the exchange is administrative fiat or supervision.

### **2.6.3 Network**

A network is not exclusively characterized by non-market and non-hierarchical modes of exchange. It is characterized by cooperation that sustains the relationship over extended periods of market activity and uses intangible assets such as tacit knowledge and technological innovation. In markets the standard strategy is to drive the hardest bargain in the immediate exchange. In networks the goal is to create indebtedness and reliance over a long period of time.

In a perfectly competitive market, if a contract is used to bind exchange partners together in a continuous relationship then the perfectly competitive market has failed or is imperfect in carrying out the exchange (Cook et al. 1983). Ronald Coase (1937) path breaking work "The Nature of the Firm" questioned the neoclassical framework of market exchanges and suggested transaction costs are the reason why firms exist. Transaction cost economics draws on questions of when the exchanges will be mediated by a market or by a vertically integrated organization to minimize cost (Williamson 1974). In Granovetter's (1985) discussion of the concept, in its initial formulation, embeddedness developed the notion that all economic behavior is necessarily embedded in a larger social context. Each approach draws into question the imperfections of the neoclassical theory when interpersonal and interdependent relations effect how economics exchanges are done.

## **2.7 The Multiple Sources of Information and Resources**

Networks involve intricate, multifaceted, and long-term relationships in which peer-to-peer or horizontal forms of exchange are common. There are many organizations making their own local management decisions on how they interact with other research, civic, and for-profit organizations. The decision to exchange information or resources is an independent process for each constituent organization. The various forms of exchange including spot transactions and long term contracts, involve the interaction between many suppliers of that information. The supply of this information could come from different sources that are a result of the location, the relationships and the collective action in the Corridor.

### **2.7.1 The Corridor as a Place of Activity**

The Corridor is a geographic region and combines science, enterprise, and civic organizations to carry out the commercialization of animal health and nutrition products. Organizations are not legally obligated to do business within the boundaries and are free to exchange with other organizations outside of the region. However, the constituent organizations benefit from federal and state legislation intended to advance the interest of the region. The intermediary and support organizations provide institutional support that can reduce the transactions costs, while the enterprise and research institutions are users and codifiers the knowledge created by research. In summary, the Corridor represents a geographical space to exchange goods, services, and information.

### **2.7.2 The Corridor as a Place of Embedded Ties**

The flows of products and services are embedded in a web of relationships at varying scales. For instance, the ties are a mix of public, private and research institutions, as well

as agricultural trade associations, commodity chains, innovation centers, and state bioscience authorities. Even in bureaucratic settings informal social relations provide a source of coordinating activities (Blau et al. 1955).

### **2.7.3 The Corridor as a Collective Activity**

While organizations in the Corridor share embedded ties, legally each organization in the Corridor are wholly independent. The livelihood of each organization depends, however, on the relationships that secure resources to operate the organization. For instance, the primary activity of an organization in the research domain is to create and codify knowledge. The Corridor's efforts are directed to use the knowledge so that it benefits a product. It requires commercial actors such as distributions companies of product manufacturers to transform the product from their research laboratories into a scaled production oriented organization. There are research organizations in the region that are capable of codifying and marketing its own research; however, utilizing the expertise of other organizations is often advantageous for all parties concerned. In addition, collectively the Corridor represents a brand or a distinction that all constituent organizations can leverage for their own gains.

### **2.7.4 The Interconnected Network of Domains**

The network is explained in terms of its broader cultural, historical, and institutional context. This study initially differentiates the Corridor according to its primary activity – domain. A domain level representation differentiates the generalized tasks involved in the commercialization of animal health and nutrition products. Networks evolve out of market-based relationships. Organizations that make investments in a relationship with another organization will want to get involved in activities that are traditionally

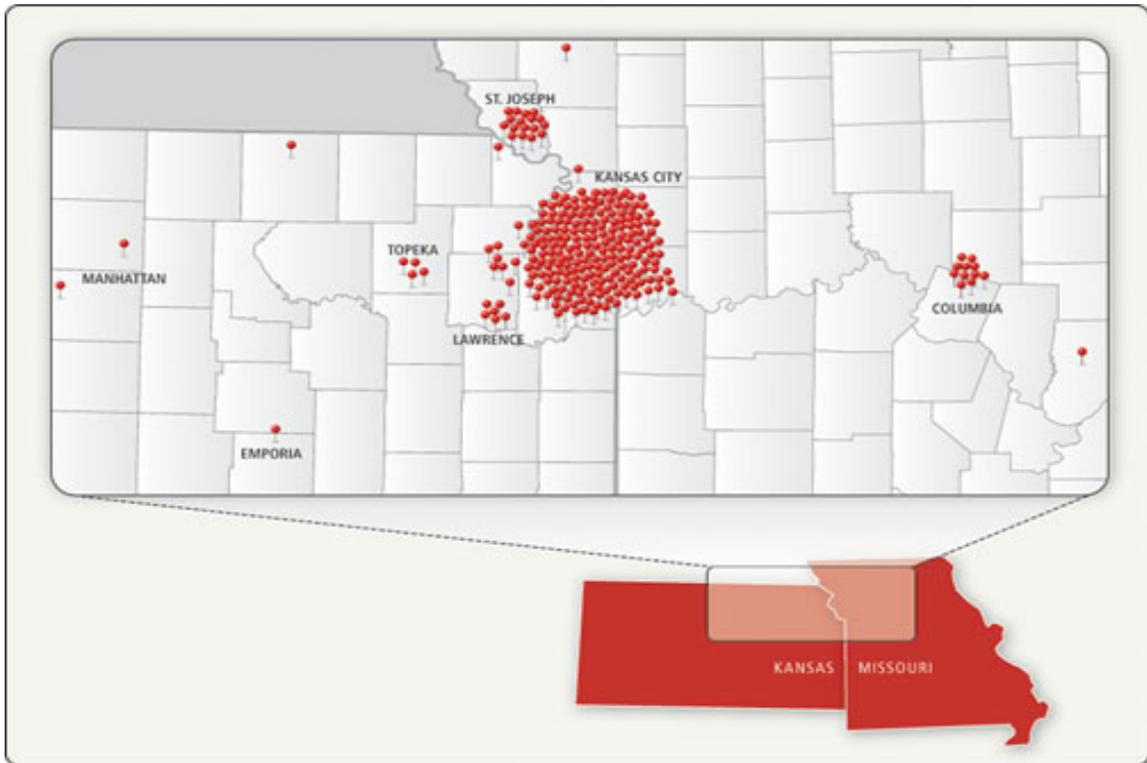
considered the other party's exclusive domain in order to minimize the risk involved. For instance, buyers may engage its suppliers in product development in order to maximize the value of the tools and equipment employed. In this way, the risk of tool obsolescence due to unilateral development changes is lowered (Zaheer, McEvily and Perrone 1998).

## **2.8 Types of Organizational Linkages**

Vertical, horizontal and diagonal ties can characterize the inter-organizational ties and interdependency in the Corridor (Thompson 1967; Lazzarini et al. 2001). For example, the vertical ties between organizations can be examined by analyzing the organizations in the support domain of the Corridor in relation to the organizations in the enterprise layer. Empirically, these ties distribute a flow of information, money, goods, and services that completes the exchange between the interdependent organizations. Horizontal ties, for example, are seen as organizations in the research and intermediary domains of the network interacting as an alliance or interacting as peers engaged in social and professional relationships. Diagonal ties are organizations in the support layers of a network that are not directly involved in organizing and commercializing activity. The diagonal tie allows for one member to take advantage of another network member's trading partners with noncompetitive repercussions (Thorelli 1986; Powell 1990; Lazzarini et al. 2001).

Horizontal ties within the network are illustrated by the collaboration between comparative medicines and animal health research. These ties have led to the involvement of legislative advocacy and the largest concentration of companies working to commercialize medicines. The metropolitan area of Kansas City has become a global industry center with more than 173 organizations involved in commercializing animal

health and nutrition products. Within this region, there are 37 global or U.S. headquarters, including five of the 10 largest animal health companies and two of the five largest global pet food companies in the world.



**Figure 2.1: Geographic representations of organizations in the Corridor**  
Source: KC Animal Health Corridor website <http://www.animalhealthcorridor.com/>

For a list of the names of organizations that are represented in Figure 2.1 refer to APPENDIX B for details.

In order to gather empirical evidence, this study focuses on the constituent organizations that are oriented toward research, civic, and profit activities. By collecting data from these types of organizations, the study can accurately explore the differences

and/or similarities between them and focus on the relationships that have the potential to take advantage of the network connections.

## **2.9 Classifying Corridor Organizations**

This system is used to classify business establishments according to the type of economic activity (process of production) in Canada, Mexico and the United States. The study's utilization of the North American Industrial Classification System (NAICS) reveals a wide variety of organizations whose primary interests are reported in 26 different subsector codes used by the classifications standards of the NAICS. The following sections provide a deeper understanding of the diversity of the Corridor when viewed in terms of its industry subsector.

### **2.9.1 Corridor Results by NAICS Subsector**

The diverse organizations in the Corridor Table 2.2 show the distribution of organizations in the Corridor by NAICS subsector codes. Six subsector codes make up 73 percent of the organizations in the Corridor. Of these six subsector codes, two of them correspond into the enterprise and intermediary domains of the study. The two subsector codes make up 20 percent of the organizations in the Corridor. This domain perspective shows that intermediate and enterprise domains make up 31.2 percent of the organizations that make up the Corridor.

# of Orgs by NAICS	NAICS	Subsector Description.
18	311	Food Manufacturing
2	322	Paper Manufacturing
2	323	Printing & Related Support Activities
14	325	Chemical Manufacturing
1	326	Plastics & Rubber Products Manufacturing
2	332	Fabricated Metal Product Manufacturing
5	333	Machinery Manufacturing
2	334	Computer & Electronic Product Manufacturing
1	337	Furniture & Related Product Manufacturing
2	339	Miscellaneous Manufacturing
3	423-421*	Merchant Wholesalers, Durable Goods
15	424-422*	Merchant Wholesalers Nondurable Goods
1	451	Sporting Goods, Hobby, Book, & Music Stores
1	453	Miscellaneous Store Retailers
2	511	Publishing Industries
2	518-514*	Internet Service Providers, Web Search
1	522	Credit Intermediation & Related Activities
3	524	Insurance Carriers & Related Activities
45	541	Professional, Scientific, & technical Services
3	551	Management of Companies & Enterprises
16	561	Administrative & Support Services
2	562	Waste Management & Remediation Service
6	611	Educational Services
5	621	Ambulatory Health care Services
1	712	Museums, Historical Sites, & Similar
18	813	Civic, Religious, Grant-making

**Table 2.2: Corridor Organizations by NAICS Codes**

\*1997 NAICS codes were 421, 422, and 514. In subsequent reporting periods, the codes were changed to 423, and 518.

### **2.9.2 A Subsector and Metropolitan Definition**

NAICS is based on a production-oriented concept, meaning that organizations are grouped into industries according to the processes used to produce goods or services. In this study, the NAICS codes are based on the three-digit subsector classification system

for the geographic area across two states and five Metropolitan or Micropolitan shown in Table 2.3.

Missouri Metropolitan Areas	Kansas Metropolitan Areas
Kansas City Metropolitan Area includes portions of both states	
Columbia Metropolitan	Manhattan Micropolitan
Saint Joseph Metropolitan	Lawrence Metropolitan

**Table 2.3: Corridor Defined by Metropolitan and Micropolitan Areas**

### 2.10 The Domain Perspective of the Corridor

A domain perspective is used to describe and categorize the organizations into their primary fields of activities. Organizational ties are used for information sharing; knowledge creation and political advocacy can play a key role in understanding how organizations operate (Smelser and Swedberg 2005: Håkansson, and Snehota, 2006). Levine and White (1961) in their study of relationships among health agencies describe domains as what the participating organization claims as its purpose. The concept of a domain, therefore, is useful term in the study of a diverse network (Thompson 1967; Omta et al. 2001).

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; (4) the support domain as providers that are not directly involved in the movement of the good or service but support activity; and (5) the demand domain, is the point where the output is consumed or in position to be purchased by the end-user.

The network is a nexus of organizations without a legally binding agreement that forces organizations to interact with one another (Dobbin 2004; Fligstein and Dauter 2007). This strength of the network is in its willingness to use the strengths and capabilities of other organizations (and in combination with its own different expertise) to advance its own interest. As in the case of the Corridor, organizations in the animal health and nutrition industry may find advantages by clustering in the region. In this sense, the network is viewed as an organizing logic in that it supports the relations between organizations (Dixit 2004). In comparison, transaction cost economics models predict the governance structure that minimizes the cost of carrying out a transaction. Table 2.1 categorizes some of the organizations involved in commercializing animal medicines; it provides examples of each domain actor and delineates the network as a sphere of activity.

### **2.10.1 The Demand Domain**

The demand domain consists of the users of the output of the bioscience network. This activity is synonymous with retail or industrial sales channels. In the Corridor, the demand domain consists of veterinarians, or outlets that sell animal medicines. It receives the product that is ready to be sold to a buyer that will dispense it to the patient. Refer to Table 2.1 for examples of the organizations involved in this domain.

### **2.10.2 The Enterprise Domain**

The enterprise domain requires the use and the integration of information originating from the organizations involved in research. This could include its R&D Department or organizations whose primary activity is to conduct research. These organizations focus on profit maximization, whether it is increasing revenue or reducing cost. The enterprise domain consists of organizations that use the codified knowledge from the research domain to manufacture and market innovations. Refer to Table 2.1 below for examples of organizations in this domain.

### **2.10.3 The Intermediary Domain**

The intermediary domain is made of institutions for collaboration. Organizations act to facilitate the potential advantages of the region by increasing the awareness and the reputation to other organizations involved in animal health and nutrition. This is accomplished by marketing and promoting the resources dedicated to animal health and nutrition with the purpose of attracting other related organizations to locate or relocate to the Corridor. The region's attractions include access to readily available resources dedicated to the industry, its skilled labor force, and a cluster of organizations already in the area. The domain is involved in attracting employers to the area, and addressing legislative issues related to animal health. Refer to Table 2.1 below to view examples of organizations involved in this domain.

### **2.10.4 The Research Domain**

This domain consists of research institutions from the private and public sectors, which are involved in providing innovations to prevent, manage, or cure of animal

diseases. The research domain is primarily, but not exclusively involved, in the selection and optimization of traits that enhances animal production and wellness. Refer to Table 2.1 below to view examples of organizations involved in research.

### 2.10.5 The Support Domain

The support domain consists of diagonal relationships with the enterprise, intermediary, and research domain. The diagonal tie allows for one member to take advantage of another network member’s trading partners with noncompetitive repercussions. The organizations in this domain provide a service. The services are positioned to sell goods and services that are not the primary functions of the organizations in the research, intermediary, and enterprise domain. These goods and services are purchased from the support domain and needed to provide animal health products, goods, or services. Refer to Table 2.4 below for examples of organizations involved in the support domain of the network.

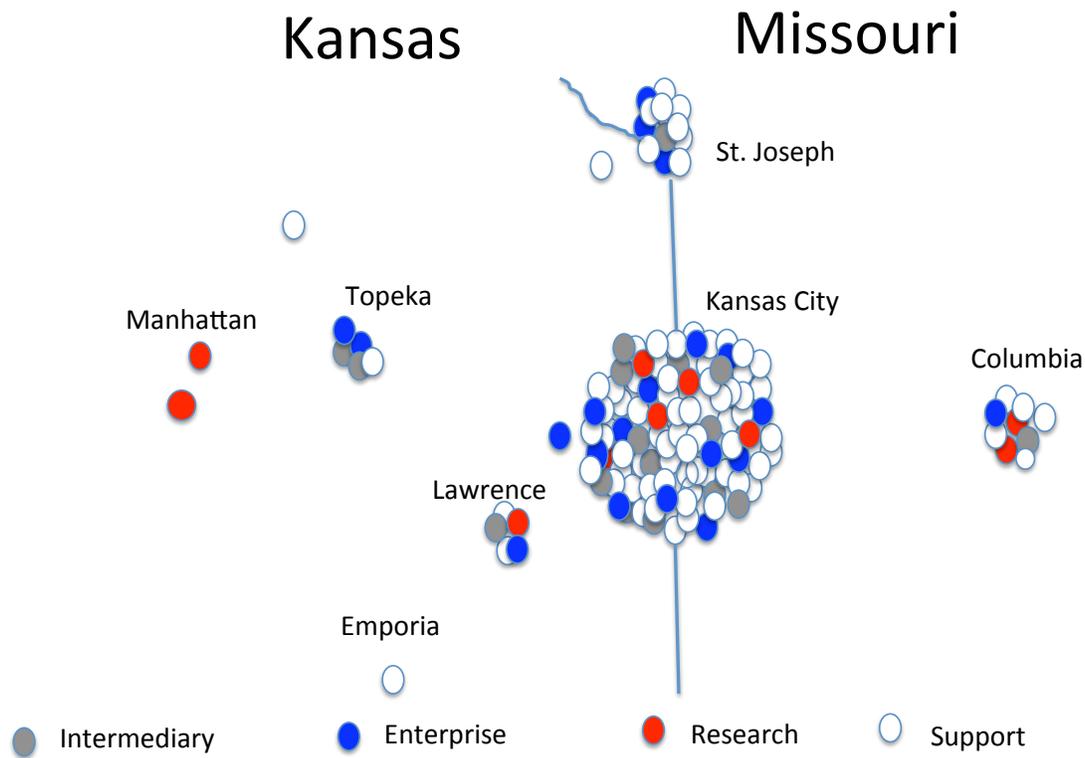
Demand Domain	Research Domain	Intermediary Domain	Enterprise Domain	Support Domain
<ul style="list-style-type: none"> <li>• Veterinary Practices</li> <li>• Consumers of animal health services and medicines for urban and rural areas</li> <li>• Federal Government</li> </ul>	<ul style="list-style-type: 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 2.4 Network Design by Domain Activity**

## **2.10 Summarizing the Domain Perspective of the Corridor**

This section invokes a multidisciplinary approach to study the Corridor, which will allow the researcher to systematically analyze the network by describing the patterns of ties between the organizations. The domain perspective helps to identify and segregate the organizations based on their primary economic activities. The Corridor is not a legal entity; it represents a network diverse in knowledge and values. Achieving commercialization goals requires probing and experimentation, negotiation, and learning among the organizations. This process typically calls for similar interpretations of the issue being solved whether it is reducing the cost or minimizing time to commercialize animal health products. Product commercialization must take into account the place-based and context-relevant factors of taking a new product or process from the concept stage all the way to the consumer. In addition, commercialization involves meeting different goals of the constituent organizations in the network, which includes advancing the interests of a diverse group of organizations.

Figure 2.2 provides a representation of the geographic and distribution of organizations within the Corridor. The map is not a precise representation of the region but is intended to depict the organizations and the domains in the region.



**Figure 2.2: Kansas and Missouri Map of Organizations by Domain**

### 2.11 Domain Level Linkages in the Network

Now that the domain level of the Corridor has been established in the previous section, the study further examines the diversity of the type of organizations that make up the Corridor. This approach provides another opportunity to assess the diversity of organizations involved and the probability that different and varying degree of organizational ties connect or do not connect organizations.

An examination of the domain level linkages in the Corridor provides a different view of the actual relationships. The empirical indicators of the relationships include the strong ties, weak ties, and reciprocity. The indicators show the influence or the lack of influence an organization or a particular domain has on the Corridor. By examining the extent of

the strong and weak ties in the network, this study can draw conclusions regarding which domain has a larger influence on how the Corridor functions.

This chapter explains the Corridor by definition, activity, subsector and linkages. This approach provides the underpinnings to establish a theoretical framework to study this diverse network of organizations. The next chapter provides further discussion on the theoretical tools to explain how this network functions.

### **CHAPTER 3: THEORETICAL FRAMEWORK**

The previous chapter distinguishes the Corridor according to its structure and nature of work. This chapter establishes network theory to explicate the functionality of networks ties in the Corridor. To understand the main theoretical principles of networks, this study regards “transactions” or simply the “exchange” as a basic unit of analysis.

Social exchange theory developed the explanation of why social structures exist, including networks (Emerson 1976). This theory states that the transaction of a good or service is a direct result of the social structure that is embedded in the exchange itself. Mark Granovetter’s paper “The Strength of Weak Ties” is an important article in analyzing networks and the exchanges that occur within networks. He hypothesizes that weak ties can act as crucial bridge and he elaborates on four dimensions that measure the strength of ties: the amount of frequency, the emotional intensity, the mutual confiding (trust), and reciprocity (Zaheer et al. 1998; McEviley & Zaheer 1999). The strength of weak tie thesis includes the influence of strong ties in the network. Both ties explain how the network functions. In his view, strong ties sustain relations within the group or organization. Weak ties play a role of a bridge by allowing new information to flow faster between different groups. Granovetter argued that weak ties are more likely to link members of different small groups than are strong ties, which tend to be concentrated within particular groups. Therefore, networks with more weak ties relationships are more likely gain greater access to new than relationships that are characterized by more strong ties (Granovetter 1973).

Social exchange theory asks several main questions but of importance to this study is its focus on the implications of how the network works. The experiments of Cook and

Emerson (1978) and Cook et al. (1983) clearly demonstrate the link between exercising power and position in a network creates a potential advantage. It predicts that the locus of power is based on the structure that allows greater access to valuable information. The discussion suggests choosing the most efficient network structure as important considerations when tapping into the potential formal and informal advantages of a network (Williamson 1976). Exchange theory and network theory both conceptualize the social structure as a configuration of an organizations position in the network, i.e. as a set of organizations linked differently in the network (Cook and Whitmeyer 2002).

This chapter presents network theory as the primary basis to offer an explanation how organizations in the network function. It presents the relevant dimensions of the network school of thought and the elements of the informal economic exchanges.

### **3.1 Social Network Theory**

The interplay between formal and informal structures is a recurring theme in organizational studies. In the organizational context, a distinction is usually made between the formal and informal ties, which facilitate economic action. Böröcz and Southworth (1998) define formal ties as being explicit, impersonal, and functionally specific relationships among individuals or groups.

The informal network connections are viewed as implicit, personal, and not fixed by any legal arrangements (Jarillo 1988). Informal exchanges are defined as voluntary cooperative relationships between organizational actors, not determined by the organization's formal ties (Krackhart and Hanson 1993; Böröcz & Southworth 1998). Informal ties can be created only between organizational actors who are not connected by a formal relationship (Böröcz 2000; Gulati 2003; Gulati et al. 2006). Informal ties persist

over time, thus generating a relatively stable pattern of network relationships. Douglass North defined informal structures (1971) as “humanely devised constraints” in social interactions. The informal structures consist of sanctions, taboos, customs, traditions and codes of conduct that influence economic activity. Both North and Granovetter conclude that relations and informal structures constrain the direction and form in which economic relationships can develop.

### **3.1.1 Granovetter’s Theory of Organizations**

Granovetter based his theory of organization on the basis of three classic 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).

Granovetter believes economic action is embedded in social structure, and at the same time, action is constrained and facilitated by the network structure. Granovetter’s concept of embeddedness implies that economic exchanges are embedded in a pre-existing social relationship. In comparison with the hypothesis of weak ties, the concept of embeddedness emphasizes trust is established in an exchange relationship before information is exchanged. But trust should develop on basis of long-term contact or communication between transacting parties. Thus, it is the concept of embeddedness that implies the strength of strong ties, which is contrary to his former hypothesis of the strength of weak ties.

### **3.1.2 Granovetter's Theory on Social Network**

It is an organization's choice to have strong or weak ties. Granovetter uses frequency, and reciprocity to predict the structure that allows greater access or control of valuable resources. While strong ties are related to a higher frequency of interaction and a denser network structure, weak ties are characterized by less frequency and interaction, less dense network and narrower reciprocal ties. There is a distinction between strong ties and weak ties. Weak ties are more likely to link members of different small groups than stronger ones that tend to be concentrated within a group. An advantage is created in choosing a structure that gains access to valuable resources. The Animal Health Corridor is a complex group of independent organizations carrying out research, providing legislative support to commercialize products. Hence, the network perspective is relevant to this study of how the Corridor functions effectively to achieve its purposes. However, the Corridor may not fully capture the potential of a bioscience network given the number of unique value drivers that make up highly diverse group of organizations. Therefore, it is necessary to investigate the usefulness of other sociological methods to fully account for the dynamic nature of the inter-organizational relationships in the Corridor.

Moreover, how the tie strength and the degree of embeddedness, helps the researchers to examine actual and potential ties in the network.

### **3.2 Inter-organizational Relationships**

Network ties can characterize the relationships between organizations and the connections carried out by individual interaction or organizational arrangements like contracts or joint development projects. Networks in bioscience have emerged to promote economic performance through relationships with other firms (Powell, 1990; Powell and Smith-Doerr 1994). It is widely viewed in the research literature that complex organizations (organizations with multiple key connections with other organizations) exist due to their ability to efficiently access information and resources. That is, transforming inputs into outputs that have more value than the inputs. Through professional, social, and exchange relationships, these organizations share advice, information, and new solutions (Fjeldstad and Stabell 1998; Nohria and Eccles 1992; Goerzen 2007).

We can also study the Corridor through the lens of economic sociology. The organizations that make up the Corridor are uniquely positioned and are examined by their complementary and varying degrees of direct and indirect activities to commercialize animal health and nutrition products. This helps fill out our understanding of the relative importance of these different, informal dimensions of how networks optimize performance. For example, some of the organizations might emphasize reducing uncertainty in their exchange relationships, while other organizations might emphasize maximizing their frequency of contact to access timely information as important. In this and many other cases, the conclusion would be the same that the networks work by its means of improving the level of interaction and frequency in transactional relationships.

### **3.3 The Concept of a Relation**

This section discusses in more depth the conceptual elements of the linkages used to study Animal Health Corridor. While the previous section discusses the primary theories that form the basis of this study, this section aims to refine the conceptual elements that have explanatory power for how the bioscience network works.

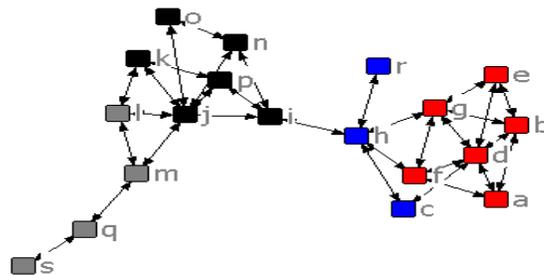
The concept of relationships includes recognizing the interdependencies between two or more entities. Relationships often represent communication, influence, trust or effect of an organizational friendship. It also can refer to conflict. Most social network studies also include attribute data describing the organizations, their relationships, or both. A social network consists of one or more sets of units—also known as “nodes,” “actors,” or “vertices”—together with the relationships or social ties among them. This research uses the concept of a relation to advance the understanding of the structure of the network and how it functions.

#### **3.3.1 Conceptual Representation of Relationships**

To study the structure responsible for how the network functions, a measure of the relative strength of the organizational ties and reciprocity are used to measure the social structure in bioscience networks (Granovetter 1985; Liu and Wei 2009).

Network analysis demonstrates the actual structure of all connections in the network. Consider for instance Figure 3.1 as an illustration of a network. It represents the relative connections between the different organizations. The network has 19 different nodes labeled by alphabets a-s. Single and double arrow lines connect the organizations. A single arrow line indicates a sequential relationship (one organization’s input is another’s output). A double arrow depicts a reciprocal relationship (simultaneous and oftentimes

parallel exchanges within the network). The absence of a line is an indication that there is no interaction between the organizations. The colors represent different types of organizations and factions. For example, all organizations whose core activities are the same have the same color. It is an indication of a subgroup within the network. Letters “i” and “h” represent a bridge and are in position to allow or inhibit key information or resources to pass through either cluster. In essence these actors are in a position to become brokers or act opportunistically.



**Figure 3.1: Network Illustration of Network Ties**

Social exchange theory views trust as economically valuable (Granovetter 1992). In the face of uncertain conditions, the strength of tie or strong ties creates a base of trust for organizations (Moran 2005). Trust reduces uncertainty needed to adapt to environmental changes (Granovetter 1982; Krackhardt and Stern 1988). Trust is the extent in which members of the network collectively trust a partner; it is seen by the joint activity to reach

mutual transactions and the willingness to make changes in the day-to-day involvement in light of unforeseen changes (Nohria and Eccles 2000). Trust becomes an expectation that characterizes the relationship between transaction partners (Granovetter 1992).

### 3.3.2 Reciprocity

Reciprocity refers to responding to a positive action with a positive action. Emerson (1981) explains it 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 the favors will be reciprocated. Intermittent reciprocity can either be predictable or unpredictable. Exchange partners whose acts of reciprocity are regular and predictable should be valued over those whose reciprocity is intermittent or random. Figure 3.2 shows a line segment with two arrows. It represents a give-and-get relationship between organizations in the network. In its simplest form a reciprocal relationship involves only two organizations. In a more complex representation, multiple double-arrowed relationships exist in the network.



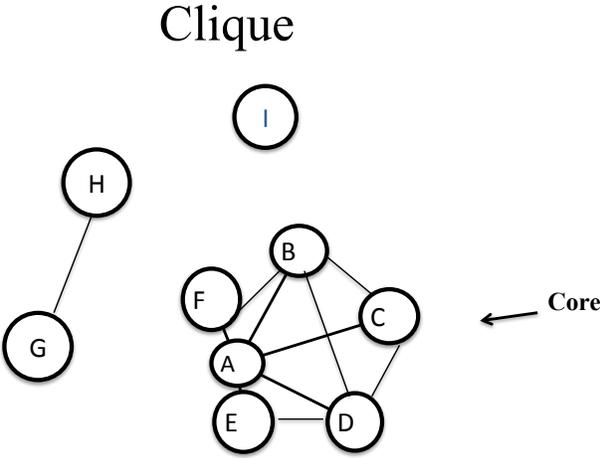
**Figure 3.2: Conceptual Diagram of Reciprocity**

### **3.3.3 Embedded or Strong Ties**

The amount of density in a network measures the relationship of actual and potential ties in a network (Krackhardt 1992, 1996). High density and high cohesion indicate a high degree of interdependence in sectors of the network. Density is the extent to which the actors in the network are tied to one another. If all of the actors know one another, then the network is perfectly dense. On the other hand, if none of the actors know one another directly or are not connected then the network density is zero. As a dimension of density, intensity explains the degree by which economic action is embedded in the social structure (Gilsing and Noteboom 2005).

In order to analyze relationships and balance between and within groups every balanced network can be divided in subgroups with positive internal relations and negative external relations. The concept of a subgroup introduces the larger concept of density and network density has been shown to be a good index for group's homogeneity and cohesiveness (Friedkin 1984).

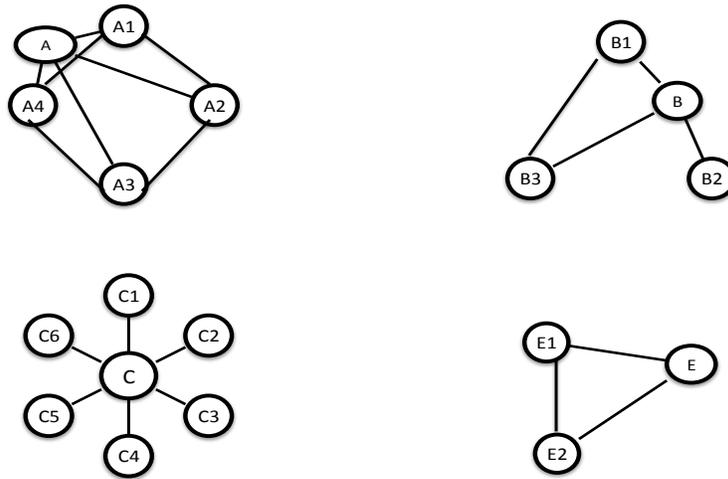
Cliques are measures of dense or how strong a network is. A clique is the maximal number of connections. Nodes included in the clique are adjacent to all the nodes in the clique (Luce & Perry, 1949; Harary et al. 1965). Thus, clique density is always 1.00. If any other network actor were added to the clique, the result would be a sub graph having one or more null ties and hence a density less than 1.00. Figure 3.3 is a conceptual illustration of a network clique. Nodes represented by a core group of organizations, which are composed of components with geodesic line segments between all actors in the group. Organizations G, H, and I are a part of the network but are not a part of this densely connected subgroup in the network.



**Figure 3.3: Conceptual Diagram of a Clique**

Factions represent a different subgroup within a network. Figure 3.4 is an example of a network with four densely populated subgroups. Note that there are no stand alone or isolated organizations. Although all organizations are connected, they are not connected to each organization in the component.

## Factions



**Figure 3.4: Conceptual Diagram of a Four Factions**

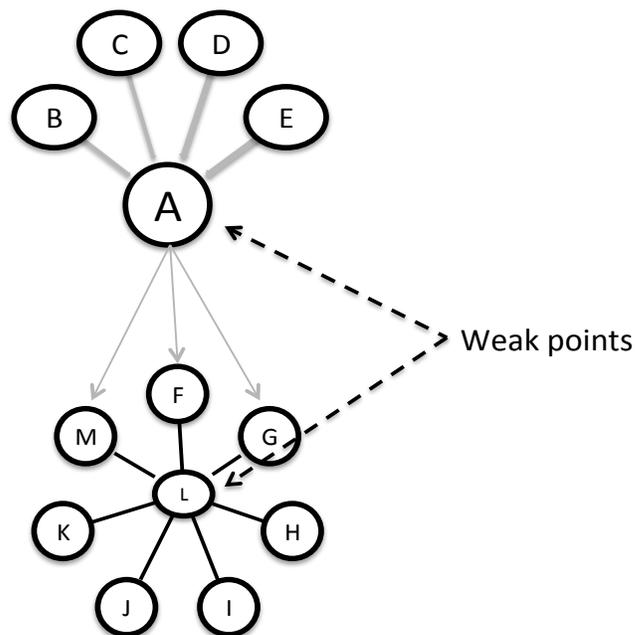
Granovetter proposes that the strength of ties comes from informal structures (interpersonal relations, ethics, morality etcetera). They are produced by higher frequencies of interaction, more emotional involvement, and more reciprocal exchanges.

### 3.3.4 Strength of Weak Ties

Granovetter (1973) defined the concept of strong ties as strong interpersonal relationship interpersonal often characterized as having a long-time relationship. In contrast, weak ties are limited to the investments of time and reciprocity in the relationship. Weak ties are more important in spreading information and gaining access to resources. These ties are described as ‘bridges’ between disconnected groups. Burt (1995) discovered that strong ties are also bridges but have a tendency to be redundant sources of information or resources, so a network that relies on the strength of its weakest ties make information available will benefit more from its weak ties than its strong ties.

Relationships in a network are also measured by the amount of cohesion. Cohesion measures the network density and closeness between organizations. It measures how united or connected the whole network is. Weak ties play a role in social cohesion to help to relate micro-level interactions to impact macro-level patterns. Figure 3.5 is an illustration of a weak point in the network. If organization A were removed, then organizations B, C, D, and E would become disconnected from the network. Organization A represents a cutpoint in the network. Likewise, organization L represents a cutpoint. If it were removed, then organizations H, I, J, and K would become disconnected from the network.

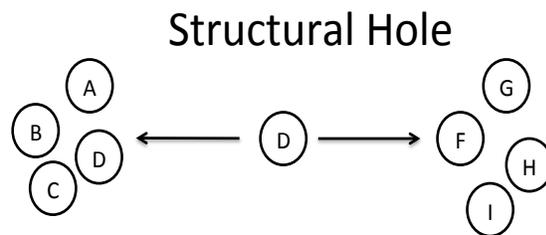
## Weak Points



**Figure 3.5: Conceptual Diagram of Network Weak Points**

Figure 3.6 is an illustration of a structural hole in a network. Organization D spans the hole and is connected to two different subgroups. It is positioned to influence (impede, facilitate) the flow of information and resource from one subgroup to another.

Structural holes are the spaces between and not within dense regions of relationships. The concept refers to some very important aspects of positional advantage/disadvantage of individuals that result from how they are embedded in subgroups. The subgroup is one of two or more groups of organizations that are connected by somewhat strong ties and who are close in proximity to one another. Unlike the clique, in a subgroup every organization is not connected. However, like the clique a subgroup is close in proximity to another organization.



**Figure 3.6: Conceptual Diagram of a Structural Hole**

The weak tie plays the role of a bridge in the process of information flows between different groups. The hypothesis of the weak tie and such empirical findings has a great influence. Granovetter (1973) found that weak ties are an important resource. Based on Granovetter's empirical findings, weak ties are not automatically bridges but that all bridges are weak ties.

### **3.4 Theoretical Explanation of How the Corridor Works**

In Granovetter's (1985) initial formulation, embeddedness is the notion that all economic behavior is necessarily embedded in a larger social context. Granovetter painted economic exchanges as embedded in social networks, and saw this as steering a middle road between over-socialized (role-based) and under-socialized (purely instrumental rational actor) approaches to explaining economic action. More recent empirical work has focused on the performance benefits of embedded ties, which are often associated with closer and more exclusive business relationships (Uzzi 1997). This study looks at the Corridor from two different levels: a domain level and at an individual organizational level. For example, it looks at which domain is more or less connected and which specific organizations are more or less is linked or not linked. The research uses both qualitative and quantitative methods to examine how the Corridor actually interacts. The interactions between the domains, as well as the interaction between the organizations in the domains are key concerns of this study. The general notion of the Corridor is it generally recognizes the potential to access valuable resources and information through its strong organizational ties. In particular, the Corridor's organizational ties form cutpoints, create strong relationships, and are reciprocal in nature.

The Corridor's heritage and the strategic plans for the region sets forth the frame to begin studying the extent of the ties that explain the Corridor interaction. Thus, it is necessary to focus our attention to explain the broader cultural, historical, and institutional context to explain how inter-organizational networks function.

### 3.5 The Concept of a Network

For the sake of simplicity, the study will now consider only the simplest network form, a binary network (every relation involves only couples of units) on the set of units  $X$ . There are three kinds of representations of a social network: the first description is the simple list of all the elements taken from the set of actors, and the list of the pairs of elements, which are linked by a social relationship of some kind.

$$A = \{(x1, x2), (x2, x1), (x4, x2), (x3, x1), (x3, x4), (x4, x3)\}$$

$$B = \{(x1, x2), (x2, x1), (x3, x4), (x4, x3)\}$$

The two relations  $A$  and  $B$  have the same set  $X = \{x1, x2, x3, x4\}$ .

#### 3.5.1 Evaluating the Patterns in the Network

One of the most powerful roles a network plays is to bridge the organizations in the networks. The network perspective is used to evaluate the patterns of relationships in the Corridor. The network analysis is a visual and mathematical perspective of organizational networks. The visual portion maps the network connections, while the mathematical part of an analysis measures the relational ties and flows between organizations.

The general of view the relational ties are within and across a domain of activity. The ties may exist between several organizations in the same domain or the relational ties may exist between organizations from different domains of activity. The measurement of network ties helps to define the structure and the strength of the actual Corridor.

When analyzed in terms of relational ties and economic action, these ties form a substructure of a group, a fascinating phenomenon arising from the unique social structure of the network. In the case of the Corridor, there are 173 organizations.

However, the ways in which the organizations are grouped make up the subgroup. These

subgroups help to explain the Corridor's patterns of interaction. The study intends to measure the number, size, and connections among the subgroups in order to determine if and how information and resources flow through the network. This approach provides a significant amount of information about the behavior of the Corridor as a whole.

### **3.6 Operationalizing the Organizational Ties**

The social network perspective provides an explanation for the structure of the network and what the corridor is actually like. Connecting tie strength with structural properties of the Corridor's underlying social network make and intriguing theoretical predictions about the actual or potential ties in the network.

One of the most common measurements of a strong tie is the density of the network. Network density ( $D$ ), for example, measures the number of nodes that are actually tied to other nodes in the network and is expressed as a proportion of all the possible ties in a network or

$$D = \frac{\lambda}{N(N - \lambda)/2}$$

where  $\lambda$  denotes the total number of lines (ties) present and  $N$  is the number of organizations in the network.  $N = 173$  organizations and  $\lambda = 498$ . Network density for the Corridor is calculated as 2% (Ahuja 2000). Based on this calculation the model can be described as a sparse network with a relatively low number of connections between constituent organizations. Although density is an important and common measure of the network's structure, a more detailed explanation of the organizational that accounts for the economic benefits, enhanced reputation, learning opportunities will provide an alternative calculation and perception of the network structure.

In order to explain the connections that exist, the study tests the tie strengths in terms of the number of strong ties, weak ties, and reciprocal relationships. Each measurement provides additional insight into the structure of the network. The structure is largely responsible for the way resources flow or do not flow between organizations. Hence, the structuralist view is used to explain the interaction of how a network functions rather than the individual characteristics that focus power, position and personalities that influence the flow of information and resources.

### **3.7 Operationalizing Weak Ties**

Weak ties are interpersonal measures and form less dense networks and tend to link members of small groups. Granovetter (1973) identified weak ties as being important to the access or control of information in a network and they provide an entry point into a network. To put it differently, new information typically emanates from sources outside of a densely populated network. The “Strength of the Weak Ties” theory originated by Granovetter and used to explain how individuals find jobs in the labor market. Job hunters use their weak ties to find out about new employment. In this study, the concept is applied to a bioscience network in an attempt to understand how the Corridor operates. That is, do strong or weak ties dominated the network.

The strength of the weakest tie is a positive and important structural characteristic and is often the attribute of the network most responsible for innovation and knowledge creation.

### **3.7.1 Weak Spots/Cutpoints**

The study used a statistical measure of the number of weak spots in the graph to determine if the structure of the Corridor would become divided into un-connected parts if and when the organization was removed. If there are such organizations, they are called "cutpoints". These cutpoints are important to the network. They may act as brokers among otherwise disconnected groups or they may be in a position to act opportunistically to benefit their own organization's needs. For instance, new information may be used by the organization in the cutpoint position to advance its own interest instead of the interest of other constituent organizations. Hence, cutpoints represent the organizations that connect the network (Hanneman 2005).

### **3.7.2 Cohesion**

To determine the Corridor's cohesiveness, the study calculates a substantial number of indexes that describe aspects of the neighborhood for each organization in the data set by using measurements of density in the network. The density of a binary network is the total number of ties divided by the total number of possible ties. We used a number of measures to analyze the extent of the cohesion and density in the network (Hanneman 2005).

### **3.7.3 Structural Holes**

As stated in section 3.7.1, cutpoints are organizations that represent weak spots in the network. A test is needed for the tie strength to discover the weak connection areas between two or more subgroups in a network. The structural holes concept (Burt, 1995) is a test to measure the network's effective size, or an organization's size minus redundancy

in the network. The larger the effective size of the network, the more chances an organization has to act as a broker between two unconnected organizations. It may occur, for instance, in a network subgroup of 3 ( $N = 3$ ) of nodes  $n_1$ ,  $n_2$ , and  $n_3$ ,  $n_1$  has a tie to  $n_2$ , and  $n_2$  has a tie to  $n_3$ , but  $n_1$  has no tie to  $n_3$ . In other words, there is a lack of ties among organizations that can be exploited in the network (Borgatti 1997).

### **3.8 Operationalizing Strong Ties**

Strong ties are interpersonal measures that form denser networks. They tend to be concentrated within a particular group and are typically linear measures of the amount of time, the emotional intensity, and the mutual confiding and the reciprocal services that characterize a tie between organizations within the network. The stronger the tie connecting two different organizations, the more similar they are. Uzzi's (1997) examination of The New York garment industry confirmed this. Uzzi was particularly interested in what he refers to as "embedded ties," strong enduring relations. While strong ties ensure confidential information is shared with the same set of people, too many strong ties may limit access to important new information.

#### **3.8.1 Cluster Coefficient**

A clustering test provides a description of the overall network and all organizations connected. It gives a sense of how all organizations are connected. One common way of measuring the extent to which a group displays clustering is to examine the local subgroups (that is, all the organizations that are directly connected to a specific organization), and to calculate the density in this neighborhood (leaving out organization). After doing this for all organizations in the whole network, we can

characterize the degree of clustering as an average of all the subgroups. If two organizations have the same ties to all other organizations in the Corridor, an in-depth calculation called a clustering coefficient provides a deeper description of the ties to organizations in the same subgroup. It explains if the proportions of the total number of ties are highly "clustered" into local subgroups compared to the density of the network as a whole.

A high clustering coefficient ranges from .00 (0 percent of all possible ties among its neighbors are present) to 1.00 (100 percent of all possible ties among its neighbors are present). In addition, the test provides an alternative measure of the number of organizations in the cluster. For instance, an organization in one of the Corridor domains might have a coefficient of .8 and 20 pairs of organizations in its subgroup. This is an indication the organization is in a highly embedded subgroup. Likewise, a coefficient of .9 with 8 pairs of organizations in its subgroup is less dense. With this approach, the study can evaluate the organizations connected to determine if the cluster influences the flow of information and resources. Or if some other part of the network structure is more responsible, such as a clique (Hanneman 2005).

### **3.8.2 Correlation Coefficient**

A common approach used by network researchers is to measure the similarity of two tie profiles. For example, the correlation coefficient is a measurement of the number of times an organization has the same number of ties with other organizations in the network. This approach, known as the Pearson correlation is to calculate the strength and direction of the association, rather than the presence or absence of a tie. The correlation ranged from -1.00 (meaning that the two organizations have exactly the opposite ties to

every other organization, through zero (meaning that knowing the one organization's tie to a third party does not help in guessing what the other organization's tie to the third party might be) to +1.00 (meaning that the two actors always have exactly the same tie to other actors (Hanneman 2005)).

### **3.8.3 Factions**

A faction is the ideal-typical network. The faction test provides an indication if the network subgroups are made of organizations in the same domain or not. This is a common test used by social network researchers to find the optimal connections between organizations. The test analyzes the factions within a network, which are responsible for the flow of information or resources. That is to infer, all connections within the subgroup would be present and the connections with other organizations would be absent (Hanneman 2005). A faction supports the notion of strong ties by likelihood of a high-density network.

In a factional structure, the flow of information is concentrated in two or more durable factions that are competing for influence or power in the network. In this study, the number of factions are set at four. This decision is based on matching the number of domains of the Corridor.

The identification of factions plays a particularly interesting role in identifying areas that are likely to break off and potentially separate from the larger network and perhaps seek their own agenda. Explaining network relationships through the presence of factions is distinctly different than when explaining network relationships through the presence of cliques in which the network ties are adjacent to one another and the absence of a tie

prevents the organizations being called a clique. Factions have density measurements that are less than a clique (Sharp 2001).

### **3.9 Operationalizing Reciprocity**

Reciprocity occurs more often in cliques than in factions. Reciprocity is the repeated nature of the interaction or the 'one hand washes the other' relationship. The formal definition of a 'clique' as it is used in network analysis is much more narrow and precise than the general notion of a high local density. Formally, a clique is the maximum number of actors who have all possible ties present among themselves. For the purposes of this study, we relax the formal definition of a clique considering this network is sparsely connected. Typically the path in a clique is one organization has a reciprocal relationship with another. This is described as one step or one path between the organizations. This study looks at a N-clique. N stands for the number of paths (Hanneman 2005). We used two paths to form a clique. So a 2-clique model has three organizations that are connected by two ties between them. In comparison, a clique has four organizations with three ties between them. In other words, the organization is connected with every other organization in the network.

At the most general level, a clique is a sub-set of a Corridor in which the organizations are more closely and intensely tied to one another than they are to other organizations within the Corridor. In terms of a working relationship, it is not unusual for organizations to form cliques based on their economic interests, type of organization, common goals, and many other factors (Mohsen 2006).

Granovetter (1973) defined the concept of a strong interpersonal tie in terms of the time and emotions invested in a relationship, as well as the reciprocity involved between

participating actors (Marsden and Campbell, 1984). Typical examples of strong ties include friendship and familial relationships. Weak ties, by contrast entail more limited investments of time and intimacy. In summary, this section reviews some of the most common measurements of strong and weak network ties. Wasserman and Faust (1994) provide a basis to employ network measures for weak ties (weak spots, cohesion, structural holes) strong ties (clustering, correlation, factions) and reciprocity (2-clique). With this analytical approach the study compare and contrast the primary functions of the individual organizations and determine which domain in the Corridor is weighted with fewer or more organizational ties involved in actual network connections.

## **CHAPTER 4: THE APPLICATION OF NETWORK CONCEPTS**

This research focuses is on the actual relationships between organizations in the Corridor, as opposed to the potential, relationships that might exist within it. The expected outcomes regarding the interactions, which explain how the Corridor functions to a great extent, are inductive and supported by the theoretical insights of social network theory.

### **4.1.2 Network Relationship Connections**

Economic exchanges take place in short or long-term relationships. The duration of the exchange has an influence on the relationship between the organizations. For instance, in a spot market, relations are not enduring, and are formed only for the purpose of a well-specified exchange of goods and resources. After the exchange, the relationship ends. For example, one might operationalize a spot market as a population of isolates. Each organization is a node that lacks any ties to the other organizations. Spot markets have a more adversarial posture toward the exchange.

In hierarchies, relations may endure for longer than a brief episode, but a clearly recognized, legitimate authority exists to resolve disputes that arise among actors. One could operationalize a hierarchy as a centralized network and expect the vast majority of ties to flow to or from one particular node.

In the network form of an organization, we do not expect to find the exchange relationships characterized as overtly episodic or with a legitimate authority resolving disputes. Instead, we expect the Corridor to have linkages or ties that allow constituent organizations to learn a new skill or acquire knowledge, gain legitimacy, improve economic performance, or manage resource dependencies.

### **4.1.3 The Actual Network Connections in the Corridor**

In the Corridor, we expect to find that organizations making up the intermediary domain have proportionately more ties with other entities in the Corridor. The general purpose of all the intermediary organizations is primarily to serve as a conduit for the flow of resources and information. Its goal is to advance the collective interest of agricultural and animal health. Based on this understanding, more weak points and structural holes are expected to be found in this domain.

We can also expect to find organizations in the enterprise and research domains to have stronger tie relationships. The research domain's primary role is to codify knowledge. While the role of the organizations in the enterprise domain is to use the codified knowledge to help commercialize animal health innovations. It is likely the enterprise domain organizations will have their own R&D Departments. However, the hyper-competitiveness in the global markets require researchers in research and enterprise domains to stay abreast of new research ideas. Powell's (1996) findings authenticate this relationship. His work observed some evidence of a liability of unconnectedness. Strong-performing biotechnology firms have larger, more diverse alliance networks than do weak-performing firms. Uzzi (1997) is particularly interested in what he refers to as "embedded ties," strong enduring relations between manufacturers and subcontractors.

Finally, we can expect a high degree of network reciprocity. Although some organizations in the enterprise and support domains compete against one another for economic benefits, there is a level of cooperation and collective interest among them. Powell (1990) argues that a norm of reciprocity is a guiding principle underlying network forms of organization. Each organization of the network feels a sense of obligation to the

other party or parties rather than a desire to take advantage of any trust that may have been established. In his analysis of business groups, Granovetter (1995) also points to a high level of trust and obligation among members of the group.

The organizational ties between the constituent organizations help to explain if the informal network is connected (or is not connected). Based on the theories from the previous chapters we can hypothesize the influence the network variables have in providing the advantages that are a result from relationship with constituent organizations. Table 4.1 summarizes of the expected influence ties have in accessing new information in a knowledge-creating network.

Representation of Relationships	
Weak Ties	Impact
Weak spots	+
Cohesion	+
Structural holes	+
Strong Ties	
Cluster Coefficient	-
Correlation Coefficient	-
Faction	-
Reciprocity	
Cliques	+

**Table 4.1: Expected Impact of Organizational Ties**

#### **4.2 Outcomes Derived from Social Exchange Theory**

The Corridor is within a geographical area in which the different types of organization are in proximity to one another and thus have some potential advantages in building relationships (social networks) with one another. Social network analysis proposes that certain structural characteristics of networks increase the probability of forming organizational ties, which influence the flow of resources between organizations. This

study explains how the network functions as an organization structure by analyzing the relational ties.

#### **4.2.1 The Strength of Weak Ties Outcome**

Weak ties, 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 (Dice et al. 1980). Organizations with more management and collaboration networks often bridge their structural holes with information.

**Proposition 1: Weak Tie organizations with more bridging weak ties to different constituent organizations have greater access to valuable resources than organizations with fewer bridging weak ties.**

When considering the Corridor is made up of public, private, and civic organizations, we can expect (or easy to assume) relationships do exist between organizations with different approaches to interacting with organizations. For instance, organizations whose primary focus is research might work closely with other research institutions but these same research oriented organizations might also benefit from the input of other organizations whose work is focused on support operations like financial services. The weak ties will provide a bridge that will link firms to new sources of information. This new found information creates new revenues, or access to quality and quantity of new sources of capital and funding creates and provides access to new qualities and quantities of sources of capital and funding (Calabrese and Silverman 2000; Burt 2001; Uzzi 1999).

The outcome is related to the findings of Ancona and Caldwell (1992a) that teams judged more innovative had more external communication with contacts in diverse functions. Companies with a heterogeneous mix of alliance partners tended to enjoy

faster revenue growth and had a dramatic advantage in patent output (Ahuja 2000; Koput and Powell 2000).

#### **4.2.2 Strong Tie Outcome**

Dice et al. (1990) found that "networks of strong ties are significantly tending to transitivity, while networks of weak ties lack this tendency, and in some cases even tend to intransitivity . . .". Strong ties impose greater demands for conformity. Uzzi's (1996, 1999) study of business networks points out that economic action benefits from initial increases in relational ties, but suffers when organizations are highly embedded.

**Proposition 2: Strong Tie organizations with more ties to similar constituent organizations have greater access to valuable resources than organizations with a lower degree of density.**

Strong bonds offer a source of inter-organizational advantages in their ability to interact and exchange confidential information or other resources. The 'strong tie' exchange is not a short-term relationship. These are time-honored relationships that have had sufficient time to develop. Strong ties are formed from high levels of trust that are developed in periods of uncertainty. Strong ties play an important role in the Corridor. There may be a tendency for similar organizations to work closely together or to form industry associations and clubs to address their collective interest. Without current interaction between actors in the Corridor, there is no opportunity to exchange critical information.

### 4.2.3 Reciprocity Outcome

**Proposition 3: Organizations with more constant reciprocal ties between other constituent organizations have a greater opportunity to gain greater access to valuable information and resources.**

Reciprocity reduces uncertainty. It includes getting and giving favors. Do actors in the Corridor initiate an exchange by performing a beneficial act for another? For example, does an organization provide assistance or lead a group initiative without knowing whether, when, or to what extent the other organizations will reciprocate in the future? There are no contracts, fines, or sanctions for these favors but they are voluntary, discretionary, and non-contractual contributions to the exchange relationship (Molm and Cook 1995). In this case, acts of reciprocity that are regular and predictable should be valued over those whose reciprocity is irregular or random.

While reciprocity is the repeated nature of the interaction or the 'one hand washes the other' relationship, cliques are described as organizations that interact with each other more regularly and intensely than others in the same setting.

## **CHAPTER 5: METHODS**

This section describes how the theoretical framework is applied to this study. The study is designed to perform a micro-level analysis to identify the ties between the organizations. The structure of the Corridor ties affects the capabilities, constraints and ultimately outcomes of the network and its constituents. In order to evaluate the structure, the study uses both quantitative network analysis and qualitative in-depth interviews to describe the structure.

Section 5.5 describes how the theoretical framework is applied to the exploratory qualitative case study. The case study will further illustrate the relationship between organizations in the Corridor. A case study is a desirable research strategy for the exploratory phase of an investigation because it “investigates a contemporary phenomenon within its real life context, especially when the boundaries between phenomenon and context are not clearly evident” (Yin 1994). Using this method enables the researcher to investigate the Corridor and the organizational ties in their natural environment.

### **5.1 The Logic Linking Data to the Network Concepts**

The exploratory phase will help compare the empirically based patterns of interaction between organizations to the potential advantages stemming from the connections (or disconnections). Based on the network study and its different domains, patterns of network ties can be seen that allow or disallow information and resources to move within and across the network domains. The predicted results should help to draw conclusions regarding how this bioscience network functions.

A pattern matching procedure involves the participants' view of their social and commercial ties compared to the responses of other participants. To do this organizations are selected from each domain to conduct interviews with key participants.

## **5.2 The Criteria for Interpreting the Findings**

This will include looking for theoretical significance reflected in the linkages between domains or the linkages between organizations by determining the expected influence of the expected tie strength. A successful model is considered successful when the observed network produces realizations with the typical network properties that match the corresponding observed actions of the network.

## **5.3 Informal and Formal Testing Methods**

This section explains the methods used to conduct research on the Corridor. Since there have been few studies at hand on the Corridor, this empirical research combines two methods, namely a case study method and a survey method as reference points to examine the relationship between the actual as opposed to the potential relationships that might exist within it. The case study method will provide a basis to develop the social network questions and test the suggested outcomes listed in the previous chapter. The case study was carried out using either a more unstructured and informal methods or more unstructured and informal methods. For example, face-to-face interviews were conducted. Each of the interview participants was asked questions related to the Corridor and they were allowed to elaborate on their answers. The survey method conversely was very structured and formal. Each question required a specific answer. No elaboration or open-ended questions were included on the questionnaire.

### **5.3.1 Quantitative Measurement Tool**

This study also sought to determine if organizational ties within the Corridor were strong, weak or reciprocal. Beyond simply looking at which organizations are tied together, the research intends to indicate the strength and direction of a relationship, as well as determine if the relationship is direct or indirect. Different types of questions are needed to get responses on difficult or inter-organizational sensitive questions. This study uses three types of questions in the survey instrument: hypothetical, factual, and direct.

Hypothetical questions are very descriptive and are designed for sensitive questions like trust or questions that ask what relationships they would explore as opposed to who they worked with in previous years. Hypothetical questions are answered in yes/no (0, 1) or on 5-point scale that indicates the strength of agreement or disagreement with a specific statement. Factual questions are explicit and relate to the nature of the organizational ties; that is the frequency, reciprocity and the degree of specificity in the exchange relationship. These questions are answered in a yes/no and a 5-point scale. Direct questions are related to formal and informal relations between individuals in the network. These questions will assess the degree of a tie's strength (or weakness) in the Corridor. The direction questions are answered in a yes/no format. APPENDIX A provides the lists of questions used in the survey.

### **5.3.2 Qualitative Measurement Tool**

The case study research is used for 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 were either 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. See APPENDIX C for details.

The advisory group is made of senior-level individuals who hold senior-level positions in their own organizations. They come from organizations that are a part 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 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. The questions from the interviews provided the researcher insight into how to write questions for the survey.

#### **5.4 Mapping the Network**

Neoclassical theories focusing on the determination of prices and outputs in markets through supply and demand have not considered the internal workings of a network as important. Some economists have traditionally viewed the internal workings of organizations as a 'black box' where inputs would go in and products would come out. These theories give no regard for the internal exchanges that created the final good or service. With a social network approach, however, we can study inside the 'black box' transactions by examining the interactions among the constituent organizations. The

methods section will map the network relationships and measure their relative significance in how informal networks connect (or do not connect) to different components within a geographical area in which the different types of organization are in proximity to one another, and thus, have some potential advantages in building relationships (social networks).

### **5.5 Case Study Method**

The case study will use an exploratory phase of the research for its real-life context found in the interaction between the researcher and the research object (Sieber 1973). It will allow for discussions with key actors in the network and provide insight regarding the relationships and linkages at the organizational and individual levels of the network. Different sources of information gathering (interviews, observation, archival data) will serve to use this information to help design the survey to gather quantitative data.

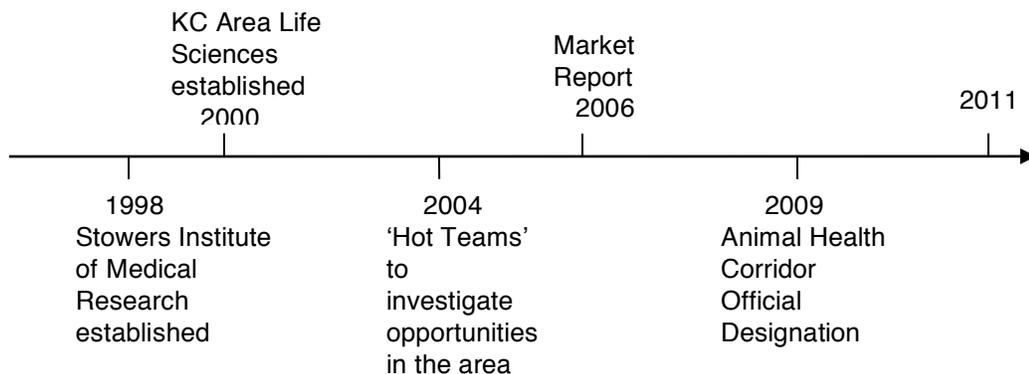
This study uses Yin's model (1994) which provides a theoretical framework based on the strength of weak tie theory. This will be followed with descriptive properties of the network to analyze the social components of the economic relationship (Wasserman and Faust, 1994 p. 4). According to Granovetter (1992), the linkages between actors' relations affect the network actors and network outcomes. This study uses the empirical indicators (strong, weak, reciprocal ties) to explain the relation and the potential for some advantage in the network. Also, the indicators will help to identify not only the normative structures but also the condition of the network.

## 5.6 Historical Development

The Corridor's history can be divided into three different stages: 1997 to 2002, 2002 to 2007, and 2007 to 2010. Figure 5.1 provides a timeline of how the Corridor has developed in recent years. The first stage, running from 1997 to 2002 can be considered as the beginning stage of the Corridor. The period is characterized by two historical events. The first is when the Stower's Institute for Medical Research was incorporated. Later additional gifts and funds raised the endowment to \$2 billion to conduct basic research. Afterwards the contributions led to the development of a strategy around the life sciences that included research institutions working collectively. During the first stage, a second significant decision was the establishment of the Kansas City Area Life Sciences as a facilitator and convener of life science organizations. This organizations expressed interests are to define and implement the strategy of elevating the area to be a national leader in the life sciences, which is broadly defined as animal health, human health and plant science.

For this study, the second stage of development was from 2002 to 2007. It is the identity stage of development in the Corridor. During this stage the Corridor recognized the critical mass of resources dedicated to animal health and nutrition. Combinations of interested parties decided investigate the potential in the area related to life science. They understood the animal health resources were significant considering the influence of the more than 100 years of stockyard and railroad tradition in Kansas City. According to interviews, this period is characterized by collaboration to elevate the regional effort (industry and academia), promotion to attract others to the region, and advocacy for legislative support.

The third stage is from 2007 to present. It is described in this study as the growth stage of development. Growth here is defined as the sense of the awareness and the financial support to organize. In this stage, the Managing Director from Bayer Health Sciences championed the idea of leveraging a critical mass of animal health assets by developing a common leadership vision and providing the initial financial resources to realize the opportunity. The main characteristic of this stage was the inclusion of other the stakeholders in animal health, including veterinary schools at the University of Missouri, and Kansas State University. The relocation of the National Bio and Agro-Defense Facility to the region and the creation of the Kansas Bioscience Authority provided research facilities and a sustainable level of funding to implement the new strategy. The creation of an investment forum designed to match investors with research opportunities also facilitated growth during this period. In 2009, the United States House of Representatives passed federal legislation to officially name the area as the “Kansas City Animal Health Corridor”, thus cementing the reputation as a national leader in the prevention of animal diseases.



**Figure 5.1: Animal Health and Nutrition Corridor Development Timeline**

### **5.6.1 Interview Procedures**

Each interviewee was contacted by phone or email with a request to discuss his or her organization's involvement in the Corridor. All 14 of the participants contacted agreed to a face-to-face meeting. Typically, the meetings were conducted at the interviewees' places of business. Note taking was the primary source of data collection. On two occasions the researcher, with permission from the interviewee, used a digital recorder to capture the conversations. Transcripts of these meetings are kept on file by the researcher.

### **5.6.2 Interview Questions**

Over a period of two years, the researcher-conducted interviews from individuals that were employed by organizations involved in animal health and nutrition and who took an active role in the activities of the Corridor. The interviews were conducted using semi-structured questions and were opened ended. This format allowed the interviewees to talk in a less structured format and led them to discuss the network relationships.

In total, 15 interviews were conducted to learn about the relationships in the Corridor. There were 7 interviews from organizations belonging to the study's intermediary domain; 2 organizations from the enterprise domain; 4 organizations from the research domain; and 2 organizations from the support domain. Each interview took 1-2 hours to complete. Of the 15 interviews conducted, only one person was interviewed on two separate occasions. The first meeting ended short of the allotted time due other business matters (unrelated to this study), which forced the interviewee to leave the meeting earlier than expected.

The first sets of meetings with interviewees were conducted over a three-month period. The questions covered the history of the Corridor, the interviewees' organization's involvement, and what benefits were received. This group was made up of individuals known to be a part of the Corridor's "working group". Each participant had second-hand knowledge on how the Corridor developed but had a greater sense of the strategic plans to elevate the reputation of the region. These interviews led to the development of social network survey questions that were related primarily to the nature of the Corridor. These meetings helped to develop questions for the survey. For instance some questions needed to be hypothetical on sensitive information to explain the extent of an organizational relationship. The second set of meetings was conducted over a two-month period. Due to changes with key leaders in the advisory group and working group, as well as the new organizations scheduled to relocate to the area, it was important to understand how these changes might influence how organizations interact with one another. Of particular interest was a change in the leadership of the advisory group. The president, whose organization is a part of the Corridor's enterprise domain, was relocated

to manage a different part of his organization's worldwide operations. In addition, another key personnel move involved an individual in the study's intermediary domain who changed jobs. The initial interviews observed that these individuals were heavily involved in their industry. The researcher interviewed the two organizations that experienced the personnel changes in an effort to gauge if and how the changes might have affected the Corridor. The outcomes from these interviews were intended to help form social network analysis questions about the specific benefits of being located in the region.

The final set of interviews was conducted over another three-month period shortly before the survey instrument was distributed to animal health and nutrition companies in the Corridor. The semi-structured interview responses helped to develop the direct social network analysis questions. This was intended to help in understanding any inter-organizational connections/linkages within the Corridor.

The two-year period of interviews provided valuable insight into how the Corridor functions, it helped to establish the historical development of the Corridor, and establish the basis of the survey questions for the quantitative analysis of the study.

## **CHAPTER 6: SURVEY METHOD**

This chapter describes the methodology employed to set up the quantitative descriptive component the empirical research and to collect the data with which to answer the research question and acquire insights into the Corridor on the organizational ties in the network.

### **6.1 Study Population**

The sampling frame of the accessible population was obtained from the roster of organizations and firms found on the Animal Health Corridor's website. It identifies the concentration of organizations and it lists the organizations according to their primary economic activity. As discussed in Chapter 2, the Corridor encompasses a mix of support and service organizations, as well as research and for profit organizations involved in commercializing animal health products. The organizations were sorted into four domains of activity: research, support, intermediary, and enterprise. To summarize their activities, a research domain's principle activities are knowledge creation and capitalization. The organizations in the support domain are not directly involved in day-to-day activities of providing animal health products and services. For instance, financial, insurance, and advertising are included in this domain. The intermediary domain's primary activities include providing civic support and lobbying for industry-wide interests. The enterprise domain activities include the processing, distribution, storage of goods and services. The enterprise domain also earns profits from the innovation.

The Corridor has approximately 173 organizations. Table 6.1.1 summarizes the number and type of organizations in the Corridor. One hundred 146 organizations make

up the enterprise and support domains. The remaining 27 are from the research and intermediary domains. The following table shows the number of organizations in each domain:

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	17	10	36	173

**Table 6.1: Number of Organizations by Domain**

### **6.1.1 The Organizational Frame**

Due to resource constraints the researcher opted to select organizations on which public information could be obtained. Thus, only publicly traded organizations from the enterprise and support domains are included in the sample frame, which results in a total of 40 organizations. The use of a questionnaire allowed participants to freely answer questions regarding the nature of the organization, the relationship specific benefits, and the inter-organizational interaction. Also, all organizations from the intermediary domain and research domains were selected to participate. The number of organizations in each of the domains is small so the only constraint the researcher faced was to obtain the contact information for the potential participant.

### **6.1.2 The Participant Frame**

It is important that the person answering survey questions is someone who has the propensity or a greater likelihood of interaction with organizations in the animal health and nutrition industry. The researcher targeted a chief research scientist, the primary

communication professional, or the person most likely to be involved with organizations external to her own to answer the survey questionnaire.

## **6.2 Asking Social Network Questions**

Social network questions are designed to obtain specific information about the relations people have with other members of a particular group. In general, well-constructed questions are questions the respondents will interpret the same way, will be willing to answer, and be able to answer accurately (Wellman and Berkowitz 1988; Dillman 2000). Social network questions are often sensitive and at times threatening (Sudman and Bradburn 1982). The questions can invade privacy or disclose information to other people outside of the organization being interviewed. The combination of these characteristics— sensitive and threatening—might increase the non-response rate considerably. These issues could create non-response problems. To minimize the non-response problem, the questions were crafted in a manner that the survey respondents would not feel like they divulged proprietary information.

In each organization in the survey sample, the study target an individual whose daily work activities result in a greater likelihood of inter-organizational interaction. Specifically, the researcher looked for the interaction that leads to information sharing, or informal and/or formal agreements. For instance, communication departments, research scientists, or product development specialists typically have more inter-organizational interaction than those involved in financial and operations related activities.

### **6.3 Survey Instrument**

The survey questions are directed toward the 20 publicly traded organizations from the support and enterprise domains and 24 organizations from the intermediary and research organizations. The purpose of the responses was to gather data on linkages and connections in the Corridor. The study uses different strategies to construct the network questions. Because of the sensitive nature of some relationships, the study employs a variety of question formats, which includes hypothetical, factual, and direct questions.

### **6.4 Social Network Format for asking Questions**

Hypothetical questions are very descriptive and are designed for sensitive questions like trust or questions that ask what transaction or exchange relationships they would explore as opposed to who they worked with in previous years. Hypothetical questions are answered in yes/no (0, 1) or on 5-point scale that indicates strength of agreement or disagreement with a specific statement. Factual questions are explicit and related to the nature of the ties; that is the frequency, reciprocity, and the degree of specificity in the exchange relationship. These questions are answered in a yes/no or a 5-point scale. Direct questions are related to formal and informal relations between individuals in the network. These questions assess the degree of ties' strength (or weakness) in the Corridor. The direction questions are answered in a yes/no format. APPENDIX A lists the questions used in the survey. Table 6.2 summarizes the type of social network questions used to minimize the non-response issues.

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 6.2: Question Format**

The research focuses on three characteristics of an organization’s network ties: weak ties, strong ties, and reciprocity. Each of these characteristics is examined to understand organizational ties that influence how the Corridor works. In this study, we look at the actual, as opposed to the potential, relationships that might exist. Therefore, a test was needed to see if the existence or the absence of a tie creates a benefit. As mentioned, this is a sensitive topic when considering strategic or proprietary relationship could be exposed. Therefore, we use hypothetical questions to gather information. The questions help explain the type of exchange relationships that exist in the Corridor.

#### **6.4.1 Survey Format**

The survey included 25 questions, which can be separated in four groups. One set of questions was designed to learn about the survey participant. A second set was designed to learn about the nature of the organization in which the respondents works, such as the organizational purpose and the amount of time it has been physically located in the region. A third set of questions covered the specific benefits, if any, that the organization received by being located in the region. The fourth and fifth sets of questions were

intended to elicit responses that were factual and direct. They cover the extent of inter-organizational ties, specifically the informal connections between organizations.

### **6.5 Tie Strength Revisited**

The interview participants were asked to give their perception of how strong the ties were between their own organization and other constituent organizations. Granovetter (1973) explained strong ties as a measurement of emotional intensity and mutual confiding. In his view it also included a dimension related to the frequency of interaction. Operationally, the number of ties between the total number of organizations and or sub-groups (cliques) defined the degree of density in the network. The sharing of valuable confidential information indicates strong ties. Weak ties allow for new information to be shared. Therefore, the density questions help to evaluate the strength or weakness of the tie based on the number of relations relative to the number of possible connections the respondents' organization has within the corridor. The survey participants were also asked questions regarding reciprocity, specifically, if their companies voluntarily provide assistance or lead initiatives without expecting anything in return. The table below reviews the variables discussed in the Chapter 3. This table includes the name of the construct, the expected sign according to the stated outcomes, and the name of the variable representing the construct.

### **6.6 Data Analysis Methods**

This section focuses on the actual relationship between the organizations within geographical region, as opposed to the potential relationships that might exist within the Corridor. The study refers to them as tools to measure the network-centered and the

person-centered responses to the questionnaire. The first set of tools focuses on the measures of similarity (based on their relations with other organizations) and structural equivalence (groups of organizations that are equivalent). This approach uses valued relations and binary relations to explain the similarities and dissimilarities of the organizations. The valued relations approach is used to describe the tie strengths of two organizations to all other organizations. It measures the linear relationship of organizations. The binary approach is used to count the number of ties that organization 'A' has to an alter organization (an organization not surveyed in the study but still, is a part of the network) in the network that is the same as organization B's tie to an alter. This is expressed as a percentage of the possible total. Also, measurements of how similar the ties are between organizations are calculated to help compare how the structural equivalences of one organization's subgroup is to another subgroup in the network. With an understanding of the network structure, the study could divide the network into separate parts known as components. The component analysis allows for the identification of weak spots in the overall structure of the network. Both of the analytical tools used are found in the UCINET software.

The second focus is measuring the person-centered questions. The use of descriptive statistics to generate a comparison of the individual responses is an important measure of how similar and dissimilar organizations are in responding to the questions.

Network questions provide response data in the form of matrices, containing either binary (yes/no, 1/0) or categorical data. The full questionnaire consisted of social network items (questions about organizations in the network). Person-centered items (questions about the person who is completing the survey) for instance demographic questions (size

of the organizations, the number of years in the Corridor, familiarity with other constituent organizations, and network questions related to each of the indicators of value listed in the table.

### **6.6.1 Social Network Analysis**

Social network analysis focuses on uncovering the patterns of organizational interaction. Tools of social network analysis can help unpack this data and sort out the influential relationships in the network. The analysis is based on an assumption of the importance of relationships among interacting units and on the intuitive notion that these patterns are important features of the lives of the individuals who display them (Omalley and Marsden 2008).

### **6.7 Survey Administration**

This study incorporated a web-based social network survey data collection software to design social network surveys, to collect social network survey data, and to retrieve and export data pre-formatted for social network analysis. We administered the survey over the Internet using a secure website from Network Genie. It allowed us to design the network survey and survey questions, manage the social network project, collect the social network survey data, and retrieve and export formatted data into a master matrix to conduct an analysis. Upon collecting the data, Network Genie encrypts and stores data on a secure network server protected by firewalls and other security measures. Both the researcher and researcher's advisor had the administrative rights and were registered as project coordinators. This registration gave those two individuals the rights to edit the survey questionnaire, activate the questionnaire, and view the results.

Network Genie generated the login information and passwords for the respondents. The researcher emailed the six-digit login identification information and passwords to each participant in the survey.

A key functionality of the software is its ability to nest subgroups. This feature allowed the participant to make a preliminary list of organizations with which it had relationships and then rank those organizations according to their preferences. This ‘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. A participant could work from a subgroup list of organizations instead of repeatedly looking through the entire list of 173 organizations. For instance, a question might have asked the respondent to choose the organizations from the list of 173. The next question would then ask another question related to the subgroup from the previous question.

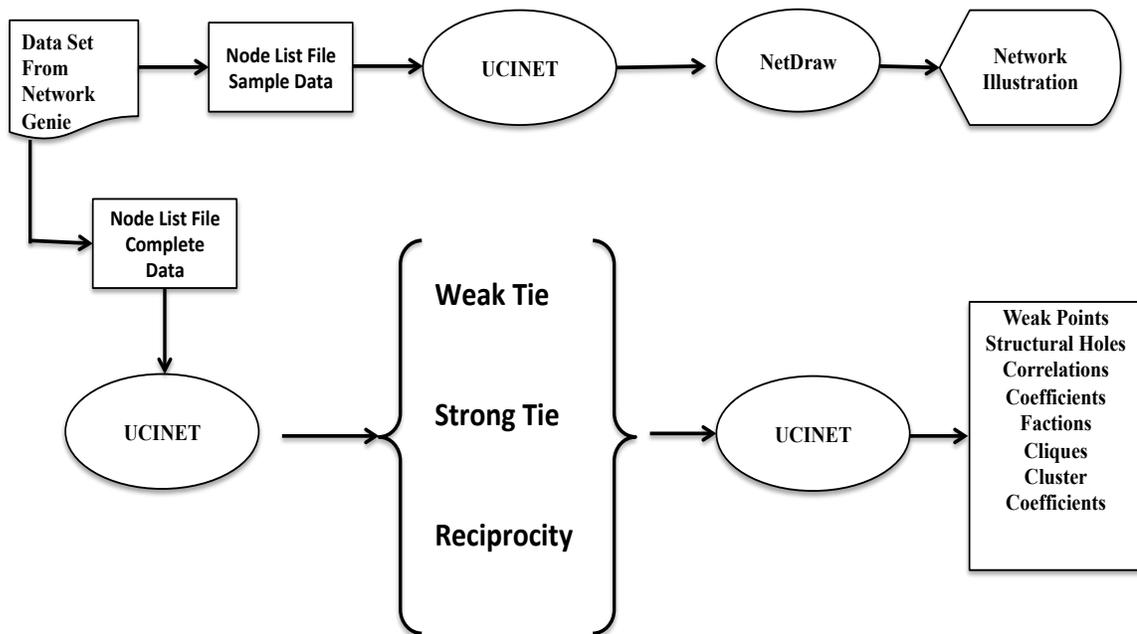
### **6.7.1 Data Retrieval**

The Network Genie software’s primary purpose is to retrieve data and export it for analysis. It organizes responses into two data tables. The first data table provides the number of links between participants, including outbound links, inbound links, and unreciprocated links. The second data table provides a binary adjacency matrix from data collected. Both the number of links and the binary adjacency matrix note the presence of any link. Therefore, if there are multiple network subgroups, the matrix reveals the presence of ties among any of these items. When only one question is asked, interpretation of this data is straightforward. When more than one social network social network subgroup identification item is asked, such as “Whom do you work more with?”

and “Whom do you work with the least?” the resulting table and matrix reflect links to both items.

The master matrix is analyzed in UCINET 6 for all network analysis and was used for the 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. UCINET is commonly used software in the network sciences. It provides a means to perform the quantitative and qualitative analysis of social networks.

NetDraw and UCINET software programs are used to map network relationships within the Corridor and to identify the structural properties of the network. The figure below illustrates how data from each interview leads to a sample network illustration and descriptive statistics.



**Figure 6.1: Process Map of UCINET Network Analysis Software**

Based on the domain structure outlined in Chapter 2 and section 2.9, social network analysis tools are used to analyze the internal (bonding) ties within the domain and external (bridging) ties outside of each domain. This analysis strategy is to explain the connections of inter-organizational relationships to help quantify the normative structures that affect how the network works. To calculate this, Social Network Analysis (SNA) software UCINET provide tools to visualize, measure, and analyze the relationships. In the context of how the network works, SNA provides an understanding of how organizations interact, and how resources move between and among them.

### **6.7.2 Survey Preparation**

After reviewing the primary purpose of each organization, the researcher grouped the range of organizational purposes according to the following objectives: to maximize profits; increase research, regional, or economic development; or to advance the collective interest of the Corridor.

### **6.7.3 Survey Logistics**

Though the study's sampling frame provided a course of action to gain a high participation rate in the survey, there were other efforts to put into operation and secure participation in the survey. This section on sampling frame explains the study's approach to contacting and informing the individual who would actually answer the questions what to expect from the survey.

The first set of meetings included introductions to individuals whose organizations were key stakeholders in the Corridor. The corridor's website provided information on the organizations which had representatives on the advisory group and its working group. The researcher arranged meetings with representatives from The Kansas City Area

Economic Development Council, The Kansas City Area Chamber of Commerce, Bayer Animal Health and Nutrition, and the Kansas Bioscience Authority. Each organization is involved in the operational activities of the Corridor, which includes promoting the region's strengths, and advocating its political interest. The intent was to provide exposure to this research by engaging influential organizations that might endorse or at the very least become aware of the research project. The next steps included identifying individuals to target and eventually distribute the questionnaire. For the survey instrument, the research used e-mail addresses to communicate with the organizations. Already having identified the organizations that are involved in animal health and nutrition in the region, the researcher needed to identify the individual within the organization who was most likely to be directly involved in exchanges or transactions with other organizations in the region. These individuals had either research related responsibilities or communications or government relations. To determine which individual in each organization was most likely to be directly involved in exchanges and transactions, the researcher chose two different approaches. The first approach included exploring the organizational relationships: of The University of Missouri Cooperative Extension (MU Extension); the University of Missouri's College of Agriculture, Food and Natural Resources (CAFNR). MU Extension has a partnership with the Kansas City Area Development Council in areas involving economic development. This connection led me to connect with individuals working for civic, government and some for-profit organizations. CAFNR holds a membership with the KC Agribusiness Council. These relationships allowed me to connect with individuals in the for-profit and trade associations. The University of Missouri's membership allowed me access to contact

information on membership. The researcher was able to cross-reference the names and organizations in the Agribusiness Council to the organizations in the Corridor and glean their email addresses. The second approach involved the use of social networking software —Network Genie— to send invitations to individuals to participate in my research and to join my professional network. Once they accepted my invitation, the researcher was able to take note of the email address. The researcher was also able to use the relationships from Mizzou Advantage, which has a One Health/One Medicine initiative that provides opportunities to connect with research scientists in the Corridor.

Over a three-month period the researcher traveled to nine meetings in Western Missouri and Eastern Kansas. The outcome of these meetings validated the historical, cultural and economic findings from the initial set of meetings the researcher had attended nearly two years earlier. In addition, the meeting outcomes reiterated the importance of the organizational ties needed to commercialize animal health and nutrition products.

#### **6.7.4 Survey Pretest**

After establishing contact with individuals within the network, a pre-test was used to test the web survey software and to study the answer patterns on the network questions. The pretest was conducted with individuals from three different organizations. One from the enterprise domain and the other two, a government organization and a trade association, were from the intermediary domain. We attempted to receive feedback pertaining to the questionnaire itself, including its length, layout, the format for the questions used, and the sequencing of the questions. The web-based survey was completed in the environment chosen by the respondents. The researcher was unable to

carefully observe the respondent as he/she is filling out the questionnaire. This inability to observe responses in time caused some concern for the validity of the survey results because when a respondent hesitated at a particular question, the question may be ambiguous or confusing. Because of this issue, the results from the pre-test were not included in the final results of this study. No changes were made to the final survey as a result of the pre-test findings.

The participants were told that they were participating in a pretest of the survey instrument. The questionnaire was conducted in the same way as the final questionnaire. Each was given login instructions and a password to the website containing the questionnaire.

#### **6.7.5 Survey Mailing List**

The final mailing list included 46 of the 173 organizations in the Corridor. The Table 6.4 below summarizes the response rate to the survey questionnaire.

Animal Health Corridor: Response Results	
Population of Corridor Organizations	46
Undeliverable	3
Survey Returned	20
Response Rate	43.5%
Refusal	1

**Table 6.4: Survey Response Statistics**

#### **6.7.6 Survey Coding**

In an alphabetized master list, the domain and numbers 1-173 identified all organizations. For instance, if company ABC was the first organization on the list the

company's domain is research, then the organization was recognized as participant 1-Research. An identification number identified each of the responding participants.

Only the primary researcher had access to the master list that contained the responses of each participant. The researcher for this study served as the survey administrator and had all rights to this information on the Network Genie website. The master list is kept in a secure location.

## **CHAPTER 7: EMPIRICAL RESULTS**

The responses from the survey questionnaire include person-centered and network-centered questions. In this section, social network analysis and descriptive statistics are used to examine the extent of the organizational ties in the region. The sample is made of 20 organizations and their relationships with 153 other organizations. The intermediary domain is made of seven respondents and the research domain is made of six respondents. The enterprise and support domains had five and three respondents, respectively. For the data management and preliminary evaluation of the data set, the researcher used Network Genie, UCINET 6.0, and Microsoft Excel 2012. Network Genie is Internet based software used to administer the questionnaire and create the master matrices from the individual survey responses. The software is specifically designed to conduct social network analysis projects. From this software, the master matrix is developed and is transferred to the other analytical tools used to conduct the actual social network analysis and generate descriptive statistics.

In addition, the responses from the semi-structured interviews provided the basis to ask the appropriate social network questions and the semi-structured interviews aided in validating the responses from the survey with responses.

### **7.1 Qualitative Results from Semi-Structured Interviews**

Granovetter placed an emphasis on weak ties. In other words, weak ties play the role of a bridge in the process of how information flows between different groups. The responses from several semi-structured interviews suggested a need to connect with other organizations is important to the innovation process. This response follows Granovetter's

argument that weak ties are more likely to link members of different small groups than the strong ones, weak ties are more likely to move in circles outside an organization's immediate domain, and weak ties will have access to information different from which is received from an organization's strong ties (Granovetter, 1973). As discussed in Chapter 5 of this study, there were three sets of interviews. Responses from interviewees did not indicate that certain organizations tended to take more formal exchanges of goods or services. From this study's perspective, the Kansas City Agribusiness Council and the Kansas City Chamber of Commerce from this study's perspective is a part of the intermediary domain. Respondents consistently identified Bayer HealthCare's Animal Health Division as a key tie within the enterprise domain. Also, the University of Missouri-Columbia and Kansas State University Veterinary School of Medicine surfaced as organizations that actively provided opportunities to connect with other organizations.

## **7.2 Results Person-Centered Network Questions**

The findings from the set of person-centered survey questions help to describe the actual relationships and to examine the profile of the individual organizations. These questions are well suited to help understand the interconnection, which explains how networks function to spread of an idea, share an improvement in a manufacturing process, or a discovery of a new material.

The first 11 questions in the survey are person-centered. See APPENDIX E for the complete details. The typical person-centered questions have multiple-choice response categories. Results are stored with weighted values. The survey was designed using the Network Genie software. These questions aimed at determining the individual, as well – the organizations role and their attitudes. Also descriptive statistics were gleaned from

the person-centered questions. The descriptive statistics provided insight into include the nature of the organization, its history and how often it interacts with other organizations in the region. See APPENDIX A for the full survey questionnaire.

Table 7.1 below summarizes the person-centered questions related to the headquarters or primary facility for the participant’s own organization and it provides some insight into the survey participant’s gender and level of education. Based on the results, the typical respondent can be characterized as a male having earned a graduate-level academic degree and whose organization is not headquartered in the region.

Headquartered in the Region  Question # 4		Highest Academic Degree Earned  Question #7			Gender  Question #8	
Yes	No	Bachelors	Masters	PhD	Male	Female
35%	65%	20%	35%	45%	80%	20%

**Table 7.1: Summary of Person-Centered Questions Related to Gender and Education**

Table 7.2 provides additional insight into the survey participant’s organization and his own role within its own organization. However, there is not a dominant characteristic other than that the respondent holds a leadership position in an organization and he is concerned primary with advancing the agricultural industry’s interests and perhaps maximizing profits.

President	Senior Manager	Manager	Supervisor	Corporation	Not—For Profit	University	Research Institute	Legal Partnership	Cooperative	Maximize Profits	Perform Basic Research	Conduct Applied Research	Regional Economic Development	Advance the interest of Agriculture
40%	35%	20%	5%	30%	40	10%	5%	5%	10%	30%	15%	10%	5%	40%
What is your primary role? Question #1				How would you describe your organization? Question #5						What is the purpose of your organization? Question #6				

**Table 7.2: Summary of Person-Centered Questions Responsibility, Organization Type, Purpose**

Table 7.3 summarizes the section intended to understand any relationship specific benefits as a result of being in the region.

Relationship specific benefits as a result on being in the region?		Willingness to Work in an Innovation Center		Developed specific tools, skills and knowledge from being in the region		Short-term relations have to provide valuable information		
Question #9		Question #10		Question #11		Question #12		
Yes	No	Yes	No	Yes	No	Yes	No	N/A
60%	40%	55%	45%	40%	60%	20%	75%	5%

**Table 7.3: Response to Person-Centered Questions #9, #10, #11, #12**

Tables 7.4 and 7.5 reveal the size of the organization participating in the survey and the length of time it has been involved in animal health and nutrition in the region.

0-19	20-99	100-249	250-499	500+
50%	15%	10%	5%	20%
The number of employees in the region.				

**Table 7.4: Summary of Response to Person-Centered Question #2**

Since 2000	Since 1990	Since 1970	Since 1950	Prior to 1950
35%	5%	15%	5%	40%
The number of years operating in the region				

**Table 7.5: Summary of Response to Person-Centered Question #3**

### 7.3 Results Network-Centered Questions

In addition to person-centered questions geared toward examine the profile of the organization the individual, network-centered questions were designed in the software to allow participants in the survey to indicate subgroups to belong. Typically the responses are binary. When these questions are asked of participants, their responses provide an understanding of whom they worked with recently or in the past. The responses help researchers understand who the other organizations are in their network. The participants were asked general questions about every organization in the network and then more specific questions from short list of organizations in the network. For instance, a question about whom they have worked with in the recent past generated a smaller list. A subsequent question about the smaller list of organization would provide an even smaller

subgroup. This question-after-question approach narrowed each organization's network from 173 organizations down to a smaller subgroup of organizations.

#### **7.4 Empirical Results Network Analysis**

The results from the survey's network-centered questions were analyzed in UCINET software. To illustrate the strength of the network's weakest tie, the strongest tie, and reciprocal relations, the tie length is an indication of the network size and the closeness of one organization to another. However, the effective size and diameter of an organization's network provides a statistical measurement that quantifies the network linkages rather than the network illustration that is sometimes interpreted subjectively.

The tie represents the connection between organizations. In contrast, if no tie exists between organizations, then there is relationship. A tie could originate from one organization; it might reach multiple organizations, and have an arrow at the end of the tie. The arrow signifies which organization receives or delivers information or resources. The ties are also represented with double-headed arrows or lines with arrows on both ends of the tie. This form of a tie represents a reciprocal relationship between organizations. These lines segments are described as inbound or outbound ties. For instance, if organizations have a relationship in the network, then line segments with arrows represent the relationship. This is an indication of a tie between the organizations. Each line segment is described as an inbound or outbound tie. If the tie originates from a source organization, then it is described as an outbound tie. If the line segment ends with an arrow and is pointed toward another organization, it is described as inbound tie.

APPENDIX D provides a detailed table of the number of reciprocal ties, outbound ties, and inbound ties for each of the 173 organizations in the Corridor. An organization with

an identification number represents each organization. This number distinguishes one organization from another. The appendix provides a detailed view of the type and number of linkages that exist. For instance, organizations 10 and 11 have a similar number of ties in the network. This is valuable information that can be used to determine the level of involvement an organization has in the network and the information can be used to compare one organization with another. The information is valuable for both strategic planning and day-to-day operations, and can be used in a number of ways; to determine the level of interaction there is in the network; to compare one organization to another; to make management decision regarding the allocation of scarce resources. In addition, conclusions can be drawn from the lack of reciprocity. For instance, an organization might have a significant number of outbound links and a considerably smaller number of inbound links. Any number of conclusions can be drawn from this. For instance, the scarcity of inbound links made indicate an organization is new to the network. Nevertheless, APPENDIX D requires additional analysis to help explain the network relationships in the Corridor.

APPENDIX G provides a network illustration of the responses to each question in the survey. Again the illustration does not include the organizations that were either not connected at all or had only one tie in the network. The organizations are identified by the domain and by the organization's density. The denser the relationships are the larger the size of the node representing the organizations.

## **7.5 Operationalizing the Strength of Ties**

Section 3.5 in this study introduces how strong ties are interpersonal measures that form denser networks. Strong ties tend to be concentrated within a particular group and

are typically linear measures of the longevity of the relationships between organizations, and the commitment to the animal health industry is an indication of strong ties.

### **7.5.1 Expanding Weak Tie Calculations**

The study identified and measured the weak points in the network, and used a statistical measure of the number of weak spots in the graph. A statistical measure is used to determine if the structure would become divided into un-connected parts if an organization were removed— cutpoints. So cutpoints represent the organizations that connect the network (Hanneman 2005). These organizations are important because they influence the flow of information and resources in the network, as such may act as brokers among and otherwise disconnected groups.

### **7.5.2 Expanding the Cohesion Tests**

The researcher used six calculations to describe aspects of the subgroup of each organization in the data set to measure the extent of the network's cohesion. The density of a binary network is the total number of ties divided by the total number of possible ties. The researcher used a number of measures to analyze the extent of the cohesion, including the sizes of the organizations' network, the number of directed ties, the density, the average distance among all connected pairs, the diameter, and the weak components. A more complete definition for each calculation is provided in section 7.6.2.

### **7.5.3 Expanding the Test of Structural Holes**

An additional test is needed to determine the weak connection areas between two or more subgroups in a network. The structural holes concept (Burt, 1995) is a test to measure the network's effective size, or an organization's size minus redundancy in the network. The larger the effective size of the network, the more chances an organization has to act as a broker between two unconnected alters. It may occur, for instance, in a network subgroup of 3 ( $N = 3$ ) nodes  $n_1$ ,  $n_2$ , and  $n_3$ ,  $n_1$  has a tie to  $n_2$ , and  $n_2$  has a tie to  $n_3$ , but  $n_1$  has no tie to  $n_3$ . In other words, there is a lack of ties among organizations (Borgatti 1997).

Various network-level indicators are shown across the different domains. Table 7.2 shows the network weak spots. Table 7.3 shows the network size and densities are shown for each tie in the network. This includes domain level density scores that are averaged for each subgroup.

### **7.6 Empirical Findings on Weak Ties in the Network**

The empirical findings from the SNA tests illustrate ties in the network. The ties are characterized as weak, strong, or reciprocal. The absence of a tie is described as an isolate. Isolates indicate an organization that is not connected in the network. This connection is needed in order to explain how of new information or access to more tangible resources like equipment, tools, or software is or is not exchanged.

To quantify the strength of the weak tie in the Corridor, three statistical measurements (cutpoints, cohesion, and structural holes) help to explain the network structure (Hanneman 2005).

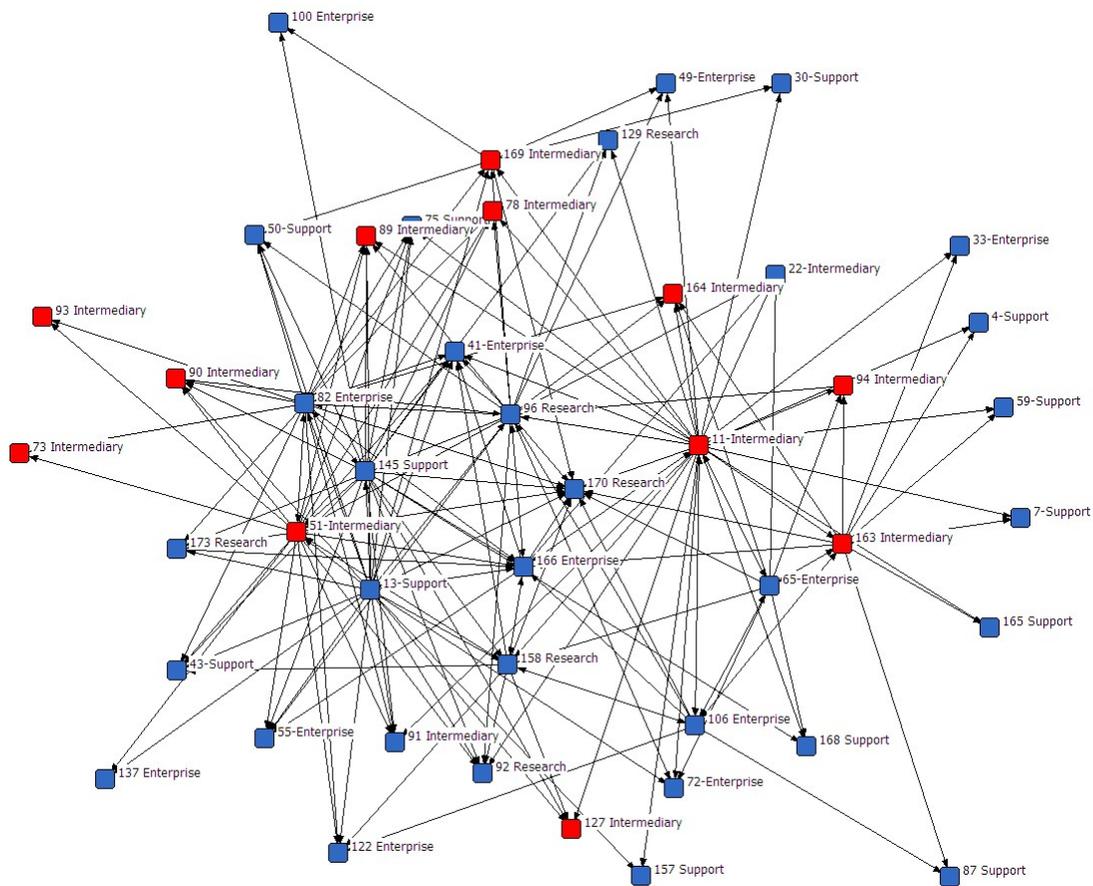
### **7.6.1 Quantitative Results from Weak Ties Relationships**

One of the major events sponsored by the Corridor is an Animal Health Investment Forum. The forum offers an opportunity for innovators to present their vision and business plans to potential investors. Neither the investors nor the presenters are necessarily a part of the region, but the opportunity does exist for all Corridor organizations to participate. The participants in the survey indicated that corporate funding and support from organizations in the enterprise, domain, and intermediary domain have been extremely important to initiating and sustaining this collective effort. Data gathered from the social network analysis did find that intermediate organizations tended to have more cutpoints, and their networks were denser than the others. This is a strong indication of their relative position to take advantage of the resources in the network.

Figure 7.1 illustrates a response to a question about which organizations the participants had worked with in the recent past. The figure does not show organizations with 0 or 1 tie to other organizations in the Corridor. Two or more ties is an indication of the number of connections an organization shares, and this information was gathered in through direct response to questions about which organizations and it has worked with in the past.

The research illustrates and tests the network for weak spots. This is another way of testing whether or not a structure would become divided into unconnected parts. Recall that an organization that represents a cutpoint or weak spot is in a position of influence and possibly power. Figure 7.1 illustrates the intermediary organization as a red rectangle and all other domains are seen in the blue rectangle. There are only 18 organizations in

the network; however, intermediate organizations appear to be represented in a higher proportion than the other domains.



**Figure 7.1: Weak Tie Network Level**  
Red = Intermediary; Blue = Enterprise, Research and Support

## 7.6.2 Empirical Findings on Weak Spots “Cutpoints” in the Corridor

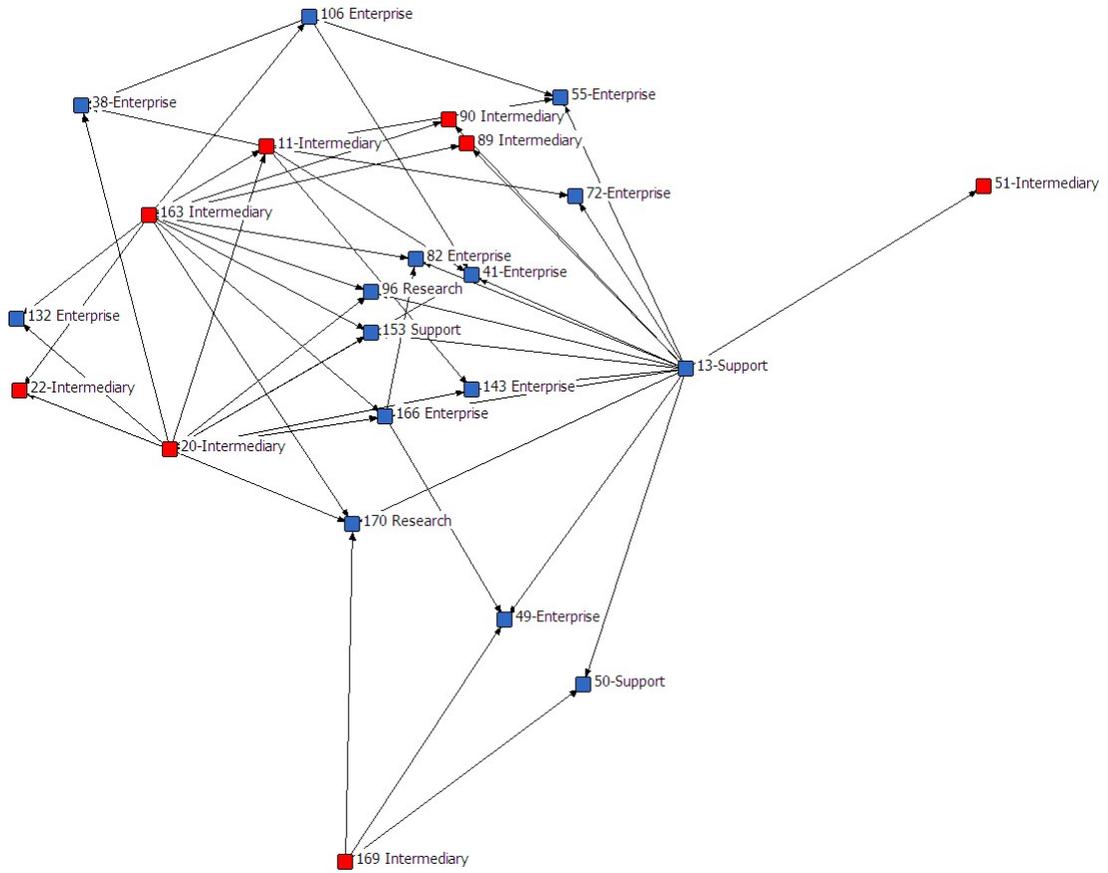
Table 7.6 represents the organizations with two or more weak spots in the Corridor.

Domain	# Weak Spots
11- Intermediary	15
13-Support	13
51-Intermediary	2
82 - Enterprise	8
92- Research	2
96-Research	3
106- Enterprise	5
145- Support	6
163-Intermediary	4
169-Intermediary	12

**Table 7.6: Weak Spots Resulting from Formal Interactions**

Table 7.3 shows that intermediary organizations account for 33 of 70 cutpoints in the Corridor. The intermediary domain includes all of the organizations whose primary activities are business associations or grant making. For instance, organization 11 has 15 cut points or weak spots in their network. A weak spot illustrates the point which organizations are likely to become disconnected in the network.

Figure 7.2 provides a narrower illustration of the network. It shows the organizational view of the ties for all of the intermediary organizations in the Corridor.



**Figure 7.2: Intermediary Domain Weak Ties.**  
 Red = Intermediary; Blue = Enterprise, Research and Support

In order to further evaluate the neighborhood surrounding the cutpoints, the researcher calculated the following measurements of cohesion. The cohesion values provide a broader explanation for the cutpoints at the domain level of the network (Hanneman 2005).

- The size of the network is the number of other organizations in an organization's network including the organization itself
- The number of directed ties is the number of connections among all the organizations in the organization's network
- The number of ordered pairs is the number of possible directed ties in the network
- Density is the percentage of ties of organizations with each other in relations to the total number of ties possible. The higher the number of ties, the higher the level of density within the network
- The average distance is the shortest path lengths among all connected pairs in the organization's network. If everyone is directly connected to everyone else the distance is one. In our example in the Corridor, the largest average path length for connected neighbors is for actor 5 (average distances among members of the neighborhood is 1.5)
- The diameter is the longest path between two connected organizations; the diameter shows the extensiveness of the organization's network
- A weak component is the largest number of actors who are connected, disregarding the direction of the ties (a strong component pays attention to the direction of the ties for directed data) and the percentage of components represent the percent of ties that are directed in the network

Table 7.7 shows by domain the following cohesion values to determine the number of weak spots in the Corridor.

	Research	Intermediary	Support	Enterprise
Size	3.667	6.524	1.870	2.577
Ties	8.857	10.571	2.442	4.596
Pairs	61.048	130.571	31.039	33.462
Density	12.424	28.607	19.283	16.235
AvgDis	0.000	0.20	0.073	0.067
Diameter	0.000	0.20	0.094	0.086
nWeakC	0.667	2.143	0.922	0.827
pWeakC	23.35%	28.6%	54.12%	31.66%

**Table 7.7: Measures of Density By Domain**

Based on the measurements in Table 7.7 the intermediary organizations have more ties and larger networks. Organizations 11 and 169, which are intermediary organizations, have a large number of connections, large network, large number of weak ties, and a high percentage of weak ties, all of which indicates the strategic position of these organizations in the Corridor and the potential for disruption if these organizations were not located in their current positions.

In a second question designed to expose the number of weak ties, the respondents were asked which organizations had they interacted within a less formal environment. This would include, for example, interactions that did not end in the exchange or transaction of a good or service, but included interactions at meetings and conferences that led to important information.

In order to quantify the weak ties related to exchanges in less formal arrangements in the network, a hypothetical question was asked concerning which organization they

would be more likely to interact within less informal settings. Table 7.8 summarizes the weak spots found in response to that question.

Domain	Weak Spots
11. Intermediary	68
13. Support	21
20. Intermediary	14
51. Intermediary	24
106. Enterprise	18
163. Intermediary	22
166. Enterprise	39
169. Intermediary	11

**Table 7.8: Weak Spots Resulting From Informal Interactions**

### **7.6.3 Empirical Findings on Cohesion**

Table 7.9 shows by domain the following cohesion values. It appears the intermediary organizations have a network that is denser and better positioned to broker information and resources than the other domains in the study. The intermediate organizations play an important role in the Corridor in terms of connecting other organizations.

Table 7.9 shows the network density measure.

	Research	Intermediary	Support	Enterprise
Size	3.363	8.62	15.33	3.5
Ties	.8182	.8750	0.000	0.00
Pairs	9.81	126.0	2.70	9.0
Density%	9.24	.898	13	0
AvgDis	2.545	7.75	33.37	3.500
Diameter	78.03	92.11	75.97	100
nWeakC	27.16	22.38	45.92	41.57
Broker	.909	1.25	0.00	0.00

**Table 7.9: Various Density Measures**

#### **7.6.4 Empirical Findings on Structural holes**

The analysis on identifying the cohesion of the network is now followed with an analysis of whether or not the ties are redundant, i.e. the number of ties each organization has minus the average number of ties those organizations has with other organizations. This calculation represents the effective size of the network (Hanneman 2005). The organization may have ties to 25 different organizations. If none of the 25 organizations has ties with any other organization, the network's effective size is 25. Alternatively, if all 25 organizations have ties with 25 other organizations the effective size is zero. Table 7.10 summarizes the size and the limitations of the network by each domain.

	Research	Intermediary	Support	Enterprise
Effective Size	13	75.7	73.9	13.9
Efficiency	1.0	.992	.9999	.636
Constraint	.822	.648	.933	.228

**Table 7.10: Size and Limitation Measures by Domain**

The research will also measure the efficiency and the effective size of the organization's network. That is, what proportion of organization's ties in its subgroup is "non-redundant"? Non-redundant ties ensure that a vast amount of information is diverse and independent. When optimizing the benefits of a network a non-redundant tie, it is necessary to build networks with non-redundant contacts. Also, the constraints test is a summary measure that taps the extent to which the organization's connections are to others who are connected to one another (Hanneman 2005). If an organization's potential trading partners have other potential trading partners, then an organization is highly constrained. These relationships constraint or direct the economic relationship in a network.

### **7.6.5 Summary of Weak Tie Tests**

Weak tie tests include measurements of weak spots, cohesion, and structural holes in the Corridor. It was expected that each test would demonstrate the actual makeup of the region and weak ties would be the informal connections between the organizations and domains, and thus would have some potential advantages in building new economic relations with one another. The study showed that at the domain level the intermediate organizations were positioned to influence the flow of information and resources between the other organizations in the network more than the three other domains.

## **7.7 Empirical Findings on Strong Ties in the Network**

The responses to the questionnaire and the semi-structured interviews added to the understanding of how informal networks strong ties connect (or do not connect) different organizations in the area and aids in the understanding of the actual, as opposed to the potential, relationships that might exist within the network. The empirical findings are summaries of the semi-structured interviews and responses from the survey responses.

### **7.7.1 Qualitative Results of Strong Tie Relationships**

The quantitative measurements used to calculate strong ties in the Corridor are the correlation coefficients, factions, and clustering coefficients. Granovetter's view of strong ties is based on frequency of interaction. It is likely frequent interactions between organizations occur because of familiarity stemming from each organization's combined histories. The region has a long history that dates back to 1871 when it was one of the country's largest stockyards. Long before the area was called the Corridor, organizations interacted amongst one another to gain economic and non-economic benefits. It is conceivable that strong ties relationships include long-term relationships needed to disseminate of confidential information.

The responses from individuals from the advisory group and working group of the Corridor revealed that the history and cultural likeness between organizations has led to collective effort. However, study was concerned with how much the collaboration from a diverse group has added to the economic activity of animal health and nutrition in the region? Strong ties had grown over the years as a result of formal the relationships that developed from organizational spin-offs, mergers, and acquisitions. Other strong ties

developed informally as a result of organizations with similar economic interest in animal health desired to work with organizations with similar social and intangible interest.

During the first set of meetings between the Corridor's advisory board and working group, the interviews led to discussions regarding the legitimacy of an overarching bioscience reputation that included not only animal health, but plant and medical sciences. A collective attitude toward the region's mass of animal health and nutrition organizations led to the development of an image or a brand that communicated the region's strength. The emergence of the Corridor's brand enhanced the legitimacy of the network. An interviewee from the Corridor's working group explained the collective benefits of being in the network:

When we introduce ourselves now to a potentially new client one of the first things they say to us are you a part of the Kansas City Animal Health Corridor. So it is the brand and what is behind the brand and that reinforces the brand is really important.

In nearly all interviews, the strong tie relationships were most prevalent as they related to the development of longer-term relationship that led to the commercialization of products. Keep in mind, these meetings involving the advisory board and working groups of the Corridor are made up of business and research institutions. In some respect these organizations compete with one another for profits and research output. Also, they benefit from the association with the region. Another interviewee from the advisory group commented:

Anyone of the organizations and institutions could be elevated into transformational. My criteria for transformation is it increasing significantly the visibility, and the reputation of the region which leads to organizations wanting to collaborate, invest or relocate here to be a part of it.

The strong tie relationships were seen as an opportunity to attract more skilled employers and skilled employees to the region. The strong ties perhaps were needed to offset some of the cultural shortcomings that attract employees and their families compared to other bioscience hubs in other parts of the nation. For instance, attracting senior and junior-level scientists to the region would not happen because of the reputation of the area alone. Instead, other organizational ties and personal ties to the region might.

Strong ties are also seen as an opportunity to pass along confidential information in a timelier manner. Although the working group met on a monthly and, at times, a semi-monthly basis, there was no real evidence of confidential information being more readily available to those organizations represented.

### **7.7.2 Empirical Findings from the Correlation Coefficients**

It is possible to measure the similarity of two tie profiles is to count the number of times an organization has the same number of ties as another organization. It calculates the strength and direction of association rather than the presence or absence of a tie. Pearson correlation ranged from -1.00 (meaning that the two organizations have exactly the opposite ties to every other organization, through zero (meaning that knowing the one organization's tie to a third party does not help in determining what the other organization tie to the third party might be) to +1.00 (meaning that the two actors always have exactly the same tie to other actors (Hanneman 2005).

Table 7.11 below shows the responses from the questionnaire on the long-term relationships or strong ties in the Corridor. It shows the similarities and dissimilarities of the structures of an organization. The table shows that most organizations have patterns of greater than .5, indicating the organizational pairs have similar ties with other

organizations. In this table organization 11 and 13 (intermediary and support organizations) have identical ties, meaning the pair has the same ties to other organizations; that is, they are structurally equivalent to one another. Likewise, organizations 13 and 169 have the same organizational pairs. There are also several organizations with negative values; this is an indication the pairs have opposite ties in the Corridor.

	11	13	51	65	82	94	106	158	163	165	166	169
11-Intermediary	1	1	0	0	0	0	0	0	0	0	0	0
13-Support	1	1	0	0	0	0	0	0	0	0	0	1
51-Intermediary	0	0	1	-.018	.705	-.015	.274	.4	-.01	-.01	.814	.574
65-Enterprise	0	0	-.018	1	-.015	.814	.814	.274	0	.574	-.018	
82-Enterprise	0	0	.705	-.015	1	-.012	-.017	.703	-.008	-.008	.814	.705
94-Intermediary	0	0	-.015	.814	-.012	1	.703	.343	-.006	.705	-.015	-.008
106-Enterprise	0	0	.274	.814	-.017	.703	1	.274	.574	.496	.274	-.012
158-Research	0	0	.4	.274	.703	.343	.274	1	-.012	-.012	.814	.496
163-Intermediary	0	0	-.01	0	-.008	-.006	.574	-.012	1	0	-.01	-.006
165-Support	0	0	-.01	.574	-.008	.705	.496	-.012	0	1	-.01	-.006
166-Enterprise	0	0	.814	-.018	.814	-.015	.274	.814	-.01	-.01	1	.574
169 Intermediary	0	1	.574	-.01	.705	-.008	-.012	.496	-.006	-.006	.574	1

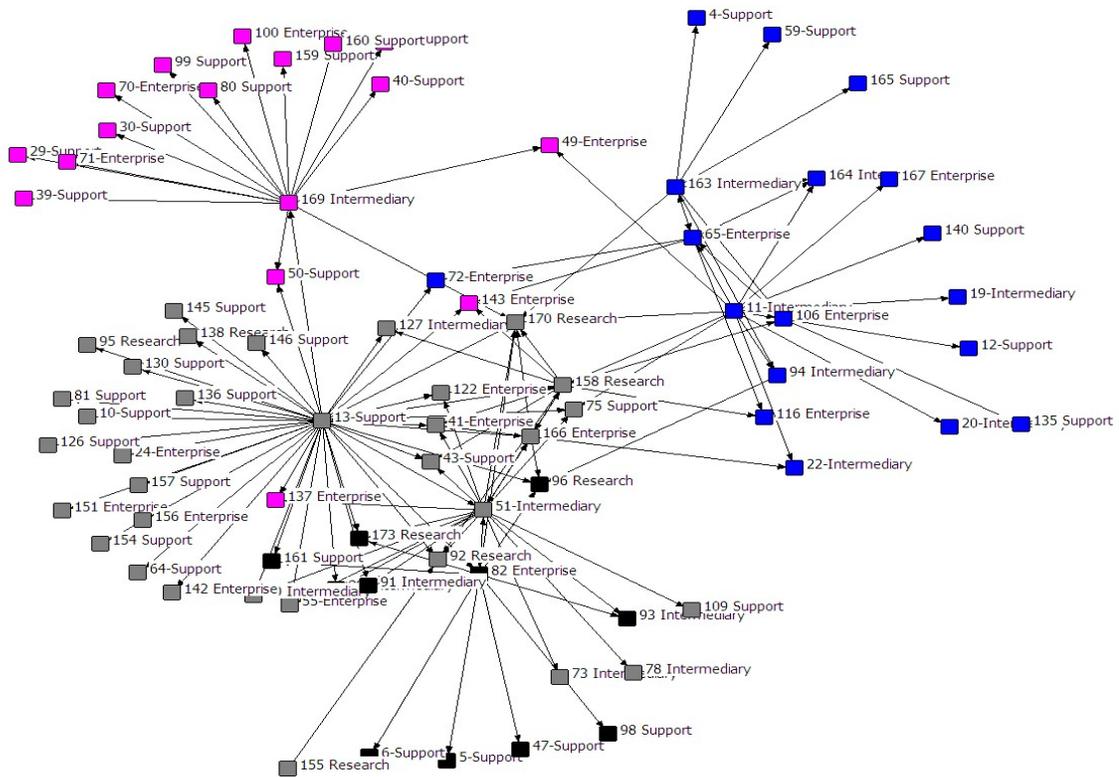
**Table 7.11: Correlation Test - Tie Structure and Strength**

The results of the correlation test show three organizational pairs whose ties with relationships match exactly and nearly 14 other pairs with exact opposite ties with other organizations. The network is sparsely connected. This leads into an analysis stemming

from similarities, or exact matching ties, to if whether or not, the network shows any tendencies to have relational ties that stem from the four domains.

### 7.7.3 Empirical Findings from the Tests of Factions

A faction fits the notion that the long-term relationships increase the likelihood of a high-density network. Factions in the graph can be described as having similar organizations, trading partners, and objectives. Figure 7.4 illustrates a network with four factions. Considering there are four domains in the network, the researcher conducted a test to determine if there was a propensity for the organizations, within the same domain, to show strong relations in a four-faction model.



**Figure 7.4: The Corridor as Four Factions**  
Each colored node represents one of the four factions.

To summarize the figure there are 76 ties in the network that indicate long-term relationships in the network. A mixture of domains makes up the four factions in the Figure 7.4.

Table 7.12 summarizes the factions by domain.

	Blue	Black	Gray	Pink
Support	10	5	14	6
Intermediary	2	2	5	6
Enterprise	6	1	7	4
Research	0	2	6	0

**Table 7.12: Summarizing the Factions**

Nearly 65% of the organizations in the model are considered support organizations. If those percentages of organizations remain consistent in the study of network factions, there will be more support organizations in the network from the support domain. However, this is not the true. The sum of the other organizations in the faction is larger than the number of organizations from the support domain. Although support organizations make up a larger percentage of organizations in the network, they do not make up the majority of organizations in a faction. This test indicates support organizations are not as connected as the organizations in the three other domains.

#### **7.7.4 Empirical Findings from the Cluster Coefficient**

Because the Corridor appears to be a sparsely populated network, the study uses clustering coefficient to calculate and explain if the proportion of the total number of ties is highly "clustered" into local subgroups. With this approach, a researcher can evaluate the organizations connected to a specific organization in the Corridor. After doing this for the entire network, the degree of clustering is determined.

The sizes of each organization's neighborhood are reflected in the number of pairs of organizations in it. For example, 82-Intermediary has 78 neighbors, and .077 cluster coefficient percent of the possible ties are present. Therefore, 82-Intermediary is not highly clustered. In another example, organization 170-Research has 28 neighbors and 24 percent of the possible ties are present. This is an indication of a larger cluster in comparison to 82-Intermediary.

The results of the clustering coefficient tests in Table 7.13 do not provide strong evidence of large cluster groups in the Corridor. For instance, organizations that have high clustering coefficients also are in small clusters or subgroups. For instance organizations 41, 43, 89, 91, 92, 122 and 173 all have high clustering coefficients but the number of organizations in their subgroups is small. The number of organizations in the cluster varies from only 3 to 6 organizations.

Organization	Clus. Coef	nPairs
11-Intermediary	0.027	91
13-Support	0.025	41
41-Enterprise	0.667	6
43-Support	0.667	3
50-Support	0.5	1
51-Intermediary	0.076	190
55-Enterprise	0.5	1
65-Enterprise	0.095	21
72-Enterprise	0	1
75-Support	0.167	3
82-Enterprise	0.077	78
89-Intermediary	0.667	3
90-Intermediary	0.5	1
91-Intermediary	0.667	3
92-Research	0.333	6
102-Enterprise	0.667	3
127-Intermediary	.5	1
137-Enterprise	0.5	1
143-Enterprise	0.167	3

Organization	Clus. Coef	nPair
158-Research	0.122	78
161-Support	0.5	1
163-Intermediary	0.054	28
164-Intermediary	0.5	3
166-Enterprise	0.262	21
169-Intermediary	0.008	120
170-Research	0.232	28
173-Research	0.667	3

**Table 7.13: Cluster Coefficient By domain**

### **7.7.5 Strong Tie Summary Results**

Two tests for strong ties and one test for reciprocity are included in this study. This was intended to help determine the informal network that is connected or not connected in the network. The qualitative and quantitative measurements of strong ties indicate some level of strong ties in the Corridor.

The strong tie tests, including the coefficient from the correlation and cluster studies, indicate some strong ties exist in the network but not enough to characterize the network as having more strong ties than weak ties. Although the organizations are studied with a domain perspective, the research and intermediary organizations show the majority of those organizations operated in factions. These factions were not exclusive to a specific domain but were made of a mix of organizations from all domains.

Though the network has some strong ties, it is relatively sparsely connected. The calculations of strong ties, how the ties are directed, how the organizations are clustered and the extent of factions in the network show that strong ties exist but do not occur frequently. The specific questions that help researchers answer this question are found in APPENDIX A. Specifically, the questions were developed to understand the long terms relationships, long-term contracts, and sharing of valuable information.

### **7.8 Empirical Findings on Reciprocity in the Network**

The results from reciprocity tests were gleaned from the semi-structured interviews. Reciprocity conveys a win-win perspective for the region. That is to infer, the benefits from gains from trade are sufficient for all parties in the exchange. There was little evidence from the interviews that indicated reciprocity is an important characteristic of

the Corridor. Although, some organizations did take a more active role in promoting the benefits of the organizations and sponsoring activities, reciprocity was illustrated by an organization performing a duty or favor without the expectation and receiving something of value in return. It is important characteristics for networked organization. Evidence of reciprocity is found in the research domain of the network. In the research domain an in-kind collaboration is important to enhancing learning and economic benefits of the network. A member of the Corridor's advisory board explained:

An asset to facilitate commercialization... another aspect is to serve as a resource for certain technologies that maybe one institution could not develop. [This] involves a collaboration involving organizations developing a genetic database to help in breeding with different species. An individual [organization] would not do that, but collectively they would.

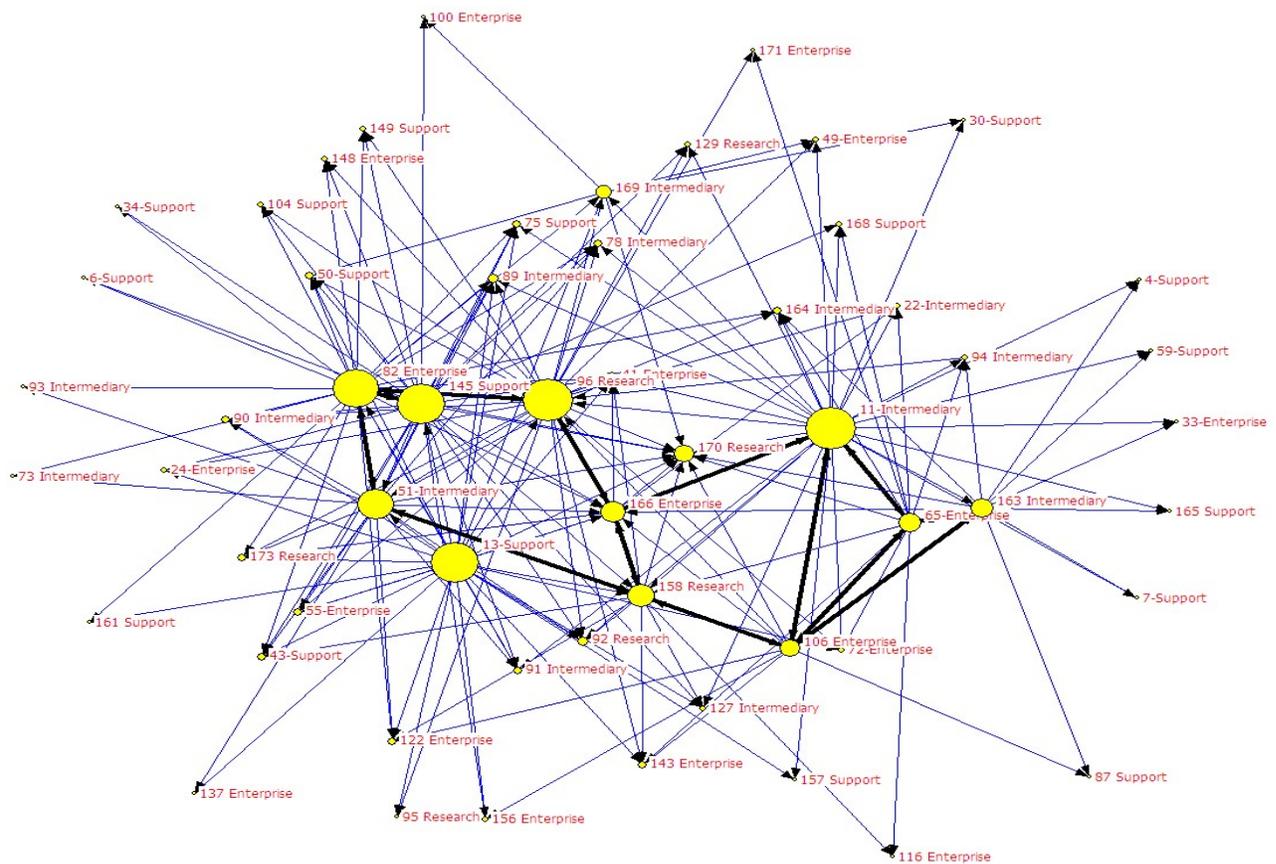
## **7.9 Empirical Findings on Reciprocal Ties in the Network**

Four types of social network questions were asked in the survey. The questions were direct, factual and hypothetical in nature, and related to the past incidences and future expectations of reciprocal behavior between organizations.

SNA tools provide a calculation to understand the exchanges that are reciprocal. A network with more reciprocal ties is often considered more stable or an equal network that is dominated by symmetric ties. Figure 7.5 illustrates the network and its reciprocal ties. The social network questions identifying organizations that have performed beneficial acts for the entire network. This might include leading activities or sponsoring events in animal health and nutrition in the region.

The organizations with reciprocal ties are connected with the heavy black lines with arrowheads at both ends of the line segment. A circle represents an organization in the

Corridor. The larger yellow nodes indicate the degree of connectedness within the organization. That is to infer, the larger the yellow circle the more connected the organization compared to an organization that has fewer connections. In addition, Figure 7.5 shows the reciprocal relationships. An organization with a higher number of ties and involved in reciprocal exchange relationships is larger than other organizations in the Corridor who are not as connected or has fewer reciprocal relations. For instance, organization 11-Intermediary has a reciprocal tie with 65-Enterprise but does not have a reciprocal tie with organization #163-Intermediary.



**Figure 7.5: Reciprocal Ties in the Network.**

Yellow nodes represent organizations with a reciprocal relationship. The greater the size of the node the denser the subgroup

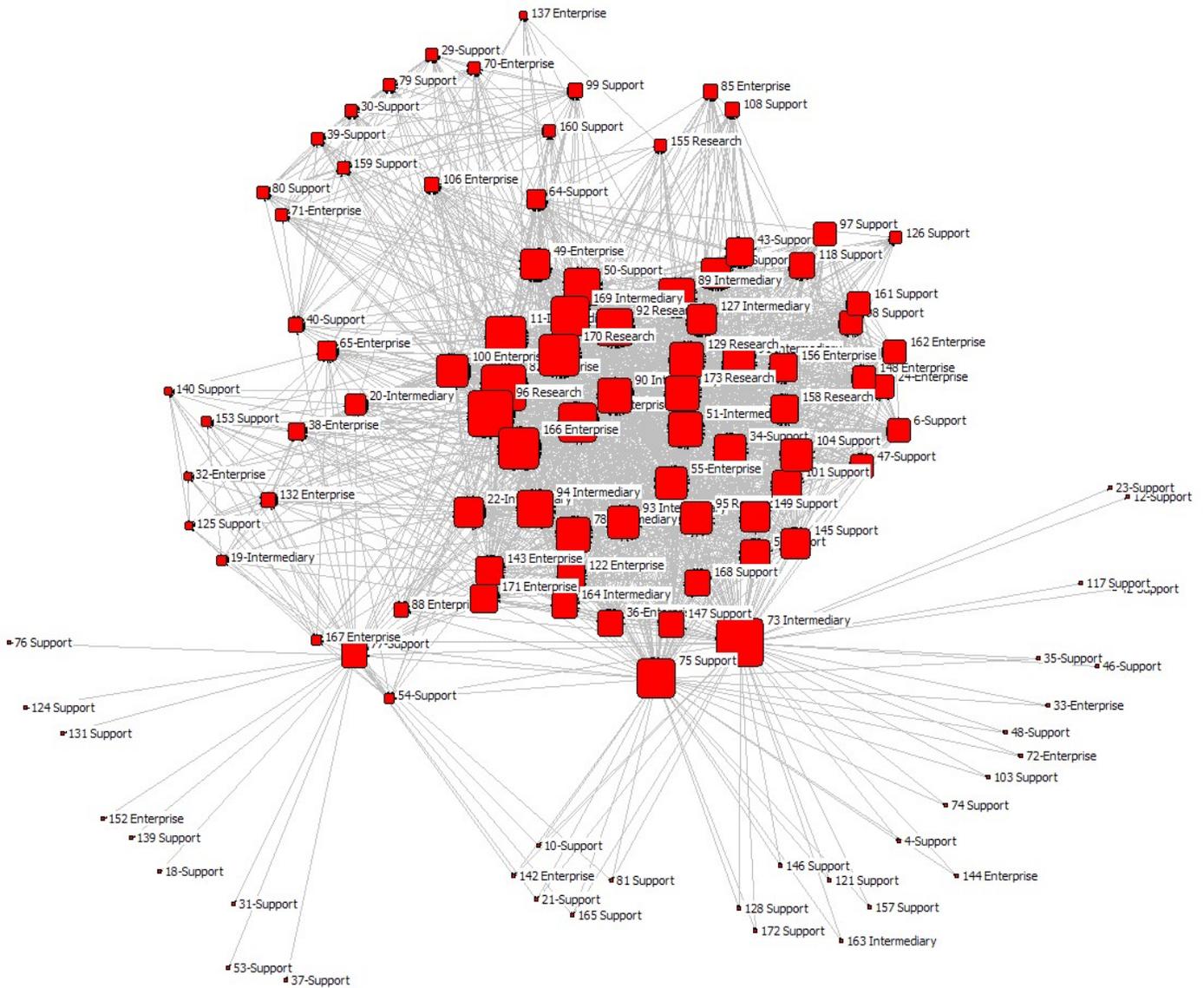
### **7.9.1 Empirical Findings from the Tests on Cliques**

Typically an organization involved in many reciprocal relationships is a part of a clique. The formal definition of a clique, as it is used in network analysis, is much more narrow and precise than the general notion of reciprocity. Formally, a clique is the maximum number of actors who have all possible ties present among themselves. For purposes of this study, the formal definition of a clique is relaxed considering this network is sparsely connected. Typically the path in a clique is one organization has a reciprocal relationship with another. This is described as one step or one path between the organizations. This study looks at a N-clique. N stands for the number of paths (Hanneman 2005). The study used two instead of one path to form a clique. So a 2-clique model has three organizations that are connected by two ties between them. In comparison a clique has three organizations with three ties between them. In other words, the organization is connected with every other organization in the network.

Using the definition of a formal clique the analysis did not identify a clique in the network. However, the 2-clique model identified 30 cliques in the network. One organization could be a part of more than one of the 30 cliques. This is an indication of a reciprocal relationship that is based on strong rather than weak ties.

The initial results reveal a small number of reciprocal ties in the network. However, by expanding the definition of reciprocity and performing a clique and organization-by-clique analysis, the results show other underlying relationships that might add to the stability of the Corridor and the passing of key information between organizations in the network.

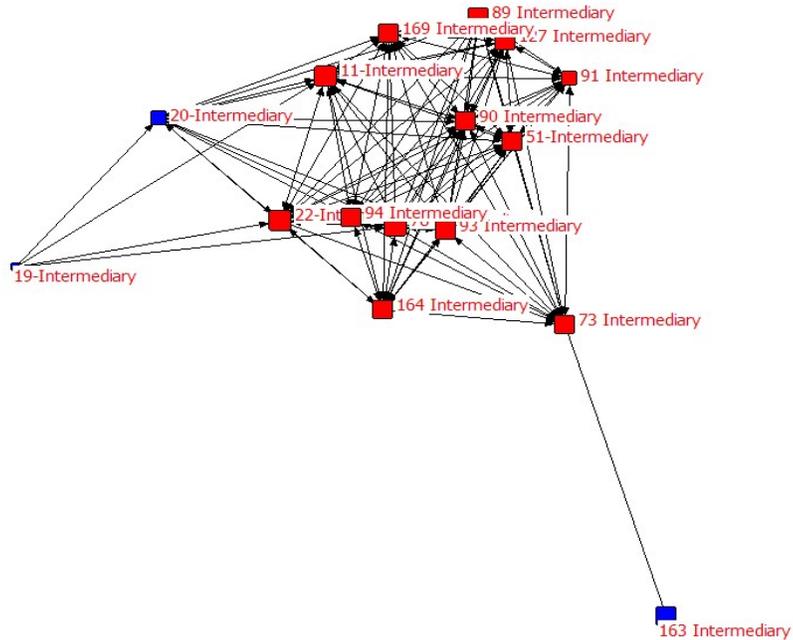
Figure 7.6 is an illustration of a 2-clique model. Subgroups are divided into relationships that are relatively close and typically have no sources of informal ties. Rectangle-shaped nodes represent the organizations. The larger rectangle indicates the organization that has more 2-clique relationships in the Corridor. Organizations with fewer 2-clique relationships are smaller and are found along the edges of the network. Organizations that were not a part of a clique were not included in the figure.



**Figure 7.6: 2-Clique Representation of the Network.** The red nodes represent organizations that are a part of a clique. The larger its size the denser its subgroup.

The number of reciprocal ties in the network initially looks very thin (Figure 7.6). For instance, only 11 reciprocal relationships exist. This would indicate instability in a network of this size. The intermediary organizations make 4 or 35% of the reciprocal

ties. However, because of a small number of reciprocal relationships the research sets out to explore relationships by analyzing the cliques. Cliques are positioned to give and receive value from other members of the clique. In the 2-clique model, Figure 7.7 below shows more friend-of-a-friend connections. It shows the reciprocal relations for just the intermediary organizations. There are 17 intermediary organizations in the Corridor. The Figure 7.7 shows how those 17 are positioned in the 2-clique model. Only nodes 19, 20, and 163 are not in the clique.



**Figure 7.7: Intermediate Domain 2-Clique Model**

Red nodes are intermediary organizations in the clique; Blue nodes are intermediary organizations not in the clique.

The models provide illustrations of the reciprocal relations that are characterized by a ‘friend-of-a-friend’ relationship. The existence of reciprocity provides a stable network, and the 2-clique model provides an additional understanding of the underlying relationships that support economic exchanges in the network.

### **7.10 Qualitative and Quantitative Results on Reciprocal Ties**

According to traditional models, networks have many reciprocal relationships. Very little quantitative evidence of reciprocity exists in the Corridor. A total of 11 organizations were found to have relations characterized as being reciprocal. Five of the organizations were from the enterprise domain. The researcher expanded the test to identify cliques in the network. Cliques are described as highly dense groups that exchange information and resources with all organizations in the network. It can be characterized as a friend-to-a-friend exchange where there are many friends. A strict definition of the clique did not reveal any cliques or reciprocity in the Corridor. However, 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 propensity of a reciprocal relation does exist in the 2-clique models in the Corridor.

### **7.11 Summary of Empirical Findings Using an Intermediary Domain Perspective**

The input from the semi-structured interviews suggested the organizations from the enterprise domain provided the initial support to help develop the Corridor. Later the intermediate organizations contributed heavily in identifying and implementing opportunities to advance the interest of the region. The findings from the network analysis support this claim. The intermediate and enterprise domains have a more

significant influence on connecting the Corridor organizations than the research and support domains.

Based on the results from the interviews and the network analysis the intermediary domain is uniquely positioned in the network to connect organizations. Their social relationships appear to provide some potential advantages that other domains do not share. The findings described the actual relationships, influence of different domains, specific organizations, and how they are connected or not connect — through bridges/weak points, cliques, reciprocity, structural holes, factions, or clusters.

## **CHAPTER 8: CONCLUSION**

This study explains the patterns of network ties that arise among populations of organizations. It suggests that the pattern of relations follows a functional logic. That is, weak ties are more predominate in a network where access to knowledge and resources is important.

The final chapter draws conclusions regarding the actual relationships between Corridor organizations, as opposed to the potential relationships that might exist within it. The theoretical approach is derived from the roots of exchange theorist Emerson (1974). Our findings provide an informal explanation of how information and resources are exchanged and they help to identify the actual links in the network. Moreover, the strength of the weak ties indicates greater opportunities for access to information. Hence, networks with more weak ties have shorter paths and lead to faster change and the ability to coordinate with other organizations.

### **8.1 Theoretical Issues**

This micro-analytical approach analyzes the subgroups in the network and the ties that connect them. The exchange theory presented in the theoretical framework has served to advance the understanding of networks. The theory suggests a set of constructs for empirical analysis and provides a manner in which organizations can be examined for their organizational ties or linkages. The structure suggests that formal and informal resources and information are moved between organizations and domains. The empirical indicators described the relationships and the structure of the network.

## **8.2 Conclusions and Implications Regarding How Networks Function**

The impact of the social relations between organizations and the potential advantage 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 are otherwise disconnected and in doing so compares the concept of a “strong tie”. Granovetter (1982) claims that strong ties are important and should not be ignored. For instance, when people are insecure they resort to the development of strong ties to reduce uncertainty. Drawing on the case analyses and survey results, the three expected outcomes asserted in Chapter 3 are outlined below and conclusions are reviewed.

### **8.2.1 Weak Ties**

Chapter 4 of this study suggested the intermediary organizations would have more weak tie relationships than other domains in the Corridor. 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/bridges, weak points, and cohesion associated with the intermediary domain. Although the Corridor is sparsely connected, several cohesions measurements, such as the number of ties, the diameter of its network, and ability for organizations to broker information rank higher than other domains in the network. These results appear to conform to the first suggested outcome. Proposition #1 is not rejected.

When considering the conditions, the empirical results indicate weak ties have a significant positive influence on connecting organizations in the network. The primary

measures on weak ties included measurements to understand the points in the network that would become disconnected in the event an organization were removed. The effective size of the network and several measurements of network density were also used to explain how the network functions. In group performance related calculations on embedded relationships, Uzzi's (1997) research found that trust, fine-grain information, joint problem solving can have both positive and negative economic outcomes. Networks provide opportunities for new information but can also constrain the activity of an organization. In this study, no real evidence was found to substantiate this. Instead, the organizations in the intermediary and research domains are positioned as a bridge to connect to other organizations or to allow information or resources to be shared.

The measurement of a cutpoint highlights the number organizations that would become disconnected from the network in the event of uncertainty or adaptation to environmental changes. There were a large number of isolated organizations in the network. These are organizations that did not have a questionnaire respondent to identify them as a trading partner in hypothetical or factual terms. Therefore, a weak tie theory best describes how the networks work and also how the intermediary organizations' ties, in particular, provide access to other organizations.

Weak ties are perceived to be positive regarding creating specific knowledge in the network. There is a mutual benefit among organizations when new information is shared. Typically, a weak tie provides an inroad or access to new information compared to strong ties. Chapter 4 of the study postulates that the Corridor, as a whole, has a large number of weak spots. Therefore, the constituent organizations have access to resources and information they would not otherwise have. The study on the Corridor substantiates the

claims of Burt, Granovetter, and other network structuralists. For example Thacker and Mayhew (1990) found that large information networks, which are full of structural holes, promote access to new information and resources.

### **8.2.2 Strong Ties**

This study's use of strong ties has less to do with the emotional intensity in social relationships and more with how confidential and validated information passes from one organization to another. In Chapter 4, the study suggests that organizations with more ties to similar organizations in the Corridor would have greater access to resources. The strong tie relationships are indicators of how similar organizations know one another. 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. For instance, the correlation test, which measured the pairs of organizations with exact or identical matches to other organizations, revealed only a few matches exists. The 2-clique and faction tests did not provide significant evidence of strong ties. These measurements are often used as indicators of relationships characterized by long-term contracts or joint projects. As expected, the research and enterprise domain organizations did not exhibit many strong tie relationships.

As a collective unit, the Corridor demonstrated low levels of strong ties as indications of interaction between organizations. Therefore, the evidence challenges Proposition #2, which suggested more strong ties between constituent organizations are more responsible for access to valuable resources. The results from the test of factions

(ideal network) and the cluster test (tendency of dense local subgroups) indicated not only the intermediate organizations, but also the enterprising organizations were clustered in similar subgroups of activity and were a part of the same factions. The support and enterprise domains of the network have fewer strong ties in comparison to the intermediary and support domains. The essence of organizations in the enterprise and support domains is the pursuit of payoffs and not the pursuit of ties.

The findings on strong ties suggest that the number of direct ties may be insufficiently configured to provide support organizations with ties to transmit information. This is consistent with Granovetter's (1973) empirical findings that having more weak ties increase the ability to act in concert. Having no strong ties breeds local cohesion and macro fragmentation.

### **8.2.3 Reciprocity**

Chapter 4 postulated the reciprocal ties in the Corridor provide a greater opportunity to gain access to valuable information and resources. Reciprocity is the repeated nature of the interaction or the 'one hand washes the other' relationship. The lack of reciprocity is an indication of unstable exchange relationships. Reciprocity provisions work well and provide strong safeguards for the parties involved; the short-term gains from opportunism are largely offset by long-term losses from a damaged reputation in the particular industry's community.

Considering the nature of the Corridor, 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. Proposition #3 is not accepted.

The amount of reciprocity in the network helps to safeguard future transactions between trading partners. Trust and the expectation of future transactions with others create an environment of reciprocal relations. All 173 organizations do not share the same level of organizational ties. For example, not one organization has the same number of outbound, inbound or reciprocal links as another organization in the study. It is not uncommon for a network to have fewer reciprocal ties than outbound ties. However, reciprocal ties contribute to maintenance of stable social systems. Transactions between organizations, including negotiations, would be carried out suspiciously and this increases the chances of opportunistic behavior (Brett and Shapiro, 1998).

However, the Corridor contains more structural holes than reciprocal ties. The empirical results shows there were few reciprocal relations in the network. However, an expansion to a 2-clique model provided strong indications of subgroup interactions, rather than reciprocity, taking place in the network.

The empirical survey results of this study suggest the intermediary organizations proportionately have more organizational ties and their networks are more densely dispersed while the support organizations, which make up the largest number of organizations, have proportionately fewer ties, are in fewer factions, and are a part of fewer clusters.

### **8.3 Implications for Organizations In the Corridor**

The implications of the findings on strong tie networks are that: (a) intermediary organizations hold key structural positions 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 while enterprise organizations do hold some key structural positions they do not hold nearly the same as intermediate organizations; and (c) research focused organizations are fixed in the network structure in clusters and have similar ties to other organizations.

The inability to create strong ties might be an obstacle that is a result from receiving information that is not confidential and timely. Likewise, the lack of weak ties prevents the highly regarded new information from supporting the commercialization of new innovation. These findings indicate a greater likelihood of developing the weak ties for the Corridor.

Results in this study indicate four organizations that are positioned to take advantage of the potential social relationships. From the enterprise domain: Bayer Animal Health, Dairy Farmers of America, and Ceva Animal Health had more weak ties than strong and had a balance of reciprocal ties in their network. From the research domain: Kansas City Area Life Sciences, and the veterinary medical schools at the University of Missouri and Kansas State University exhibited a similar proportion of ties and reciprocity. From the intermediary domain: The Kansas Cooperative Council and KansasBio Organization. No organizations from the support domain demonstrated significant organizational ties that could lead to access to resources and information.

Perhaps a distinguishing characteristics or the common theme among these

organizations is an organizational focus on innovation and science. This emphasis leads to managerial incentives across the research and intermediary domain.

#### **8.4 Implications of Public Policy and Public Opinion to Support the Development of Networks**

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 plans to update Kansas City's long-standing 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, bioscience is used to solve problems or make useful products that cure or prevent diseases. The findings from this study suggest that having a strong and committed organization in the intermediary domain, which supports the efforts of the enterprise domain, is important if not necessary, to ensure a sustainable network.

Underlying the current drive for public-private partnerships in biosciences is the widespread belief that government is not very effective in choosing good projects (i.e., picking winners) and managing research.

Managers should be rewarded for funding projects on the margin—those that are

socially beneficial but would not be undertaken without a subsidy—and punished (or at least not rewarded) for funding inframarginal projects—those that firms would undertake without a subsidy.

## **CHAPTER 9: LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH**

The focus of this study is on the economic relationship within the geographical region called the Corridor and the actual, as opposed to the potential, relationships that might exist within it. The central argument of network research is that organizations are embedded in networks of interconnected social relationships that function to increase learning, enhance reputations, and provide economic benefits.

The research on the empirical indicators and consequences of networks help to explain the recent theoretical and empirical trends, and give directions for future research. Exchange theory and transactions cost analysis provide other opportunities to explore the intangible and tangible underpinnings of exchange. When any network is viewed from both perspectives, a greater understanding emerges than if it were viewed by from any single perspective.

The use of two social scientific perspectives has come to dominate organizational research and can help answer the research question. The blind spots and distortions of each of the two social perspectives are complementary. Often one's blind spot is another's focus so that one's strength is another's weakness. Each theory makes valuable suggestions regarding how networks function. For instance, the organizational and contracting insights from the transaction economics framework provide chances to study market coordination and managerial control in collaborative relationships. In addition, network analysis could provide an insight into the political economy and informal institutions that will develop as the region develops (North 1990).

This study also suggests that cutpoints are fertile grounds to form opportunistic

behavior. 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.

### **9.1 Alternative Proxies**

The informal and formal variables tested for in this study could be replicated in other networks that are located geographically near one another. This would allow us to validate the findings of this study. Also, a second case analysis would provide an opportunity to test some of the conclusions of this present analysis that may be specific to other statewide or regional bioscience initiatives involving not only animal but also plant and human health networks.

State and local governments continue to establish strategies and inter-organizational collaborations to implement their own bioscience initiatives. For instance, collaborations like the Kansas Heartland Innovations, which support public and the commercialization of plant, bioenergy, and biomaterial innovations.

### **9.2 Longitudinal Study**

The Animal Health Corridor, in name only, is relatively new. As data becomes available from sources like the Economic Census, network researchers can continue to evaluate the national, regional, and local effects. Network analysis provides other variables to estimate the likelihood of a transaction. Perhaps a study involving key organizations in the Corridor such as those organization with more cutpoints than others or organizations that has above average cluster coefficients in large subgroups. Another network-centered approach to study the Corridor is to use the data collected in this study

to perform a density test by domain or by faction. With this information a researcher could ask respondents other person-centered questions related to centrality. Centrality is also a reflection of an individual position and degree of power in the network. Central measures such as closeness and betweenness help to identify power or the less influential organizations in the network. This follows the work of Shaw (1964), and the reviews of small group laboratory studies on centralized networks are efficient for simple tasks. The decentralized networks are efficient for complex and uncertain tasks. Also the findings of Oh, Chung, and Labianca's (2004) on internal density and the number of bridging relationships to external groups in informal socializing network provide another view of centrality within the network.

### **9.3 Integrating Granovetter and Williamson**

A combination of both perspectives – network and transaction cost analysis- has a distinct advantage in the study of how networks function. The study of a network of embedded ties that promote strong ties are useful but by itself may focus too much attention on local resources and historical conventions (Granovetter 1985; Krackhardt 1992). Transaction cost tools to explain network connections but it is underdeveloped when it comes to including trust as being important in safeguarding the completion of the transaction (Coase 1937; Granovetter 1992).

Mark Granovetter and Oliver Williamson make important contributions surrounding the emergence of networks. While social network theory supports the informal structure (strong and weak ties) to study economic action, transaction cost economics is in getting

the formal governance structure right. Value is created by choosing a structure that improves transactional efficiency or by choosing structure that allows access to resources.

## APPENDIX A



Division of Applied Social Sciences  
College of Agriculture, Food and Natural Resources  
University of Missouri-Columbia  
Agricultural Economics – Agricultural Education – Agricultural Journalism – Rural Sociology

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**You are an innovator in animal health and nutrition.** The KC Animal Health Corridor is a unique organizational model for promoting regional economic growth, research, and development. In our view, lessons learned from the Corridor experience will be of assistance scientists, business planners and regional developers elsewhere in the country. In order to find out more about how the Animal Health Corridor creates value and to provide more national exposure to this model, we have designed a brief set of questions about your organization's participation in it.

I will send you login instructions to a secured website on March 20th. It is important the **chief research scientist, design engineer or a communications professional** completes the questionnaire. If not, then someone that is the most likely to interact with other organizations in the Animal Health and Nutrition Corridor will suffice.

Your participation in this survey is entirely voluntary and if you agree to fill out the questionnaire you may decide to not answer specific questions. Your responses are completely confidential and there will be no way to identify a specific company or individual who responds to the questionnaire in the summary statistics obtained from this study. Completing the questionnaire should take less than 20 minutes.

If you have any problems or questions about this research or the survey, you may contact the principal investigator Keith D. Harris (doctoral candidate) at 816-916-0332 or his academic advisor Dr. David Obrien at 573-882-0392. We would be happy to answer any questions that you may have.

If you have any questions regarding your rights as a participant in this research and/or concerns about the study, or if you feel under any pressure to enroll or to continue to participate in this study, you may contact the University of Missouri Institutional Review Board (which is a group of people who review the research studies to protect participants' rights) at (573) 882-9585.

REGARDS  
KEITH D. HARRIS  
USDA NATIONAL NEEDS DOCTORAL FELLOW  
UNIVERSITY OF MISSOURI-COLUMBIA

# NETWORK GENIE

## Tangible and Non-tangible Economic Benefits Preview

The Animal Health and Nutrition Corridor is a unique organizational model for promoting research, development, and regional economic growth. In our view, lessons learned from the Corridor experience will be of assistance to scientists, business planners and regional developers elsewhere in the country. In order to find out more about how the Corridor works and to provide more national exposure to this model, we have designed a brief set of questions about your organization's participation in it. We are particularly interested in the kinds of relational benefits associated with being a part of the Corridor. Therefore, it is critical that we get feedback from as many organizations as possible. It is important that the person answering these questions is someone who does business with individuals in other Corridor organizations. We are targeting either a chief research scientist, the primary communication professional or the person most likely to be involved with organizations external to their own for this study.

Your participation in this survey is entirely voluntary and if you agree to fill out the questionnaire you may decide to not answer specific questions. Your responses are completely confidential and there will be no way to identify a specific company or individual who responds to the questionnaire in the summary statistics obtained from this study. Completing the questionnaire should take less than 20 minutes.

In this section, please help us to understand the nature of the organization in which you work.

1. The primary purpose of my organization is to:

- a) Maximize profits
- b) Perform basic research
- c) Conduct applied research
- d) Regional economic development including job creation and increasing investment opportunities
- e) Advance the agricultural related interests in the region

2. How many employees work in the Animal Health Corridor for your organization?

- a) 0-19
- b) 20-99
- c) 100-249
- d) 250-599
- e) 500+

3. How long has your company has been geographically located in the Corridor?

- a) Since 2000
- b) Since 1990
- c) Since 1970
- d) Since 1950
- e) Prior to 1950

4. Is you organization's headquarters located in the Kansas City Animal Health Corridor?

- a) No
- b) Yes

5. Please indicate which term best describes your organization?

- a) Corporation
- b) Government Organization
- c) Not for profit non-governmental organization
- d) University
- e) A Research Institute
- f) Legal Partnership
- g) Cooperative

Now tell us a little about yourself.

6. How would you describe your role and responsibilities within your organization?

- a) Manager
- b) Mid-Level Manager
- c) Senior-Level Manager
- d) President/Owner

7. What is the highest academic degree you've earned?

- a) Some College
- b) Bachelors
- c) Masters
- d) Doctorate

8. What is your gender?

- a) Male
- b) Female

In this section please help us to understand any relationship specific benefits as a result of being in the Corridor.

9. Specific knowledge refers to the special skills that are developed when designing a Specific good or service. It could include the creation of a new product or the enhancement of a good or service. Has your organization's employees (scientists, design engineers, communication personnel) accumulated specific knowledge regarding animal health and nutrition because of their interaction with other individuals/organizations with the Corridor?

- a) No
- b) Yes

10. Would you consider working in a product innovation center or a research center with other scientist, design engineers, or others engaged specifically in automating a process, or patenting a product, or supporting activities related to commercializing animal health and nutrition goods and services?

- a) No
- b) Yes

11. Do you have any specifically designed tools, equipment or machinery that could not be used in any other relationships within the Corridor?

- a) No
- b) Yes

12. Consider a project you've work on that has ended in the past year. Have the short-term relationships in the Corridor provided the most valuable information compared to the long-term relationships? [Valuable information denotes the perceived receipt

of information and/or advice that had a positive impact on your work].

- a) No
- b) Yes

This section is intended to understand any inter-organizational connections/linkages within the Animal Health Corridor.

13. Which organization(s) in the Animal Health Corridor has your organization worked within the recent past?
14. How frequently does your organization communicate with this organization?
  - a) Rarely
  - b) Some times monthly
  - c) Some times weekly
  - d) Some times daily
15. Which organization(s) in the Animal Health Corridor has provided your organization with valuable information?
16. Which organization(s) in the Animal Health Corridor does your organization have a long-term relationship?
17. Which organization in the Animal Health Corridor would your organization consider entering into a long-term contract for goods and services?
18. Which organization(s) in the Animal Health Corridor would you consider informally sharing information or exchange goods and services without a contract. (Put those you would most likely consider at the top of your list.)
19. Which organization(s) in the Animal Health Corridor would your organization consider entering into a joint agreement to commercialize a good or service or to advance the collective interest of the Animal Health Corridor?
20. Which organizations(s) in the Animal Health Corridor have you interacted with in less formal meetings?

21. Which organization(s) would your organization consider exchanging at least one of the following: news, information, data, software for work related purposes?
22. Which organizations would your organization likely interact with at a trade show, association meetings, veterinary conferences etc.?

We're almost done. Just three more questions about your interaction with other organizations in the Corridor.

23. Which organization(s) has performed beneficial acts in the Animal Health Corridor, such as provided resources to solve a problem, sponsored a Corridor related activity or worked on a committee?
24. Which organization(s) in the Animal Health Corridor would your organization consider performing a beneficial act without knowing whether, when, or to what extent the other will reciprocate in the future?
25. This organization has done something to performed a beneficial act to benefit other organizations in the Animal Health Corridor, such as provided resources to solve a problem, sponsored an animal health related activity, led or worked on a committee. (Put those who performed the most beneficial acts at the top of your list.)

## APPENDIX B

### Organizations Listed in the Survey

AccuTec Services	Center Johnson County	KC Supply	Shor-Line
ACHFoam Technologies	Cereal By Products	KCBio Medix	Southwestern Association
AdFarm	Cereal Food Processors	Kelly Scientific Resources	Sparhawk Laboratories
ADM Milling	Cereal Ingredients	Kennel-aire	Star Lab Forage, Inc.
Advanstar Communications	Ceva Animal Health Inc	KHC Wealth Management	Stinson Morrison Becker
Aerrotek Scientific	CII Laboratory	KSU Olathe Campus	Stone Manufacturing Supply Co.
Ag Processing	Clipper Distributing Co.	Labconco Corporation	Stowers Institute Medical
AGD Insurance	CMA Consulting	Labtech Specialty Staffing	Teva Animal Health
Agri Pulse	Coffeyville, Resources LLC	Land O'Lakes	The Duff Company
Agri-Associates	Coffman Group	Lansing Trade	U.S. Animal Health Association
Agri-Laboratories	Columbian TecTank	Lathrop & Gage	United Missouri Bank
Agriculture Future of America	Conklin Company	Life Science Legal	University of Missouri -College of Veterinary Medicine
AgriThority	Copan Pharmaceuticals	Lime Light Technologies	Vedco Inc
Agro-International	CRB Engineers & Builders	Lockton Companies	Veterinary Specialty Products
AgTech	Cyber Feed Company	Lonza,Inc	Webster Veterinary Supply
Alpha Scouts	CVR Energy	MAC Equipment	Zupreem
Amark Packaging Systems	Dairy Farmers of America	Manna Pro	
Ameri-Pac Inc.	Darling International	Marlen	
American Angus	Data Core Marketing	Mars Petcare	
American Hereford	Data Source	McAlister, Software	
American Micro	Davidson Architecture & Engineering	McCown Gordon Construction	
American Royal	Dechra Veterinary Products	McKinley Communicatons	
Anderson Fallon	Del Monte Pet Products	Med-Pharmex	
Aratana Therapeutics	Durvey Inc	Medix Staffing Solutions	
Aspen Veterinary Resources	Elanco	Merck Animal Health	
Austin Nichols	Fleishman Hillard	Merit Packaging	
Authentus Group	Fresh Perspectives	MFA Feed	
Axcet HR Solutions	Gallagher Animal Management Systems	MGP Ingredients	
B.M. Scott & Associations	Global Prairie	Missouri Technology	
Bank Midwest	Grafton Staffing Companies	MO Bio	
Bank of Kansas City	Greater Kansas City Chamber of Commerce	Morgan,Hunter,Companies	
Bartlett and Co	Grey Healthcare Group	MRIGlobal	
Bayer Animal Health	H.C. Davis Sons Mfg. Co	MWI Veterinary Supply, Co.	
Beckloff & Associates	Hennessy Associations	Nancy, Shawver, Consulting	
Big Shot	Hill's Pet Nutrition Inc.	National Beef-Packing Company LLC	
Bill Barr & Co	Hoefer Wysocki- Architects LLC	National Feed Commodities Inc. Atchison, KS	
BioPredic International	Hovey Williams	NAVC,Clinician's Brief	
BioZyme Inc	IdentiGen	Nestle Purina Petcare	
Blair Milling and Elevator Co., Inc.	Industrial Fumigant	NestlePurina ProductTechnology Ctr	
Blasdel Cleaver Schwalbe Comm	Intl FC Stone	Norbrook, Inc. USA	
Boehringer, Ingelheim, Vetmedice	iVet Professional Formulas	North America, Intevet/Schering-Plough Merck Animal Health	
BOK Financial	Kansas Bio	Orbis Biosciences, Inc.	
Brakke Consulting	Kansas BioScience Authority	Ortho-Equine	
Bryant, Lahey & Barnes Advertisin	Kansas City Area Development Council	Osborn&Barr, Communications	
Burns & McDonnell	Kansas City Area Life Sciences	PAULO	
Butler Milling	Kansas Cooperative Council	PBI/Gordon Corp.	
CC Capital Advisors	Kansas Department of Agriculture	Pfizer, Animal,Health	
Callahan, Creek	Kansas Farm Bureau	Phoenix Pharmaceutical	
CareFusion	Kansas State Olathe	Polsinelli Shughart PC	
Cargill Animal Nutrition, Inc	Kansas State University College of Veterinary Medicine	Pulse Needle Free Systems	
Centaur, Inc	Kansas Technology Corporation	Quest Diagnostics	

## APPENDIX C

### Interview List

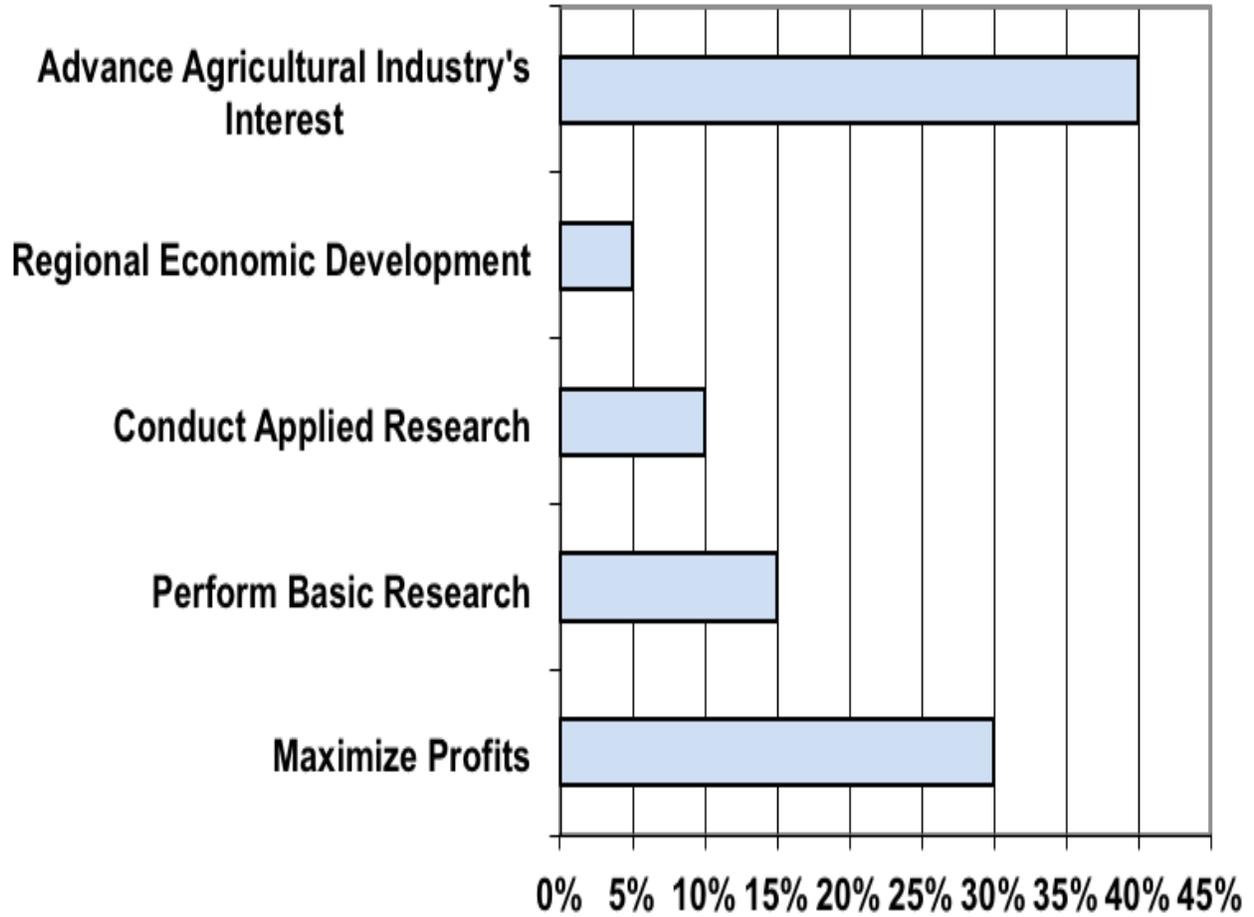
1. Ms. Lynn Parman 3/17/2010 10:00-10:40A Vice President, Bioscience Development, Kansas City Area Development Council
2. Dr. Neal Olsen 4/21/ 2010 10:00-10:35A Dean University of Missouri Veterinary Medicine
3. Dr. Dan Getman 4/26/2010 3:00 – 4:05P, President Kansas City Area Life Sciences
4. Mr. Robert Walker 4/30/2010 10:00:10:45A Director of Communications Bayer Animal Health Sciences
5. Mr. Tony Simpson 7/14/210 9:00-9:30A Director of Commercialization, Heartland BioVentures Kansas Bioscience Authority
6. Mr. Tony Simpson 7/30/2010 Director of Commercialization, Heartland BioVentures Kansas Bioscience Authority – Telephone conversation
7. Ms. Kim Young 7/6/2011 2:30-3:15P VP BioScience Development, Kansas City Area Development Council
8. Ms. Catherine Dobson 7/27/2011 3:00-3:45P Catherine Dobson Government Relations & Policy Development
9. Ms. Gina Bowman 12/29/2011 12:00 noon to 1:05P Vice President, Government Relations - CVR Energy, Inc.
10. Dr. Carolyn Henry 1/12/2012 1:30- 2:00P PhD Oncology University of Missouri-Columbia, Facilitator One Health One Medicine Mizzou Advantage
11. Ms. Nora Lockton and Ms. Gina Bowman 12:30 – 1:00P 1/19/2012 Government Relations Kansas City Area Chamber of Commerce
12. Dr. Steve Wyatt 2/3/2012 11:00-11:40A Vice President University of Missouri Extension Economic Development
13. Mr. Bill Duncan 2/10/2012 10:00-11:15A Retired President Kansas City Area Life Sciences

14. Dr. Mike Nichols 2/21/2012 10:30-11:05A Vice President Research and Economic Development University of Missouri-System
15. Mr. Jeff Boiley 3/20/2012 11:00A -12:15P President & CEO Center for Animal Health Innovation

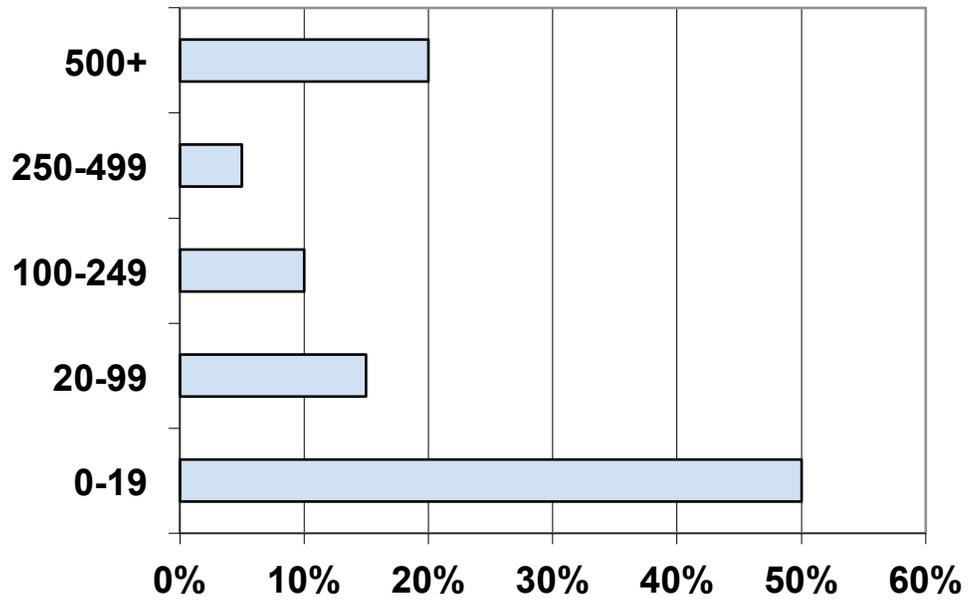
# APPENDIX D

ID	Outbound Links	Inbound Links	Unreciporated Linkes	ID	Outbound Links	Inbound Links	Unreciporated Linkes	ID	Outbound Links	Inbound Links	Unreciporated Linkes	ID	Outbound Links	Inbound Links	Unreciporated Linkes
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4	0	3	0	54	0	3	0	104	0	5	0	154	0	2	0
5	0	3	0	55	0	9	0	105	0	0	0	155	1	2	1
6	0	3	0	56	0	2	0	106	22	5	18	156	0	6	0
7	0	3	0	57	0	0	0	107	0	0	0	157	0	3	0
8	0	0	0	58	0	0	0	108	0	3	0	158	11	10	8
9	0	2	0	59	0	3	0	109	0	2	0	159	0	0	0
10	0	2	0	60	0	0	0	110	0	0	0	160	0	0	0
11	48	6	42	61	0	0	0	111	0	2	0	161	0	3	0
12	0	2	0	62	0	0	0	112	0	0	0	162	0	3	0
13	46	0	45	63	0	0	0	113	0	0	0	163	24	4	21
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18	0	1	0	68	0	0	0	118	0	3	0	168	0	6	0
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20	15	2	14	70	0	0	0	120	0	2	0	170	0	14	0
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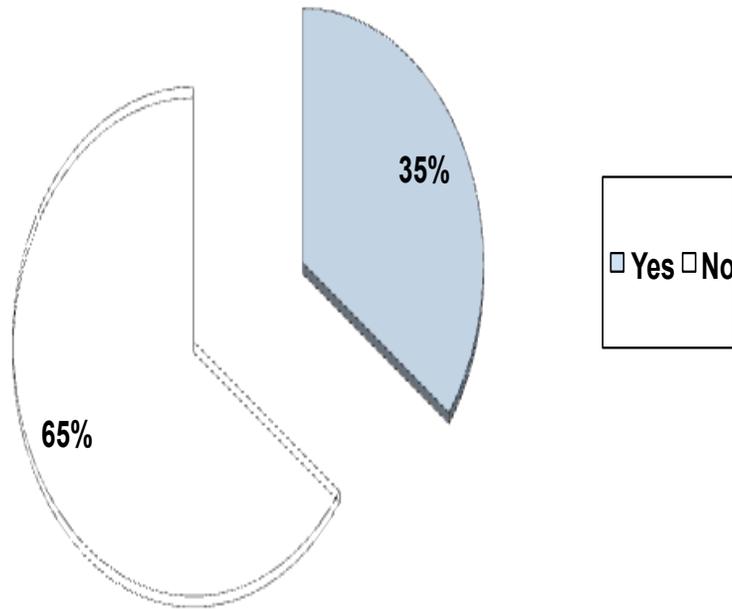
## Organizational Purpose



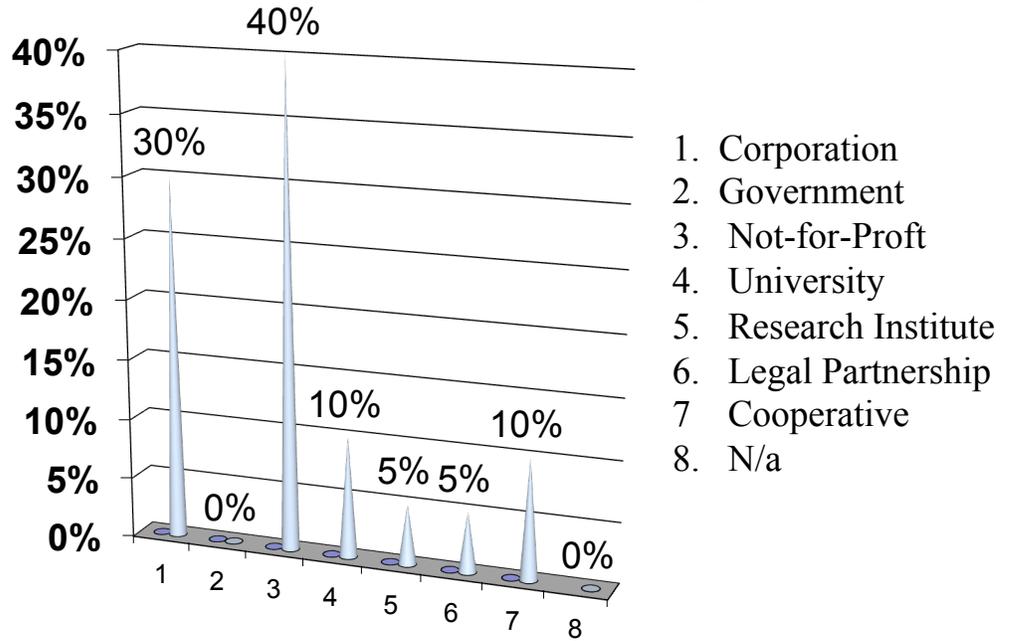
## Number of of Employees in the Region



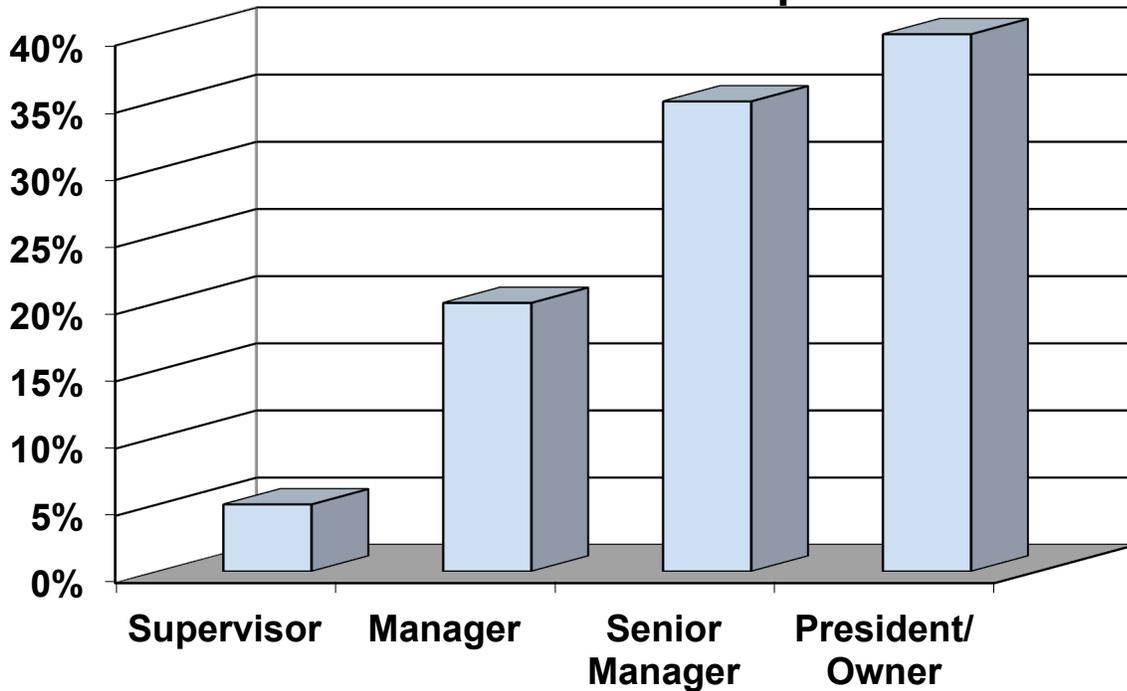
### Organizations With National Headquarters In the Region



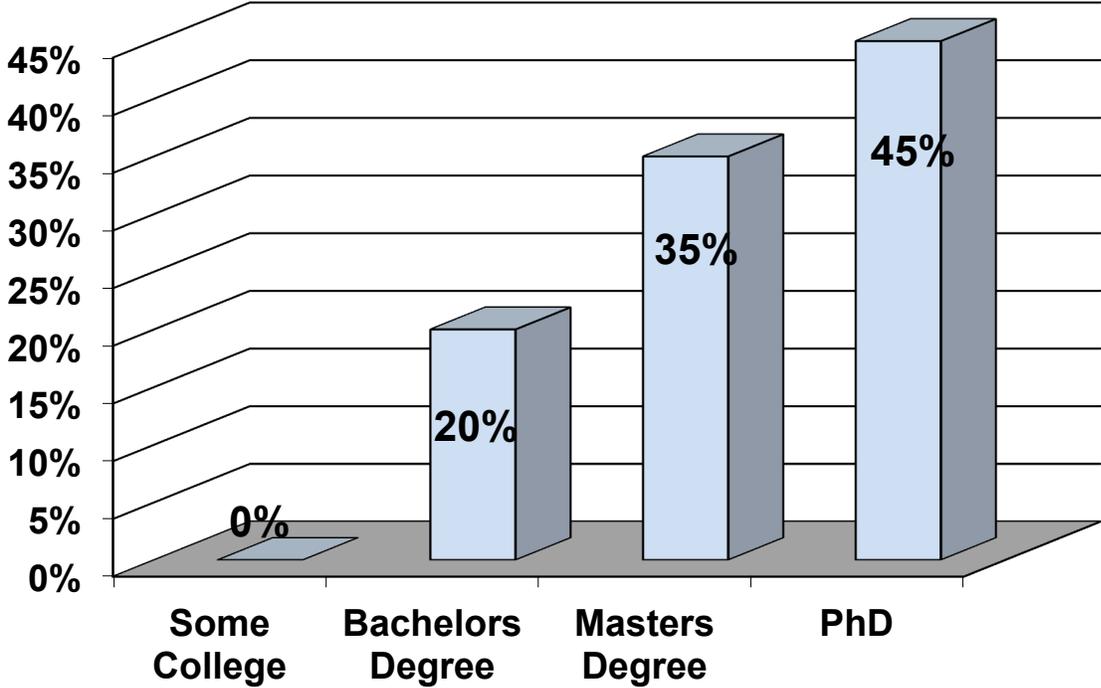
## Organization Description

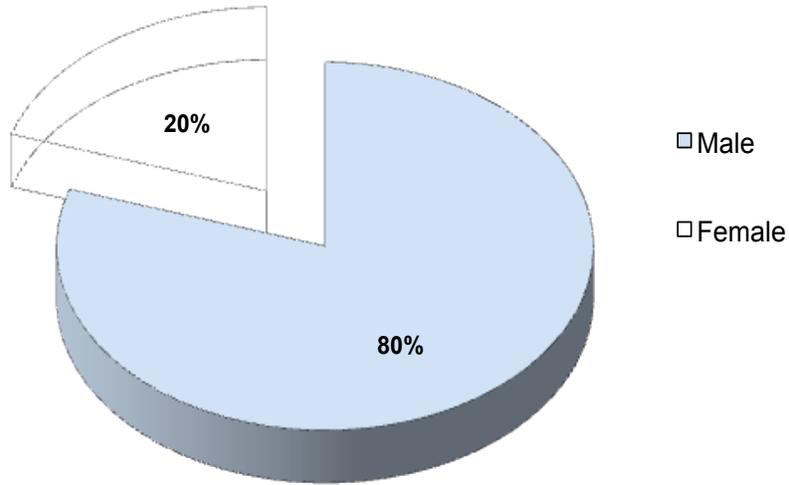


## Roles and Responsibilities

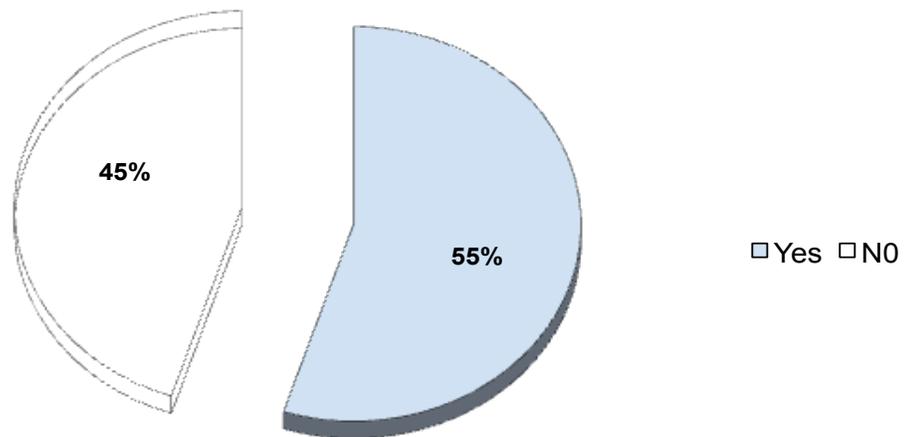


# Level of Education

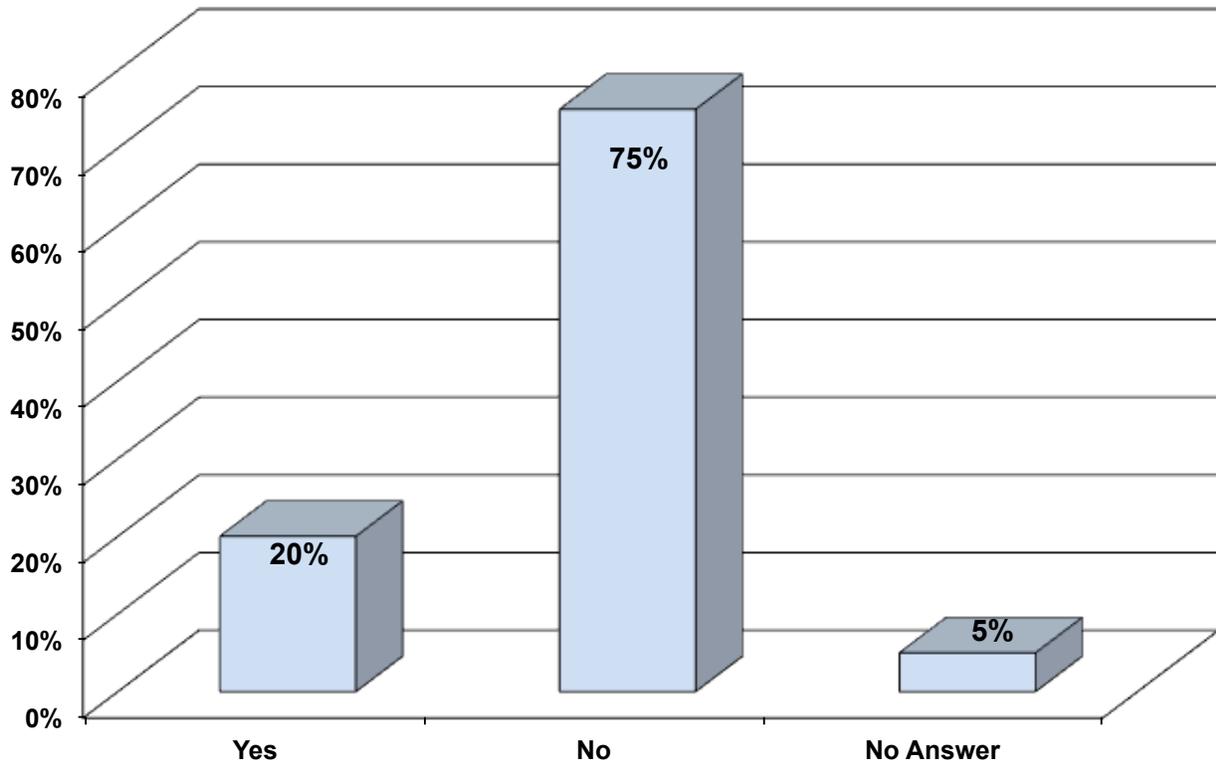




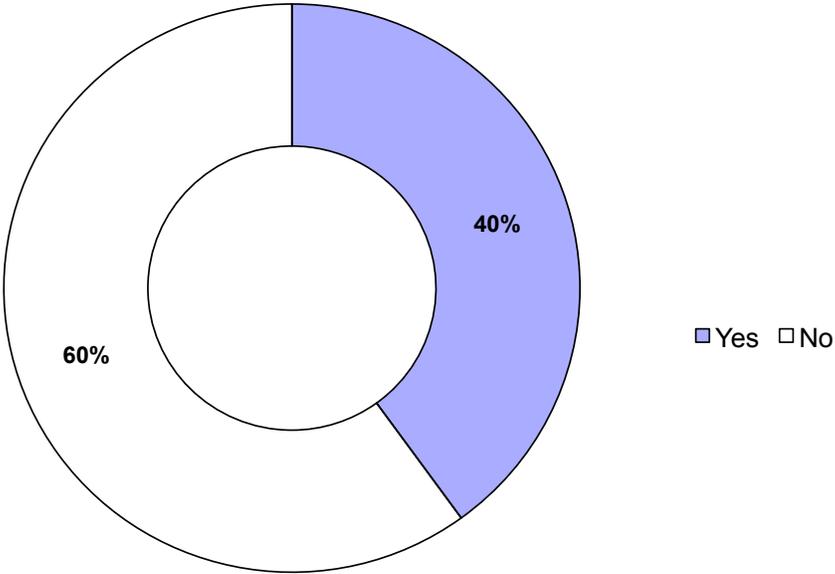
**Would you work in an innovation center with colleagues?**



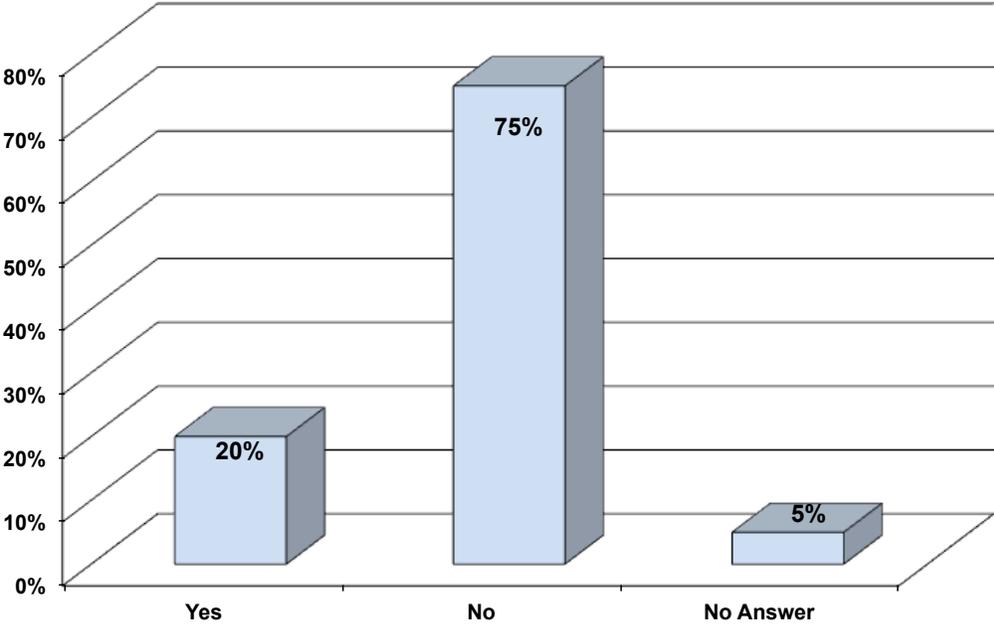
**Have you received value from any short-term relationships in the Corridor?**



**Has your organization received relationship specific benefits as a result on being in the Corridor?**



**Have you received value from any short-term relationships in the Corridor?**



# APPENDIX F

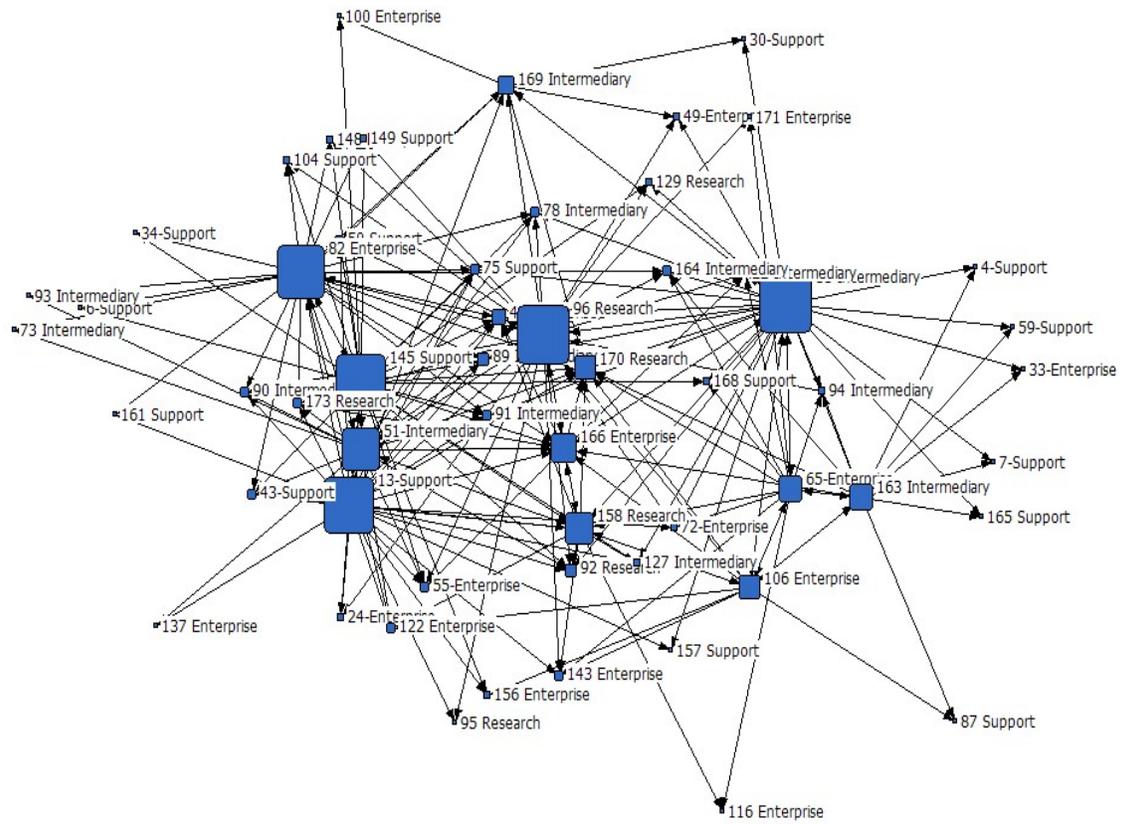
## Counties that make up the Metropolitan Areas from 1997-2009

Year	Columbia, MO Metropolitan Statistical Area	Lawrence, KS Metropolitan Statistical Area	Kansas City, MO-KS Metropolitan Statistical Area	St. Joseph, MO-KS Metropolitan Statistical Area	Manhattan, KS Metropolitan Statistical Area
2009	17860 29019 Boone County, MO 17860 29089 Howard County, MO	29940 20045 Douglas County, KS	28140 20059 Franklin County, KS 28140 20091 Johnson County, KS 28140 20103 Leavenworth County, KS 28140 20107 Linn County, KS 28140 20121 Miami County, KS 28140 20209 Wyandotte County, KS 28140 29013 Bates County, MO 28140 29025 Caldwell County, MO 28140 29037 Cass County, MO 28140 29047 Clay County, MO 28140 29049 Clinton County, MO 28140 29095 Jackson County, MO 28140 29107 Lafayette County, MO 28140 29165 Platte County, MO 28140 29177 Ray County, MO	41140 20043 Doniphan County, KS 41140 29003 Andrew County, MO 41140 29021 Buchanan County, MO 41140 29063 DeKalb County, MO	31740 20061 Geary County, KS 31740 20149 Pottawatomie County, KS 31740 20161 Riley County, KS
2007	17860 29019 Boone County, MO 17860 29089 Howard County, MO	29940 20045 Douglas County, KS	28140 20059 Franklin County, KS 28140 20091 Johnson County, KS 28140 20103 Leavenworth County, KS 28140 20107 Linn County, KS 28140 20121 Miami County, KS 28140 20209 Wyandotte County, KS 28140 29013 Bates County, MO 28140 29025 Caldwell County, MO 28140 29037 Cass County, MO 28140 29047 Clay County, MO 28140 29049 Clinton County, MO 28140 29095 Jackson County, MO 28140 29107 Lafayette County, MO 28140 29165 Platte County, MO 28140 29177 Ray County, MO	41140 20043 Doniphan County, KS 41140 29003 Andrew County, MO 41140 29021 Buchanan County, MO 41140 29063 DeKalb County, MO	31740 20061 Geary County, KS 31740 20149 Pottawatomie County, KS 31740 20161 Riley County, MS
2002	17860 2929019 Boone County, MO 17860 29089 Howard County, MO	29940 20045 Douglas County, KS	28140 20059 Franklin County, KS 28140 20091 Johnson County, KS 28140 20103 Leavenworth County, KS 28140 20107 Linn County, KS 28140 20121 Miami County, KS 28140 20209 Wyandotte County, KS 28140 29013 Bates County, MO 28140 29025 Caldwell County, MO 28140 29037 Cass County, MO 28140 29047 Clay County, MO 28140 29049 Clinton County, MO 28140 29095 Jackson County, MO 28140 29107 Lafayette County, MO 28140 29165 Platte County, MO 28140 29177 Ray County, MO	41140 20043 Doniphan County, KS 41140 29003 Andrew County, MO 41140 29021 Buchanan County, MO 41140 29063 DeKalb County, MO	31740 20061 Geary County, KS 31740 20149 Pottawatomie County, KS 31740 20161 Riley County, KS
1997	1740 29019 1 Howard County	Boone C 4150 20045 1	Douglas C Johnson County, KS Leavenworth County, KS Miami County, KS Wyandotte County, KS Cass County, MO Clay County, MO Jackson County, MO Lafayette County, MO Platte County, MO Ray County, MO Bates County, MO Franklin County, KS Clinton, MO Linn, MO	St. Joseph, MO MSA Buchanan County Doniphan County, KS Andrew County, MO DeKalb County, MO	Manhattan, Kansas Riley County Pottawatomie County Geary County

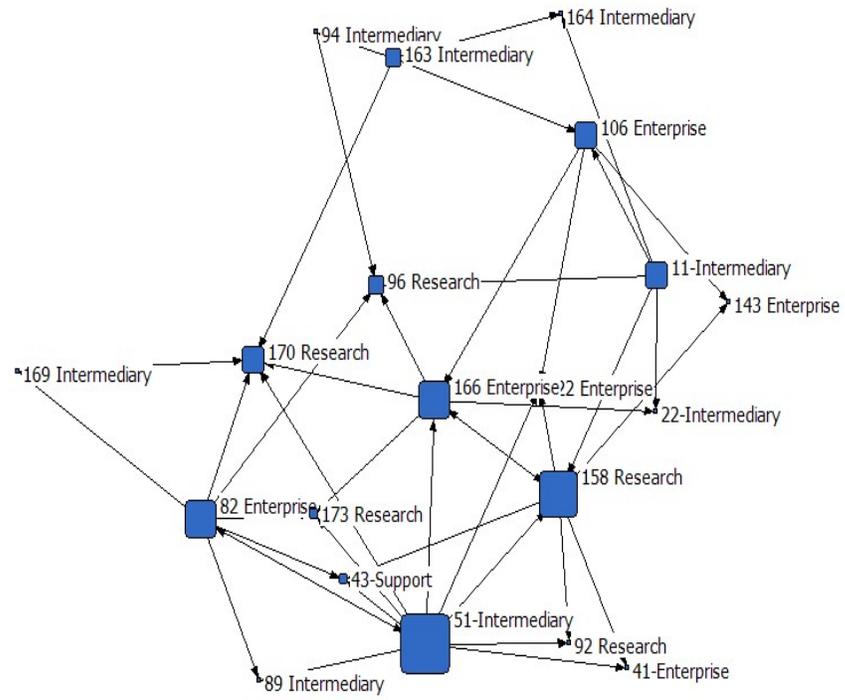
Source: <http://www.census.gov/population/metro/data/def.html>

APPENDIX G

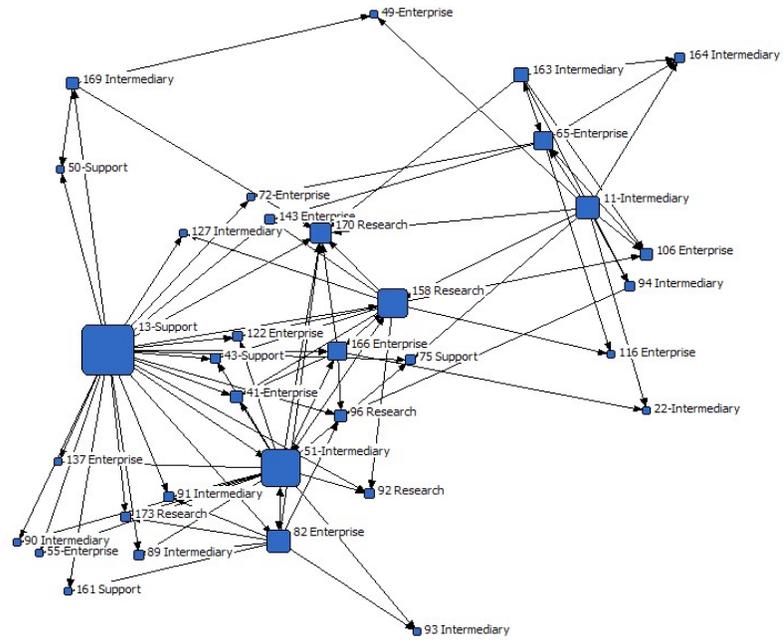
Question #14



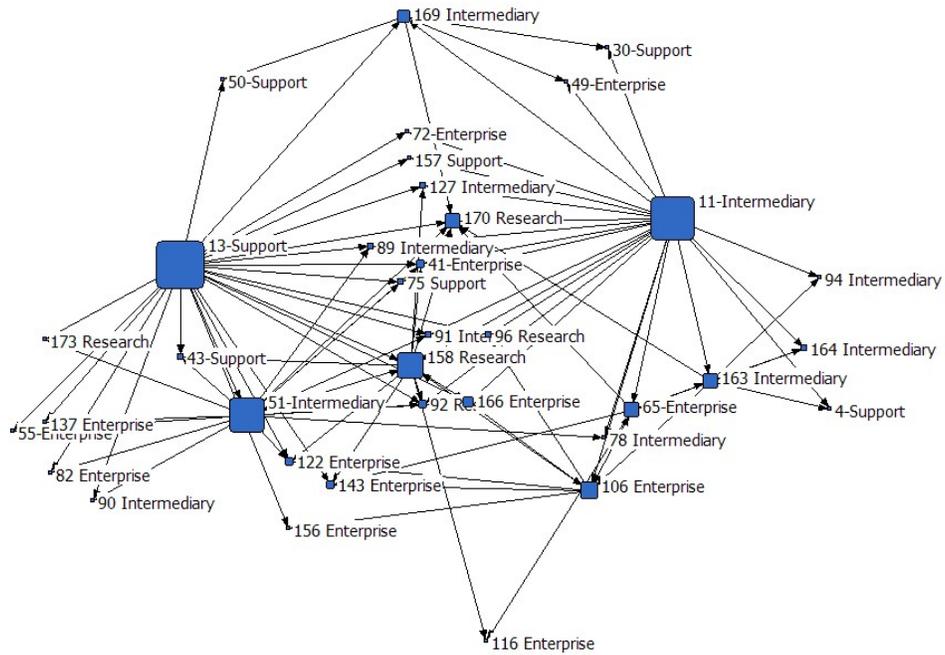
Question #15



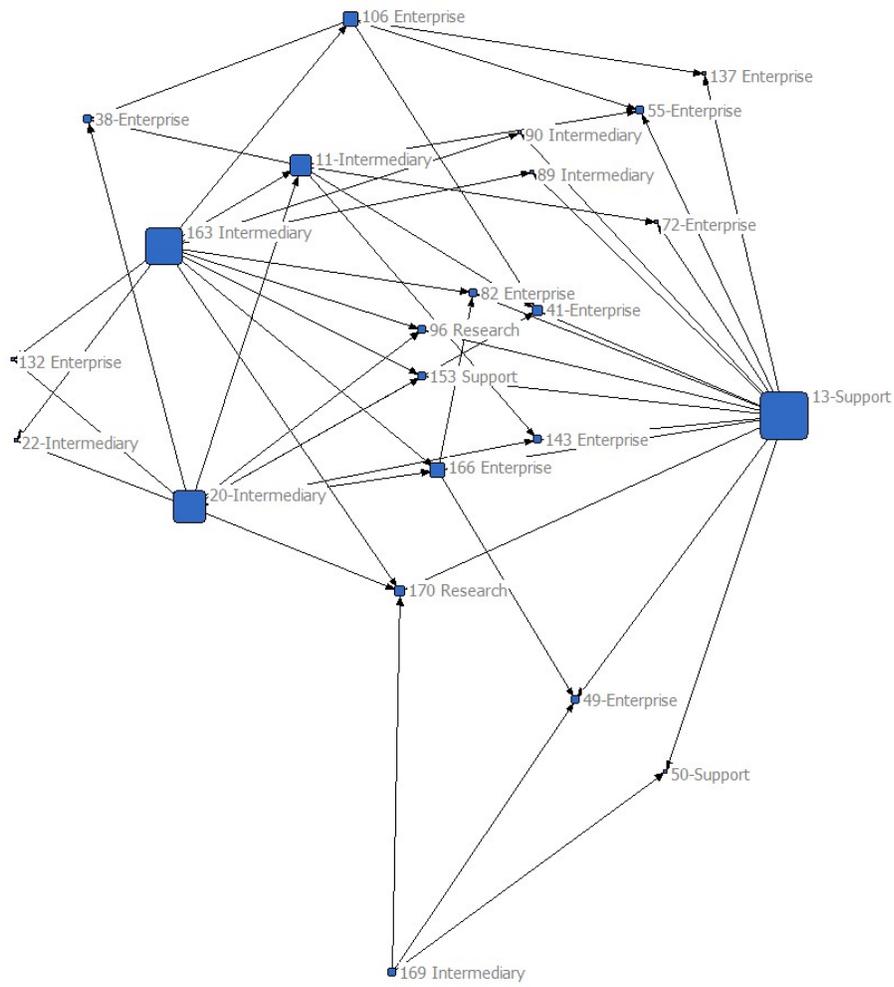
Question #16



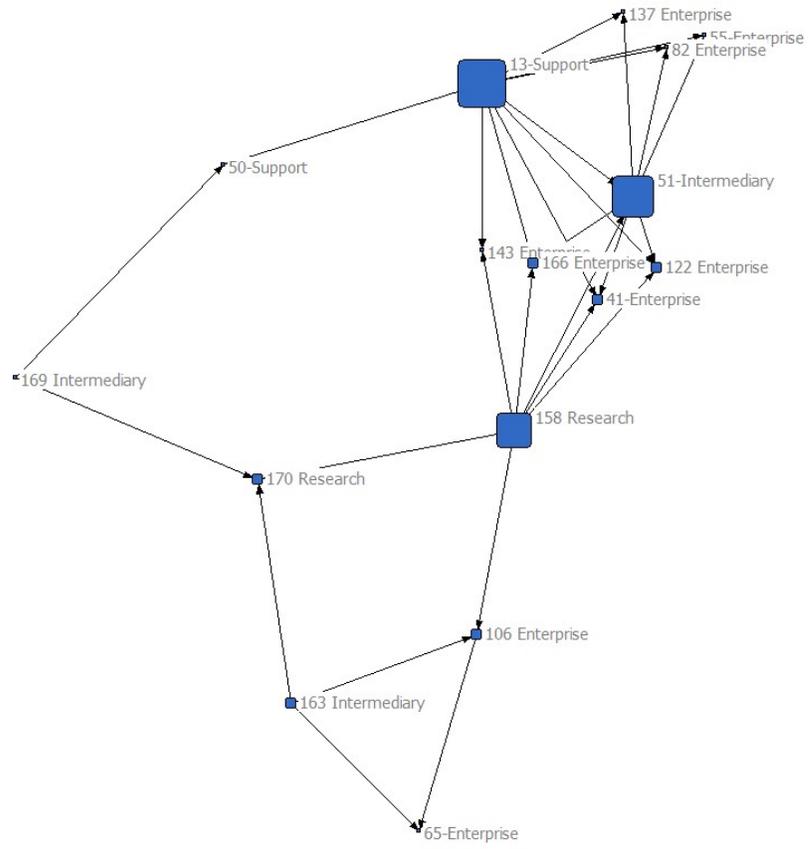
Question #17



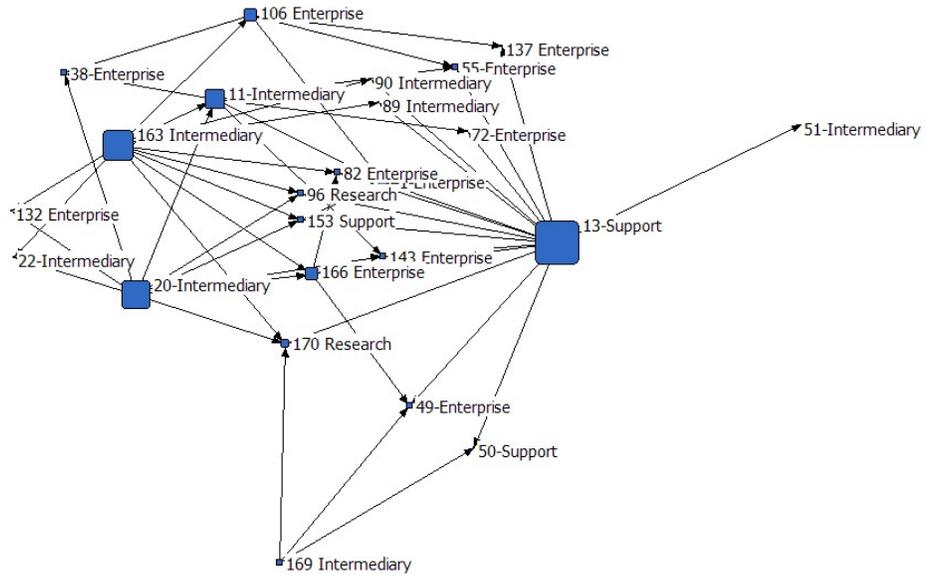
# Question #18



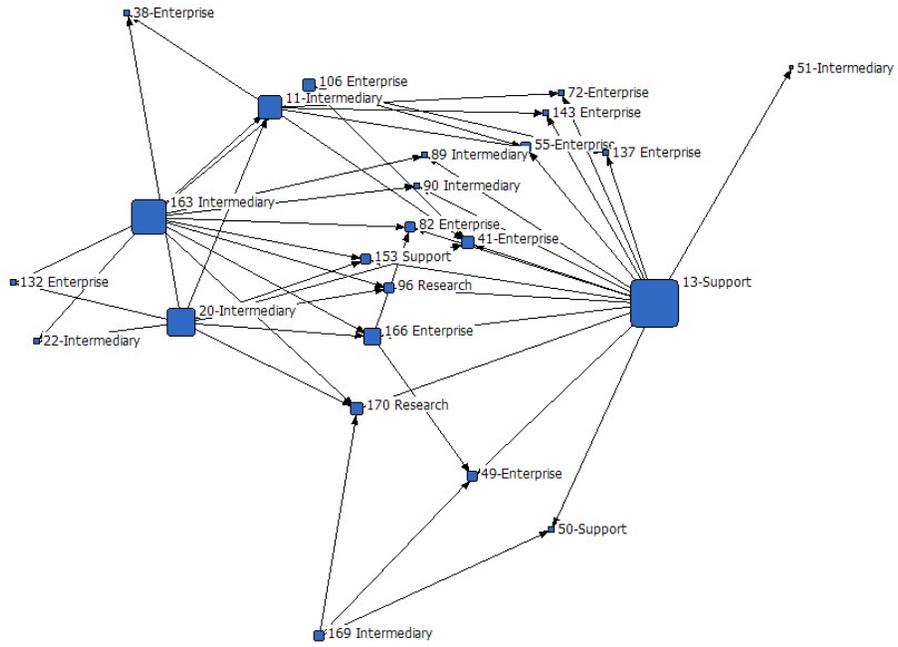
Question #19



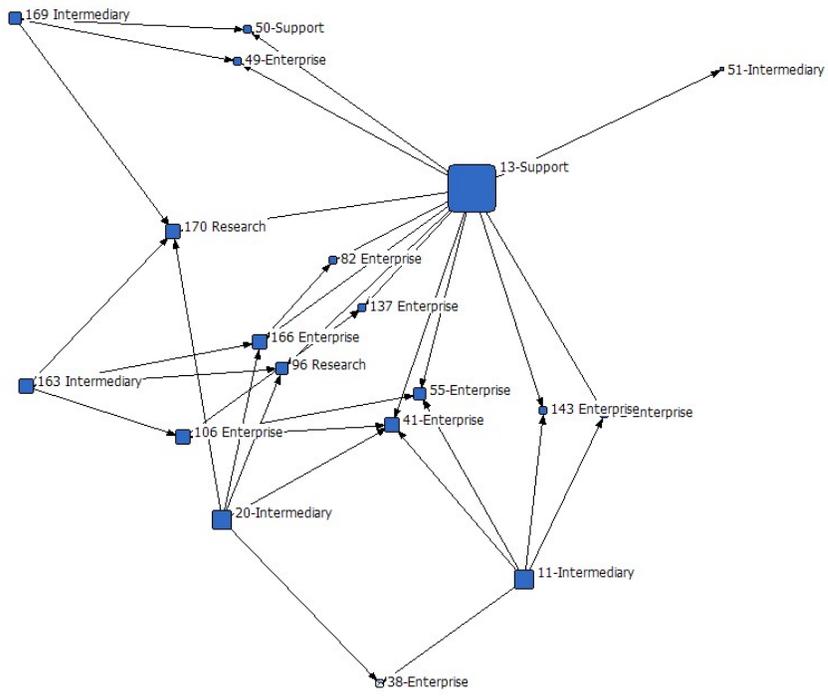
Question #20



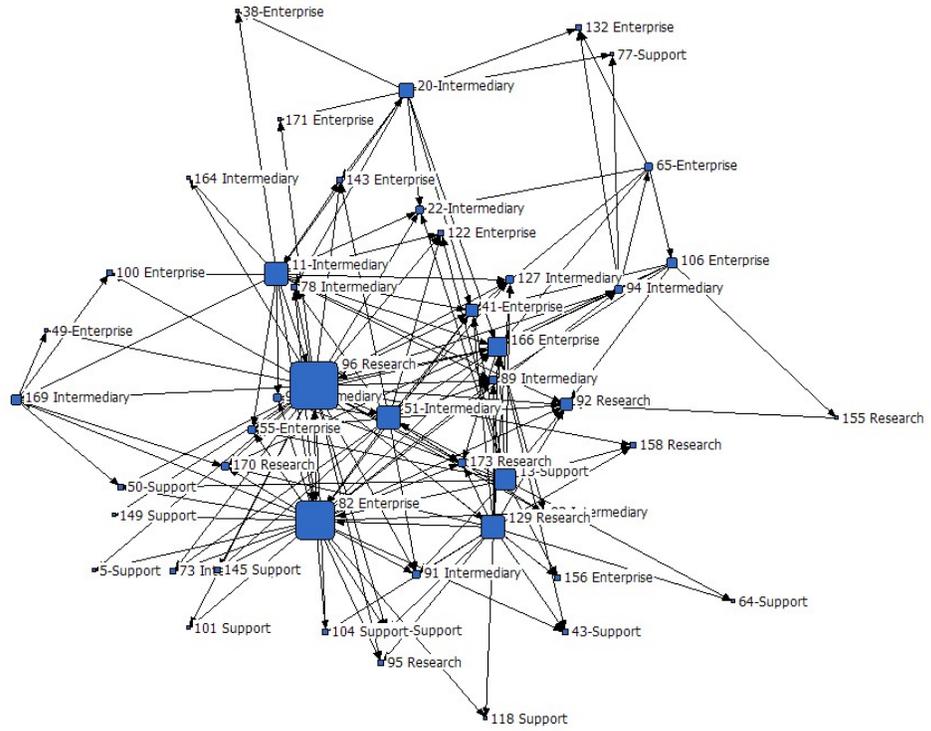
Question #21



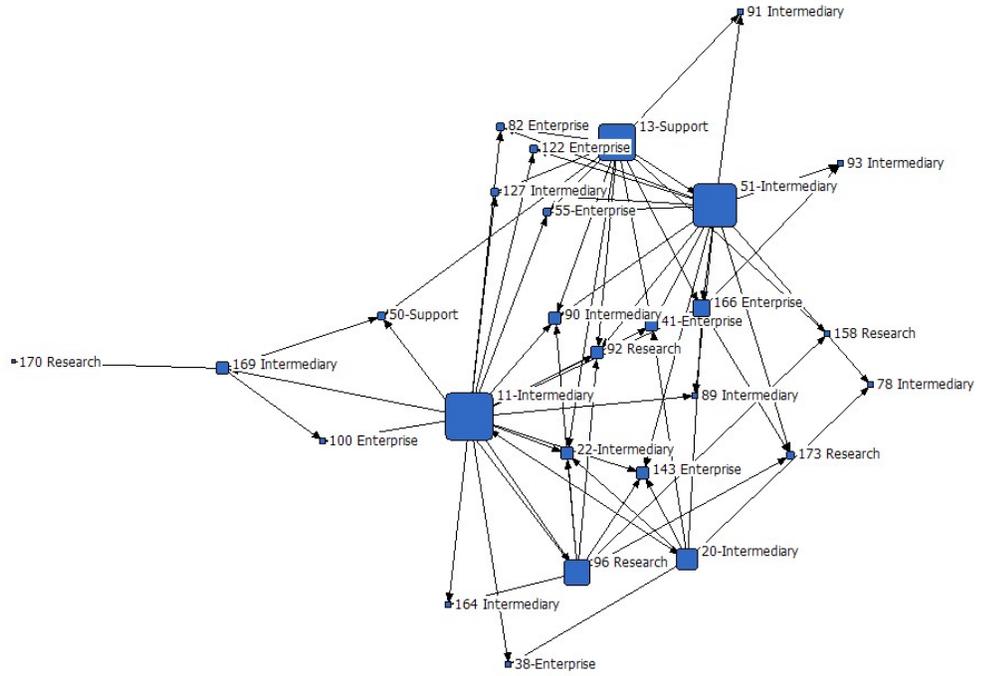
Question #22



Question #23



Question #24





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## VITA

Keith Harris' journey to complete a doctoral degree started after struggling to answer a seemingly simple question. That is, how do to live a life of significance? Keith already enjoyed a successful career in Corporate America. He been spent 20 years in the food industry and his work supported some of the world's most successful and recognizable food brands. His career experiences in the food supply chain gave him first-hand knowledge of how dynamic and challenged the food industry had become. The consolidation of companies in the industry, the volatility of input prices, and many newly formed trading relationships, partly characterized the evolving industry, which is responsible for providing food in "nutritionally acceptable and socially desirable manner".

In order to complement and augment his experience in the food industry and meet his life's objective, Keith decided to pursue a career in academia. The role of a college professor met the goals of significant living, which includes, among other things, setting examples for students and provided a life-long opportunity to apply knowledge. The completion of the doctoral program does not signal the end of the journey. Instead it represents the beginning of something significant.

One's work may be finished some day, but one's education never.

Alexander Dumas, c1856