

DIMENSIONS OF SOCIAL NETWORKS AS PREDICTORS
OF EMPLOYEE PERFORMANCE

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Research of social networks has revealed that certain components of network position can have an impact on organizational effectiveness, yet relatively little research has been conducted on network position and individual performance. This study sought to determine if a relationship exists between an employee's social network position and an individual's job performance.

The participant organization was a network of individuals within an Information Technology (IT) department at a major defense company. A social network analysis (SNA) was conducted to determine the employee's network position, measured by centrality and constraint. Centrality refers to the extent to which an individual is connected to others. Constraint refers to how constrained or inhibited an individual is within the network. Performance was measured by annual appraisal ratings provided by the employee's supervisor. Hierarchical regression analysis was performed to determine relationships between the dependent variable (performance) and independent variables of centrality and constraint. Secondary variables also studied in relation to the model included education level, service years (tenure), job grade, and age.

The overall model revealed 17% of variance explained. The primary predictors of network position, centrality and constraint, were not statistically significant predictors of performance ratings. Three variables, job grade, tenure and age, were found to be statistically significant predictors of employee performance. Further research is suggested to provide additional insight into the predictive value of these variables.

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CHAPTER 1

INTRODUCTION

Studies of employee social networks have revealed potential competitive advantages for organizations. Research has shown that “appropriate connectivity in well-managed networks within organizations can have a substantial impact on performance, learning and innovation” (Cross & Parker, 2004, p. vii). Individuals well-positioned in employee networks are more likely to be promoted, obtain higher salaries (Burt, 1992), show greater influence in decision making (Friedken & Johnson, 1998), and foster innovation (Ibarra, 1993a). However, relatively little research has been conducted on social network position and its relationship to individual employee performance (Sparrowe, 2001; Mehra, Kilduff & Brass, 2001; Ahuja, Galleta & Carley, 2003). This study seeks to determine if a relationship exists between an employee’s social network position and an individual’s job performance.

The participant organization for this study was a network of individuals within an Information Technology (IT) department at a major defense company. A social network analysis (SNA) was conducted to determine the employee’s network position, measured by centrality and constraint. Centrality refers to the extent to which an individual is connected to others. Constraint refers to how constrained or inhibited an individual is within the network. Performance was measured by annual appraisal ratings provided by the employee’s supervisor. Regression analysis was performed to determine relationships between the dependent variable (performance) and independent variables of centrality and

constraint. Secondary variables also studied in relation to the model included education level, tenure (years of service), job grade, and age.

Background

Social Capital

Recent interest in social networks has arisen from the popularization of social capital, which has emerged as a business competence, receiving wide attention in business journals and popular literature (Burt, 2005; Cohen & Prusak, 2001). Social capital refers to the advantages individuals possess by being connected to others. This advantage is created by a person's location in the structure of network relationships. Social capital "explains how people do better, because they are somehow better connected with other people" (Burt, 2005, p. 4).

Organizational benefits of social capital include enhanced knowledge sharing, lower transaction costs due to a high level of trust and cooperative spirit between coworkers, lower turnover rates, and greater coherence of action due to organizational stability and shared understanding (Cohen & Prusak, 2001). Additional benefits include privileged access to knowledge and information, preferential opportunities for new business, reputation and influence, and enhanced understanding of group norms (Inkpen & Tsang, 2005, p. 5).

Social network analysis has emerged as a tool for enabling social capital. A basic tenet of almost all social capital theories is that the network is one of the most powerful assets that any individual can possess (Cohen & Prusak, 2001):

Some prominent theorists believe that network-centrism will be *the* guiding principle of successful organizations in the near future, since networks so powerfully create and manage knowledge, enforce social norms, encourage commitment, and create more democratic workplaces. We have no doubt that networks are critical to organizational social capital and that investing in network vitality grows social capital. (p. 79)

Social capital is enhanced by an individual's network position in relation to other individuals, and is captured from the *embedded resources* in such networks (Granovetter, 1985; Lin, 1999). The social structure defines the kind of capital that can create competitive advantage (Burt, 2005):

Social capital has the potential to be a powerful technology applied to a critical issue. The technology is network analysis. The issue is performance. Social capital promises to yield new insights, and more rigorous and stable models, describing why certain people and organizations perform better than others. (p. 5)

Structural Holes

The concept of structural holes (Burt, 1992) redirected attention to the shape and typology of an individual's social network position as a key enabler of social capital. Structural holes are gaps in the social network across which there are no current connections between people. These gaps can be connected or "bridged" by individuals that can gain control over the flow of information across

the gaps. This “bridging of structural holes” is a key step to realizing the advantages of social capital (Kilduff & Tsai, 2003):

Individual actors (people, sub-units, organizations) have been portrayed as seeking to increase their social capital by performing a liaison role of connecting two otherwise disconnected cliques, or by bridging from one group to which they belong to another group that they join. Structural hole research focuses attention on the importance of these liaison and bridging ties. Actors (individuals) can leverage their investments in social relations by establishing relations with a diverse set of groups (preferably groups that are not connected to each other) rather than establishing all of their relationships with members of one group. (p. 28)

Centrality

Another core network measure is centrality, which refers to the extent to which a given individual is connected to others in a network. Centrality is considered “one of the most important and widely used conceptual tools for analyzing social networks. Nearly all empirical studies try to identify the most important actors within the network” (Everett & Borgatti, 2005, p. 57). Centrality is implicit in any discussion of social capital or structural holes (Kilduff & Tsai, 2003, p. 30), and has been associated with instrumental outcomes including power (Brass, 1984), influence in decision making (Friedken & Johnson, 1998), and innovation (Ibarra, 1993a).

Networks and Performance

Many studies have attempted to determine how social capital may impact learning, performance and effectiveness (Baker, 2000; Cross & Parker, 2004; Lin, 2001). However, relatively few studies have explicitly examined the link between network centrality and individual job performance (Sparrowe 2001; Flap & Volker, 2004). When such studies have been performed, results have been conflicting. One study found that employees occupying central positions in the workflow network were no more likely to be high performers than employees occupying less central positions (Brass, 1981). Another study found a positive relationship between the network centrality of master of business administration team members and grades (Baldwin, Bedell, & Johnson, 1997). Research on officers and enlisted men in three high-technology military organizations showed that people with two or more network contacts performed better than people with one or no network contacts (Roberts & O'Reilly, 1979). Mehra, Kilduff & Brass (2001) noted:

Previous work has focused on the effects of structural position on outcome variables such as power and promotions, but has offered little conclusive evidence concerning performance in organizations. Given these suggestive but inconclusive findings, it is useful to examine directly whether structural position predicts workplace performance. (p. 123)

This study acknowledges the importance of social capital, structural holes, and network centrality as key components in an employee's social network.

Analyzing these components in relation to individual performance will provide further data to the body of knowledge in this area and can potentially reinforce the capabilities of network position as a mechanism to realize competitive advantage.

Theoretical Framework

Researchers have considered the network approach as both a set of methods and a theory. Social network analysis has operationalized a range of important concepts including centrality, structural equivalence, and cliques, but “it is hard to argue that they constitute a theory” (Kilduff & Tsai, 2003, p. 36). Scott (1991) argued that social network analysis is an “orientation towards the social world that inheres in a particular set of *methods*. It is not a specific body of formal or substantive theory” (p. 37).

Others have claimed to detect in the social network approach “a theory of social structures” (DeGenne & Forse, 1994, p. 12). This study builds theoretical foundations of network analysis from prior work in social psychology. Balance theory was developed as a theory of cognitive consistency (Heider, 1958), focusing attention on the interpersonal structures of organizations and how individuals split into different tightly knit groups or cliques (Kilduff & Tsai, 2003, pp. 42-43). Social comparison theory (Festinger, 1954) noted that individuals learn about themselves by comparing themselves to others. People choose similar others with whom to compare, and social comparison has strong effects on attitudes and effects. We are drawn into friendships with similar others in order to evaluate our opinions and abilities.

Social comparison theory led to the principle of homophily, which emphasizes that people like to associate with others that are similar to themselves. In contrast, heterophily theory (Simmel, 1950) looks towards individuals who interact with others who are dissimilar from themselves. Simmel's concept of "the stranger" illustrates the individual who dwells in one society, yet retains allegiance to another (Kilduff & Tsai, 2003):

The stranger is a role that is both near and remote from the group within which he is embedded. Those occupying the stranger role can use their distant and proximate connections to *broker relations* between the groups within which they dwell and the groups with which they maintain distant relations. (p. 54)

Heterophily and balance theory led to the study of the strength of weak ties (Granovetter, 1973), which focused on the strength of interpersonal ties between individuals. A tie can be defined as a combination of the amount of time, emotional intensity, intimacy (mutual confiding), and reciprocal services between two individuals. The strength of the tie ranges from weak (characterized by relationships that are infrequent and distant) to strong (with relationships that are frequent, long-lasting, and affect-laden). According to the weak tie hypothesis, more diverse information is likely to derive from weak rather than strong ties (Granovetter, 1973). Burt's (1992) "bridging of structural holes" approach leveraged off of Granovetter's theory, in which individuals can take advantage of network position by maximizing weak ties through network position between specific groups.

The theoretical foundation of performance is based on the idea that the structure of social interactions enhances or constrains access to valued resources (Brass, 1984; Ibarra, 1993b). Resources exchanged through informal networks have substantial value, including work-related resources of task advice and strategic formation. This resource exchange is likely to be positively related to job performance (Sparrowe, 2001, p. 317).

Statement of the Problem

Network analysis has revealed key components of social networks in relation to employee effectiveness, yet there has been relatively little research concerning network position and individual performance (Flap & Volker, 2004; Mehra, et al., 2001; Sparrowe, 2001). Rather than focusing on direct performance measures, many researchers rely on proxies for performance, such as work satisfaction and commitment (Brass, 1984), absenteeism (Sanders & Hoekstra, 1998), rank and timing of promotion (Burt, 1992; Erickson, 2001; Podolny & Baron, 1997), income (Burt, 2000b) and influence (Ibarra, 1993a). However, “direct studies on networks and job-performance are practically non-existent” (Flap & Volker, 2004, p. 174). This study attempts to clarify the relationship between network position and employee performance.

The concept of social capital has been promoted in popular literature as a cure for many ills in society, yet the term lacks definition and clarity. Regarding networks and performance, studies often “lack a theoretical grounding and do not conceive of networks as social capital. Cohesion and performance are mainly discussed on the group level” (Flap & Volker, 2004, p. 173). This study is an

attempt to address these discrepancies by defining and measuring social capital as a form of network position.

From a Human Resources (HR) standpoint, individual performance is a vital measure of employee effectiveness that virtually all organizations develop and monitor through performance management systems and methods. Millions of dollars a year are spent on state-of-the-art performance management systems, developed to enable employees and organizations to succeed. If network analysis can reveal key social network components that are related to employee performance, individuals and organizations could benefit and gain competitive advantage in the marketplace.

Purpose of the Study

The purpose of this study is to determine whether a relationship exists between network position and employee performance. Measures of network position include centrality and constraint, while performance is measured by individual performance appraisal ratings obtained from company HR records. Additional secondary variables analyzed in relation to the model include education level, tenure (years of service), job grade, and age. Results from this study may reinforce previous findings that there is a relationship between network measures and employee effectiveness, which could enable competitive advantage within organizations.

Limitation

A limitation of this study is that the tools used for data collection were part of client property, including the social network analysis survey.

Delimitation

Delimitations of the study include the fact that data collection was limited to one sample (an existing department within the Information Technology division of the company). One-site sampling schemes are not uncommon in network analysis, as a clear network boundary can be defined under social network research design (Krackhardt, 1988).

Definition of Terms

Actor – a discrete individual, organization, event, or collective social entity that links to others in a network. Also known as “node.” Typically considered the primary individual of study within a network.

Alters – the set of nodes (or actors) that the ego has ties with.

Balance – incorporates the notions of reciprocity and transitivity. A network with a high degree of balance is one in which a tie between two people tends to be reciprocated, and if two people have a common tie to a third person, then the two people tend to have a direct tie to each other.

Betweenness Centrality – the extent to which an actor serves as a potential “go between” for other pairs of actors in the network by occupying an intermediary position on the shortest paths connecting other actors.

Bridge – a strong (or weak) relationship for which there is no effective indirect connection through third parties. In other words, a bridge is a relationship that spans a structural hole. The relationship between two people is a hole-spanning bridge when there is no effective indirect connection between the people (Burt, 2005, p. 24).

Brokerage – the ability to broker or pass information between people: “The social capital of structural holes comes from the opportunities that holes provide to broker the flow of information between people, and shape the projects that bring together people from opposite sides of the hole (Burt, 2005, p. 19).

Centrality – the degree to which the network of individuals revolves around a single individual. Refers to the extent to which an individual occupies a central position in the network in one of the following ways: having many ties to other actors (degree centrality); being able to reach many other actors (closeness centrality); connecting other actors who have no direct connections (betweenness centrality); or having connections to centrally located actors (eigenvector centrality) (Kilduff & Tsai, 2003).

Clique – a group in which (a) all actors have direct ties with all other actors in the group, and (b) there is no outside-the-group actor to whom all group members have a tie (Kilduff & Tsai, 2003).

Closeness Centrality – the extent to which the most direct paths connecting an actor to each of the other actors in a network are short rather than long. This measure is only meaningful only for a fully-connected network in which there are

no isolated actors. A high closeness score means an actor can access many other actors and is therefore relatively independent of the control of others.

Constraint – a summary measure that varies with three qualities of the network: size, density, and hierarchy (Burt, 2004, p. 362). Constraint is used to measure brokerage. Constraint on an individual is high if an actor's discussion partners talk a lot to one another directly (dense network) or if they share information indirectly via a central contact (hierarchical network). More constrained networks span fewer structural holes, so performance and the value of an actor's ideas should have a negative association with network constraint.

Degree Centrality – the number of connections that an actor has in a network. It can be broken down into two components: in-degree centrality (e.g., the number of people who ask the actor for advice) and out-degree centrality (e.g., the number of people the actor gives advice to).

Density – the measure of how many connections there are between actors, compared to the maximum number of connections that could exist between actors: the higher the proportion, the more dense the network. If all actors are isolates, density = 0; if all actors are connected to other actors, density = 1.

Dyad – two actors connected by a tie. Thus, a friendship dyad consists of two friends.

Ego – the primary actor (or “node”) in a network of individuals.

Eigenvector Centrality – a measure of actor centrality that takes into account the centrality of the actors to whom the focal actor is connected (Bonacich, 1987).

Thus, an actor whose three friends have many connections will have higher eigenvector centrality than an actor whose three friends have few connections.

Embeddedness – generally refers to either the overlap between social ties and economic ties or the nesting of social ties within other social ties. An actor's behavior is embedded to the extent that he or she tends to transact with exchange partners who are personal friends or kin; or if their exchange partners tend to transact with each other (Granovetter, 1985; Uzzi, 1996).

Homophily – the tendency for actors to interact with, and share the opinions and behaviors of, other actors similar to themselves on such dimensions as ethnicity, age, educational attainment, and gender, etc. (McPherson, Smith-Lovin & Cook, 2001).

Isolate – an actor with no ties to any other actor in the network.

Reachability – one actor can reach another actor in the network if there is a path connecting the two actors, that is, a way for actor A to get a message or a resource to actor B either directly or through intermediaries. A reachability matrix is one that represents, for each pair of actors, whether one can reach the other or not.

Reciprocity – a balance theory principle concerning the expectation that if A has a tie (such as friendship) with B, that tie will be reciprocated by B (i.e., B will be friends with A). The extent of reciprocity in a network can be assessed as the number of reciprocated ties divided by the number of dyads.

Social Capital – At the individual level, social capital consists of the benefits that accrue to an actor as a result of the actor's social network connections (Burt,

2000b). At the communal level, social capital consists of “civic spirit grounded on impartial application of the laws” (Portes, 2000; Putnam, 1996).

Social Isolate – an individual in a network who has no ties to others.

Social Network – a set of actors and the relations (such as friendship, communication, advice) that connect them.

Strength of Tie – measured as a “combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and reciprocal services which characterize the tie” (Granovetter, 1985, p. 1361). Strong ties are those social relationships that are frequent, long-lasting, and affect-laden (Krackhardt, 1992), whereas weak ties are “infrequent and distant” (Hansen, 1999, p. 84).

Structural Hole – a gap between two actors or two clusters of actors (A and B) that can be spanned by another actor (C), who may, thereby, become the only member to belong to both A and B (if these are clusters), or who serves as the only intermediary between A and B.

Two-step Reach – the percentage of the network which can be reached by an actor (individual) in two steps or less. Considered a measure of network centrality.

Network Size – the number of contacts in a network (N).

CHAPTER 2

OVERVIEW OF THE LITERATURE

This chapter emphasizes the recent literature of both theoretical and empirical work concerning social capital and networks. It reviews findings on structural hole theory as a core enabler of network performance. The focus of this study is on network components of centrality and constraint in relation to individual performance.

Social Capital

Social capital has become a core concept in business, political science, and sociology, with an increasing number of research articles and chapters on the topic. The term social capital “appears across the internet as a business competence, a goal for non-profit organizations, a legal category, and subject of university conferences” (Burt, 2005, p. 5). While the concept of social capital has found widespread popular acceptance (Cohen & Prusak, 2001; Putnam, 2000), there has remained an uncertainty about its meaning and effects (Koka & Prescott, 2000). The multifaceted nature of social capital “has resulted in a bewildering array of definitions and measurements of the concept” (Flap & Volker, 2004, p. 7).

Coleman (1988) defined social capital as a function of social structure producing advantage, and Burt (1992) noted “the advantage created by a person’s location in a structure of relationships is known as social capital” (p. 4).

Others stressed that social capital is comprised of the “stock of active connections among people based on trust, mutual understanding and shared values and behaviors that bind members of human networks and communities and make cooperative action possible” (Cohen & Prusak, 2001, p. 4). Social capital can be defined, at the individual actor level, as the potential resources inherent in an actor’s set of social ties, and social capital leads to the “benefits that accrue to the collectivity as a result of the maintenance of positive relations between different groups, organizational units or hierarchical levels” (Kilduff & Tsai, 2003, p. 26).

A central component of social capital is the development of individuals by forming relationship networks of people in key groups, departments, or organizations. Through social capital, individuals can develop network ties with others. These ties actually become social capital resources between the two groups (Inkpen & Tsang, 2005, p. 7).

Structuralist vs. Connectionist Approaches

The “structuralist” and “connectionist” approaches of social capital reflect two contrasting perceptions of an individual’s role within the social world. The structuralist approach (Burt, 1992) focuses on the structure or configuration of ties in a social network. This topological emphasis tends to neglect the content of ties and focuses on patterns of interconnections (Borgatti, 2003, p. 1002). This approach was championed by Blau (1977) and others (Mayhew, 1980; Wellman, 1988), where networks are seen as defining the individual’s environment and his

or her context of action, as well as providing opportunities and constraints on behavior (Borgatti, 2003, p. 1000).

In contrast, the connectionist approach (Coleman, 1988; Lin, 2001) focuses on the individual's personalities and their unique capabilities that can *transcend* the social structure. This approach calls for a network where individuals are able to coordinate with each other for mutual help and sharing (Coleman, 1988). Coleman's view is similar to that of Putnam (2000) who defines a group's social capital in terms of broad cross-cutting interconnections among all group members (Borgatti, 2003, p. 994). The connectionist perspective implies that an individual's success is a function of the quality and quantity of resources controlled by the individual's "alters," or connected individuals (e.g., Anand & Khanna, 2000; Oliver, 2001).

The connectionist approach can be considered a more "cooperative" approach to social capital, where individuals see networks as a basis of identity that convey a sense of belonging to the group (Podolny & Baron, 1997). An individual's ties with others are considered conduits where one can obtain additional information and resources. Coleman's view stressed that a cohesive network is a resource to its members in the sense that it promotes the willingness to cooperate with and provide help to others (Flap & Volker, 2004).

In contrast, the structuralist view focuses on an individual's potential advantages within the network in the spirit of competition with others. This approach allows one individual to "play off of others" to obtain competitive advantage (Flap & Volker, 2004, p. 176). This view notes that two individuals will

have similar outcomes (e.g., adopt the same point of view) because they occupy structurally similar positions, even if there is no tie connecting them. The structuralist emphasis is on the structure of the network determining action. The individual has an advantage in competitive situations if those who are connected to him do not have ties to each other (Flap & Volker, 2004). Borgatti (2003) noted:

Studies that examine the *consequences* of the network are typically consistent with a structuralist agenda. In contrast, studies that examine the causes of network variables often clash with structuralism because they explain the network in terms of actor personalities and latent propensities (e.g., Mehra et al., 2001), which is an anathema to the strong structuralist position (Mayhew, 1980).
(p. 1000)

The structuralist approach emphasizes the possibilities for action that social ties provide the individual, accompanied by a “rational actor” assumption to social capital theory to the effect that actors deliberately choose their ties in order to maximize gain. This instrumental, individual-oriented aspect of social capital contrasts with the environmental determinism found in much diffusion (e.g., Valente, 1995) and social influence research (Friedken & Johnson, 1999). The contrary (connectionist) approach emphasizes the homogeneity in actor attitudes, beliefs and practices (Borgatti, 2003, p. 1002).

The structuralist approach embraces the study of social networks as a mechanism to enhance social capital (Burt, 2005). This approach to social capital

has led to many studies to attempt that find relationships between social capital and desired outcomes. The connectionist approach has been found to be lacking in many facets of social capital (Flap & Volker, 2004):

There always seem to be exceptions to the associations between networks and their effects. For example, social support does not always lead to better health (Tijhuis, 1994). Moreover, effects of networks seem to be conditioned by institutions (Stinchcombe, 1989). Furthermore, networks and social support do not cure all problems (Fischer, 1982). (p. 4)

Research has shown that for social capital benefits to be realized, it is not so much the number of people offering help nor the cohesion within the social network that makes the difference, but rather, the specific resources within one's network that are critical (Moerbeek, Ultee, & Flap, 1995). Rather than an individual's social network position serving as the "solution" to enable social capital, an individual's *choice of resources* makes the true difference.

Rather than focusing on network position, some researchers measure social capital in terms of manager/subordinate relationships. This may include (a) the intensity of relations to boss and colleagues; (b) the quality of the relation between boss and colleagues; (c) the density of the advice network at work; and (d) the relative number of work relations in the personal network (Flap & Volker, 2004, p. 183).

Critics of the structuralist approach have argued that the notion of an individual "investing in resources" in the network actually fails in practice.

Important elements of social capital such as trust actually accrue as a by-product of social interaction, and the reward that arises from it is intrinsic to the interaction itself (Arrow, 1999). Others doubt that there is any instrumental value incorporated in the social capital concept at all (Solow, 1999). Even supporters of the concept admit that not all social capital needs to be the result of a conscious investment decision (Riedl & Van Winden, 2004). Social capital should “not be recognized as a universal good” (Flap & Volker, 2004, p. 11-12), and the negative side of such capital should be considered as well – “the so-called ‘dark side’ in which social ties imprison actors in maladaptive situations or facilitate undesirable behavior” (Borgatti, 2003, p. 994). Individuals with a high degree of social capital have been shown to leave firms at a higher degree than others, leading towards organizational exit (Krackhardt & Porter, 1986).

Social Capital: A Consensus

A more robust approach to social capital and the creation of value in firms was presented by Nahapiet & Ghosal (1998), built on the formulation of value creation arising from the combination and exchange of resources. This approach identified three dimensions of social capital: structural, relational and cognitive, which theoretically justified how attributes of each of these dimensions facilitate the combination and exchange of resources within firms.

Although scholars differ on a concise definition and approach, the premise behind the notion of social capital refers to people deliberately investing in social relationships in the anticipation of beneficial returns (Coleman, 1988; Lin, 2001). Social capital remains a relational resource, enabling individuals to realize their

goals or defend their interests (Flap & Volker, 2004, p. 5). The concept encompasses the ability of individuals to secure benefits by virtue of membership in a network of individuals (Portes, 2000).

Social Capital Benefits

Many studies have been performed to determine how social capital may impact learning, performance, and effectiveness (Baker, 2000; Cross & Parker, 2004; Lin, 1999, 2001). Social capital has been claimed to provide significant organizational benefits, including power (Brass, 1984), leadership (Sparrowe & Liden, 1997), mobility (Boxman, De Graaf & Flap, 1991), and employment (Fernandez, Castilla & Moore, 2000). An individual's position within social networks can confer advantages such as organizational assimilation (Sparrowe & Liden, 1997); promotions (Burt, 1992); enhanced knowledge sharing; lower transaction costs due to a high level of trust and cooperative spirit; lower turnover rates; and greater coherence of action due to organizational stability and shared understanding (Cohen & Prusak, 2001). Researchers have found that individuals with a high degree of social capital have privileged access to knowledge and information, preferential opportunities for new business, reputation and influence, and enhanced understanding of group norms (Inkpen & Tsang, 2005). Certain types of social networks can enhance knowledge transfer and learning (Hansen, 1999; Reagans & McEvily, 2003). Social interaction as a manifestation of structural dimensions of social capital and trust is significantly related to the extent of interunit resource exchange, which in turn has a significant effect on product innovation (Tsai & Ghosal, 1998). Their research indicated clear

performance implications for the role of intrafirm or intraunit networks by showing how social capital contributed to product innovations at the business unit level.

This is consistent with the argument that organizational advantage can be achieved through resource sharing among different organizational units (Ghosal & Moran, 1996).

Structural Capital

Network studies of social capital, or *structural capital*, focus on benefits that individuals receive by either (a) occupying a central position within the network (Brass & Burkhardt, 1993; Powell, Koput & Smith-Doer, 1996), or (b) having a network with a certain structure that enables these benefits to be realized (Burt, Hogarth, & Michaud, 2000; Coleman, 1988). An individual's position in the network is described in terms of a desirable pattern of ties or relationships among between other members. The benefits to the individual are principally a function of the topology of the local network, and ties are implicitly conceived of as forming a leverage able structure (Markovsky, Skvoretz, Willer, Lovaglia & Erger, 1993). Structural capital studies seek to relate the network structure of a group to its performance (e.g., Athanassiou & Nigh, 1999). This kind of study started with the work of Bavelas (1950) at MIT, who investigated the relation between centralization and group performance (see review by Shaw, 1971).

Structural Holes

To illustrate the advantages of social capital, Burt (1992) posed the concept of structural holes. Individuals within a social network form clusters of

friends, such as acquaintances and business associates. For example, an individual in cluster A rarely passes information to an individual in cluster B. Gaps between clusters are holes in the structure of information flow, or more simply, structural holes (Burt, 2005, p. 16). These structural holes are the empty spaces in social structure, or “gaps in the social world across which there are no current connections” between individuals (Kilduff & Tsai, 2003, p. 28). Individuals with a high degree of social capital bridge the gaps created by such holes (Burt, 2005, p. 24). These individuals are able to access more information by being exposed to more new and varied bits of information, and in turn become more effective employees (Burt, 2005):

A person whose network spans structural holes has contacts in multiple groups which can be an advantage in terms of breadth of knowledge, early knowledge, and opportunities for strategically coordinating across groups. A hole-spanning network that provides these advantages is social capital. People who have the social capital of brokering connections across structural holes have an advantage in detecting and developing rewarding opportunities, since previously unknown information can be obtained and utilized. (p. 55)

There has also been interest in the ways that the absence of ties between individuals defines the structure of the network and the opportunities to build social capital (Borgatti, 2003). Research on balance theory studied the absence of ties between individuals who have friends in common (e.g., Holland & Leinhardt, 1977). This pioneering work on block-modeling aimed to discover, in

any social network, the “zero-blocks,” or the groups between which there are few or no connections (Lorrain & White, 1971). This work led to the current interest in structural holes.

Burt’s (1992) structural hole approach is consistent with Granovetter’s (1973) “strength of weak ties” theory. Researchers often refer to the strength of an interpersonal tie, which can be defined as a “combination of the amount of time, the emotional intensity, the intimacy (mutual confiding) and reciprocal services which characterize the tie” (Granovetter, 1973, p. 1361). The strength of the tie ranges from weak (characterizing relationships that are infrequent and distant) to strong (relationships that are frequent, long-lasting, and affect-laden). According to the weak tie hypothesis, more diverse information is likely to derive from weak rather than strong ties (Granovetter, 1973). Burt’s “bridging of structural holes” approach serves as a mechanism that enables weak ties to flourish.

Research has shown that individuals who can effectively span structural holes gain greater advantages. Senior managers who span structural holes are more likely to be promoted early (Podolny & Baron, 1997). Loan officers with networks that span structural holes were shown to be more likely to bring a deal to closure (Mizruchi & Sterns, 2001). People whose networks bridge the holes “are brokers rewarded for their integrative work, rewarded in the sense of more positive individual and team evaluations” (Burt, 2005, p. 7). In a French chemical firm, salary increases were more likely for individuals who span structural holes (Burt, et al., 2000). Mehra, Kilduff & Brass (2001) found that supervisors in a

small technology company gave higher performance evaluations to employees whose networks bridged otherwise disconnected parts of their organizations.

Organizations with management and collaboration networks that bridge structural holes seem to learn faster and be more productively creative (Burt, 1992, p. 9). Geletkanyca & Hambrick (1997) reported higher company performance when top managers have boundary-spanning relationships beyond their firm and industry, and McEvily & Zaheer (1999) reported greater access to competitive ideas for small manufacturers with more nonredundant sources of advice beyond the firm. Stuart & Podonly (1999) reported a higher probability of innovation from semiconductor firms that establish alliances with firms outside their own technological area.

Constraint

The “bridging of structural holes” can be measured in multiple ways. Burt (2000b) notes that “even a simple count of bridge relationships seems to work; people with more bridges do better” (p. 33). The more concise method to measure brokerage of structural holes is through the amount of closure in the network, determined by constraint. Constraint can be considered as a measure of an individual’s inability to span structural holes (and therefore possess less social capital). An individual can be constrained in a network if (a) she has too few contacts; (b) she has contacts closely connected with one another; or (c) she shares information indirectly via a central contact. Constraint is measured through a constraint index, a concentration measure that illustrates the extent to which all of a person’s network time and energy is concentrated on one contact

(Burt, 1992). An individual with high constraint is typically dependent on one or only a small number of individuals within the network, therefore being exposed to less varied information and unable to expand his or her social capital. In turn, there should be a negative association with performance and network constraint (Burt, 2005, pp. 26-27). An individual with a high degree of constraint will be less able to span structural holes. Therefore, network constraint has an inverse relationship with centrality. Individuals with a high degree of network constraint had less positive performance evaluations, while individuals whose discussion networks spanned numerous structural holes had twice the odds of obtaining an outstanding performance rating (Burt, 1992, p. 25).

Centrality

The focus of network position as an enabler of social capital extends beyond the concept of structural holes. Network centrality “is implicit in any discussion of social capital or structural holes” (Kilduff & Tsai, 2003, p. 30). Centrality refers to the extent to which a given individual is connected to others in a network and is the structural property most often associated with instrumental outcomes, including power (Brass, 1984), influence in decision making (Friedken & Johnson, 1993) and innovation (Ibarra, 1993a). Centrality is “one of the most important and widely used conceptual tools for analyzing social networks. Nearly all empirical studies try to identify the most important actors within the network (Everett & Borgatti, 2005, p. 57).

A central individual in a network is one who is involved in many ties, or relationships with others (Wasserman & Faust, 1994, p. 173). This definition was

first developed by Bavelas (1950), through experiments on communication networks. This led to more studies in the 1950s and 1960s (Burgess, 1968; Rogers & Agarwala-Rogers, 1976) which sparked developments of the concept of centrality by Freeman (1979).

The key forms of centrality include (a) *degree centrality*, referring to the number of ties one has to other actors; (b) *closeness centrality*, or the ability of an actor to reach many other actors; (c) *betweenness centrality*, or the ability to connect other actors who have no direct connections; and (d) *eigenvector centrality*, referring to how many ties the actor has with other central individuals in the network. Another useful measure of centrality is provided by “two-step reach,” which gives the percentage of the network which can be reached by the individual in two steps or less (Borgatti, Everett & Freeman, 1992). Two-step reach is a centrality measure closest to degree centrality and provides a clear view, in the form of a percentage, of how central an individual is in relation to others in the network. For example, an individual with a Two-step reach value of 0.41 can reach 41% of others in the network in two steps (contacts) or less.

Central individuals, because of their numerous connections to others, have more relationships to draw upon in obtaining resources and are therefore less dependent on any single individual (Cook, & Emerson, 1978). Centrality not only enables one’s ability to reach and obtain information from others, but also enhances the ability to control resources, since central individuals can choose from a greater number of alternative individuals when exchanging information (Cook & Emerson, 1978; Sparrowe, 2001).

Employees with higher centrality have shown greater social influence and a higher likelihood of promotion (Brass, 1984). Individuals with a higher number of social ties (centrality) gain non-redundant information concerning opportunities and resources (Roberts & O'Reilly, 1979). Persons occupying central positions in the network were rated as more influential and satisfied with their tasks than persons in peripheral positions (Davis, 1963; Leavitt, 1951; Shaw, 1954). Laboratory findings indicated that persons in central positions are more often perceived and selected as leaders of the group (Cartwright & Zander, 1968; Shaw, 1954).

Centrality vs. Brokerage

The concepts of constraint and the “brokerage of structural holes” are different than network measures of centrality. The importance of one over the other has been an area of debate. Cook & Emerson (1978) showed that the most central people in a network need not be the people who most benefit from exchanges with others. The people who did best were brokers with exclusive exchange relations to otherwise disconnected partners. Burt (2005) noted that in one study, “competitive advantage came from brokerage rather than a dominant central position” (p. 39). Others have emphasized centrality as the core measure to review when analyzing network position (e.g., Mehra, et al., 2001):

As a measure of the extent to which each individual occupied a structurally advantageous position...we used betweenness centrality (Freeman, 1979). We chose this measure rather than a more local measure of autonomy, such as constraint (Burt, 1992), because

betweenness centrality takes both direct and indirect ties into account (Brass, 1984; Krackhardt, 1990; & Brass & Burkhardt, 1993), whereas constraint focuses primarily on the direct ties in the ego's immediate circle of contacts. (p. 131)

In actuality, centrality and constraint can be considered complimentary measures of network position. Actors who bridge across structural holes tend to have high betweenness centrality in the network in the sense of being go-betweens for those actors not directly connected to each other.

While centrality is beneficial both to the individual and the network as a whole, a central individual exposed to a plethora of communications can become a bottleneck, often due to the sheer volume of information received. Central individuals can also exhibit a tendency to hoard information (Cross & Borgatti, 2002) and be more likely candidates of organizational exit (Krackhart & Porter, 1986).

Network Position and Performance

This study looks to both components – centrality and constraint – as primary measures of network position that can impact performance. Although previous research has demonstrated a relationship between network structure and instrumental outcomes, relatively few studies have explicitly examined the link between network centrality and job performance (Sparrowe, 2001, p. 316). Baldwin et al. (1997) found a positive relationship between the network centrality of master of business administration (MBA) team members and their grades. Brass (1984) found that the centrality of employees' positions in a network

representing the flow of work was indirectly related to job performance via job characteristics.

Studies have shown that individuals with ties across social divides gain new (non-redundant) information concerning opportunities and resources. This ability to obtain resources (such as information) has been shown to be directly related to individual and group performance (Roberts & O'Reilly, 1979).

Individuals who connect disconnected others can facilitate the flow of information across the whole system of coordinated activity that makes up the organization, which in turn contributes to the accomplishment of organization-wide goals. This approach builds on work in organization theory emphasizing that job performance consists of individuals contributing to the tasks specific to the organization (Burns & Stalker, 1994, p. 97).

An individual's measure of centrality in communication networks has been empirically associated with several variables that may lead to enhanced performance, including influence (Brass & Burkhardt, 1993) and cognition (Walker, 1985). Ibarra (1993b) found that centrality appeared to mediate the impact of individual attributes and formal position on administrative innovation roles. Research on officers and enlisted men in three high-technology military organizations showed that people with two or more network contacts performed better than people with one or no network contacts (Roberts & O'Reilly, 1979). A study of R&D communication groups indicated that centrality mediated the effects of functional role, status, and communication role on individual performance (Ahuja, et al., 2003). Cross & Cummings (2004) found a significant

relationship between betweenness centrality and performance across two separate organizations. Mehra, Kilduff & Brass (2001) found that supervisors in a small technology company gave higher performance evaluations to employees whose networks bridge otherwise disconnected parts of their organizations.

Summary

This review of literature has included theoretical foundations of social capital and reported benefits, as well as an overview of the network approach to social capital in terms of measurement and core components that leads to enhanced social capital, and finally, reviewed the relationship between network measures and organizational benefits, including individual performance.

Research efforts in the area of social capital have been numerous and varied. The interest in social capital in popular literature has led to lack of clarity around a definition of the term, leading to a plethora of papers, conferences, and popular literature claiming that the benefits of social capital can be realized without defining or clarifying the relationship between exactly what it is and how it can be measured.

Claimed benefits of social capital have included enhanced knowledge transfer, innovation and performance, and a higher likelihood of promotions and salary increases. Social network analysis has provided some cogency as to how such capital can be measured. This study focuses on the concept of structural holes, measured by network constraint, and the network position of centrality as key enablers of social capital. By examining the relationship between network position and centrality, this study provides further clarity on potential relationship

between these variables, and contributes further to the body of knowledge in this area.

CHAPTER 3

METHODOLOGY

The purpose of this study is to determine whether a relationship exists between network position and employee performance. For this study, network position is comprised of two variables: network centrality and constraint. Employee performance serves as the independent variable and is measured by annual performance appraisal ratings obtained from company HR records. Secondary variables obtained in the analysis are age, tenure (years of service), job code (rank), and education level. This chapter presents the methods used in the study. Specific sections discuss the research hypotheses, design, population of interest, research sample, data collection, and analysis of the data. Assumptions, limitations, and delimitations of the study were presented in chapter 1.

Research Hypotheses

H_1 : There is no significant relationship between network centrality and performance ratings.

H_2 : There is no significant relationship between network constraint and performance ratings.

H_3 : There is no significant relationship between job grade and performance ratings.

H_4 : There is no significant relationship between education level and performance ratings.

H_5 : There is no significant relationship between tenure (years of service) and performance ratings.

H_6 : There is no significant relationship between age and performance ratings.

Research Design

This study attempts to measure the effect, if any, of network position on individual employee performance. Secondary variables are also analyzed for potential relationships. This study is performed as a non-experimental, causal-comparative design, which attempts to determine potential relationships between the variables with no experimental manipulations performed (Gall, Gall & Borg, 2003; Grimm & Yarnold, 1995). Hierarchical regression was performed with performance as the dependent variable and centrality and constraint as the primary independent variables. Secondary independent variables were job grade (rank), tenure (years of service), age, and education level. To isolate the effects of the primary independent variables, the regression analysis was performed through a hierarchical, two-model approach. Model 1 included performance in relation to the secondary independent variables only. Model 2 employed regression with performance in relation to all independent variables. Analysis was performed using SPSS REGRESSION and SPSS FREQUENCIES for evaluation of assumptions.

Population

The population of interest was comprised of Information Technology (IT) professionals within engineering and defense companies.

Sample

A social network analysis (SNA) was conducted with a small Information Technology (IT) department of a large (80,000 + employee) defense company. Survey participants were chosen by company management. Employees were asked to list key individuals within the company with whom they interact to obtain work-related information. The resulting list of individuals (N = 371) constituted the network of study.

Company management announced the survey via email to selected participants, and the social network analysis was conducted through a Web-based form (see Appendix A). This survey included questions to determine relationships between coworkers within the network. The final company network contained 371 employees, describing a total of 3,905 relationships in the network.

Instrumentation

A social network analysis survey was completed by participants to determine relationships between individuals within the network. From this data a binary matrix was created which places senders on each row and recipients on each column. If a link between the two individuals is present, a 1 is placed into that cell. The absence of a link is represented by a zero. The social network analysis package *UCINET* (Borgatti, et al., 1992) was used to convert these matrices into measures of network position, including centrality and constraint. Analysis was then performed in SPSS to determine potential relationships among variables.

Centrality was computed as a measure of two-step reach, computed through the *UCINET* network analysis software package (Borgatti, et al., 1992). Two-step reach provides the percentage of the network which can be reached by an individual in two steps or less. Constraint was provided as a concentration measure that varies from zero to 100 with the extent to which all of a person's network time and energy is concentrated in one contact (Burt, 1992). Network constraint occurs when (a) an actor has few contacts (e.g., in a small network); (b) the contacts are closely connected with each other, as in a clique in a dense network; or (c) individuals share information indirectly via a central contact (such as in a hierarchical, formal network of contacts) (Burt, 2005, pp. 26-27).

Performance was measured by annual performance ratings conducted by the employee's direct manager, obtained from company HR records. Ratings were comprised of (a) meets expectations, (b) exceeds expectations, and (c) far exceeds expectations. Within work organizations, the vast majority of performance ratings come directly from their immediate supervisor (Bretz, Milkovich, & Read, 1992; Scullen & Mount, 2000), and often supervisory ratings are considered the most likely valid reflections of true performance (Arvey & Murphy, 1998). Secondary variables included education level, tenure (years of service), job grade, and age, obtained from company HR records. Job grades were provided on an ordinal scale of 1 to 13, from lower to higher rank (see Appendix D for further detail).

Data Collection

Data collection was performed through the following phases: (a) management's assessment of individuals to attend training and complete the survey; (b) administration of the survey; and (c) analysis of results. The assessment phase included the project sponsor reviewing employees to be interviewed. This study resulted in nominees for a leadership training program. The company sponsor sent an email to all candidates announcing the social network survey followed by a link to the Web-based form to complete the survey. The survey itself asked the recipients: "Who are the four or five people that you turn to or will turn to in order to best accomplish your goals and objectives as a member of your department?" Respondents listed these individuals, in addition to their years known. Refer to the Appendix A for further survey detail.

Data Analysis

Survey data were analyzed using the social network analysis software package *UCINET* (Borgatti, et al., 1992). Descriptive statistics of the data were analyzed. Data were first assessed for normality of distribution and identification of missing data and determination of outliers. Missing data was omitted from the analysis. For each variable, means, standard deviations, and correlations were determined.

Hierarchical regression was used to test the research hypotheses, using performance as the dependent variable, and centrality, constraint, education level, tenure (years of service), age, and job grade as the independent variables. Results of these analyses determined the strength of the overall effect of the

model (total variance explained). Hierarchical regression was employed where centrality and constraint were treated as control variables via a blockwise selection method. Further results are analyzed to determine the statistical significance, if any, of the individual predictor variables.

Squared structure coefficients were also calculated for the regression. The structure coefficient (r_s) is the correlation of a predictor with \hat{Y} (i.e., only the explained portion of Y), and “is very useful in giving us a better understanding of what the synthetic variable, derived by weighting the observed variables, actually is” (Thompson, 1992, p. 11). For example, analysts that focus on beta weights alone in multiple regression can be short-sighted. A predictor can have a beta weight of zero, but actually be an exceptional powerful predictor variable (Thompson & Borello, 1985). Squared structure coefficients inform the researcher regarding the proportion of \hat{Y} variance explained by the predictors, and “one must always look at both beta and structure coefficients when evaluating the importance of a predictor” (Thompson, 1992, p. 11).

Summary

This chapter described the methodology of the study. Details were provided regarding experimental hypotheses, research design, population, sample, and variables.

CHAPTER 4

FINDINGS

The purpose of this study was to determine whether a relationship exists between employee network position and individual performance. Secondary variables were also analyzed to determine potential relationships to performance. This chapter provides the details concerning participants in the study, instrument reliability, data assessment, and data analysis. Each research hypothesis is then tested, using the results of hierarchical regression analysis.

Participants in the Study

A social network analysis (SNA) was conducted with a small Information Technology department from a large (80,000 +) defense company. Survey participants were chosen by company management. Employees were asked to list key individuals within the company with whom they interact to obtain work-related information. The resulting list of individuals (N = 371) constituted the network of study.

Score Reliability

Company management announced the survey via email to selected participants, and the social network analysis was conducted through a Web-based form (see Appendix A). The survey included questions to determine relationships between coworkers within the network. Of the 130 employees surveyed, 98 people responded to the survey. The response rate was 75%. The final company network contained 371 company employees, describing a total of

3,905 relationships in the network. The network included 13 social isolates (individuals with no listed relationships with others).

Prior to analyzing data and testing the research hypotheses, data was examined to ensure neither the individual nor the bivariate relationship frequencies violated statistical assumptions. These assumptions include normality, homoscedasticity, and linearity. Listwise deletion was performed to exclude missing data from the analysis. Summary statistics were calculated for responses to each variable set to provide mean, standard deviations, and variance. Measures of skewness and kurtosis were also calculated to assess the distribution of each variable response set.

Table 1

Variable Means, Standard Deviations and Distributions

Variable	Mean	SD	Skewness	Kurtosis
Performance	1.78	0.697	0.336	-0.919
Job Grade	4.94	2.219	0.958	1.351
Service Years	15.51	10.609	0.092	-1.140
Age	45.84	9.525	-0.409	0.192
Education	3.51	1.663	0.669	1.873
Two-step-Reach	21.49	13.055	1.229	2.482
Constraint	0.44	0.291	0.973	0.420

Table 1 summarizes descriptive statistics of the data, including values for skewness and kurtosis. Skewness refers to the symmetry of the distribution of data points and values outside of a range of -1 to +1 may be considered substantially skewed (e.g., Hair, Anderson, Tathane & Black, 1995). Extreme skewness was not found in the data, except for a positively skewed value for

centrality (two-step reach), indicating that few people in the sample were highly central. Kurtosis is a measure of the “peakedness” or “flatness” of a distribution when compared to normal. A negative kurtosis value indicates a flat distribution, whereas a positive one denotes a peaked distribution. The primary independent variables of centrality and constraint generated peaked distributions, while the dependent variable of performance revealed more of a normal distribution.

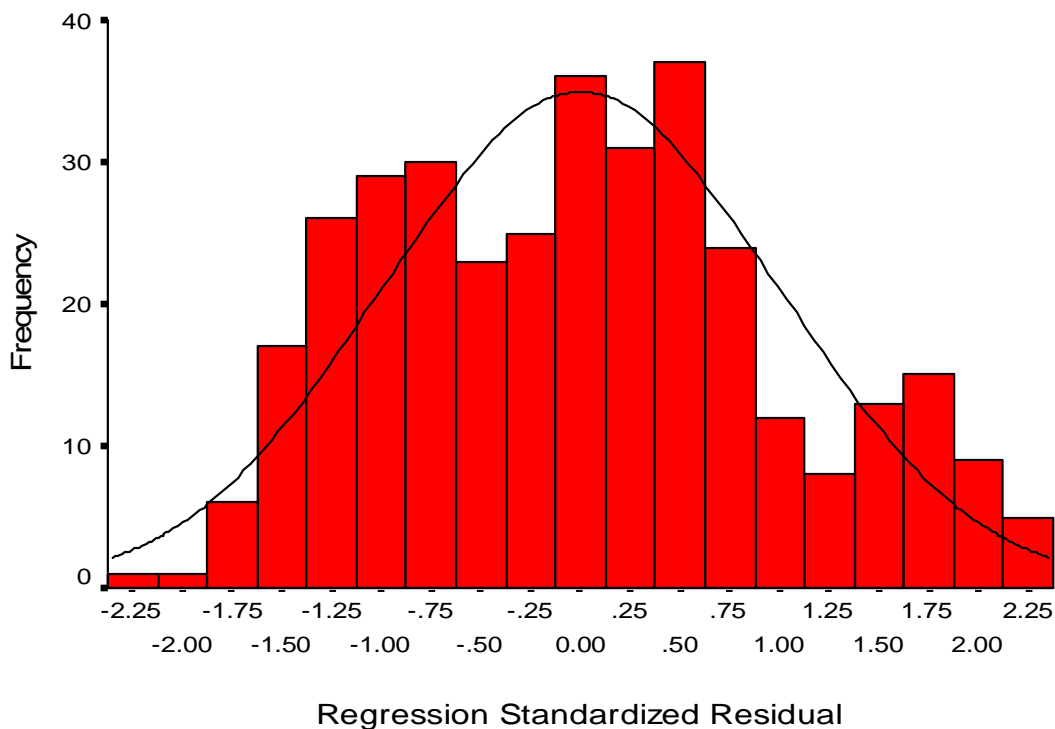


Figure 1. Regression standardized residual for performance.

Data were analyzed graphically for homoscedasticity and linearity. Figure 1 provides a visual examination of the standardized residuals for the dependent variable, which failed to reveal evidence of nonlinearity or heteroscedasticity. Figure 2 provides a visual examination of the normal distributions of the dependent variable (performance) and the primary control variables of centrality

and constraint. Given the result of the data assessment, the researcher proceeded with the analysis and testing of research hypotheses.

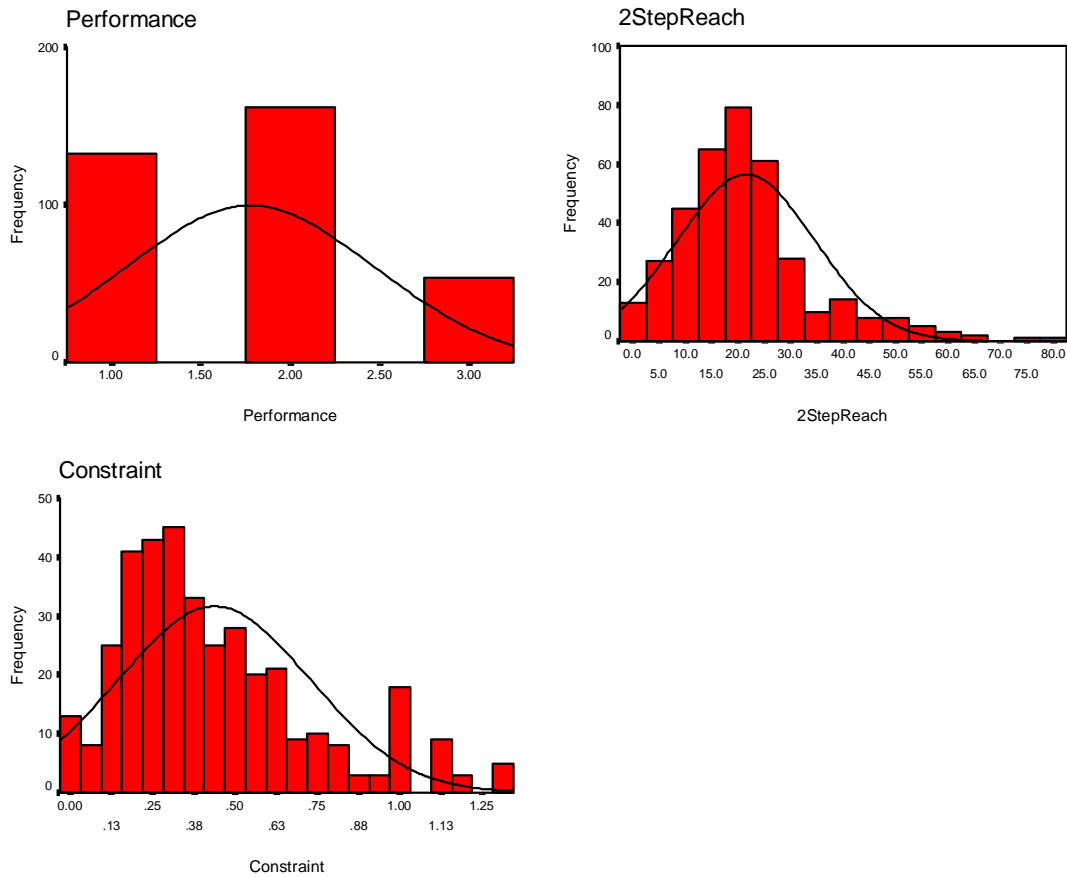


Figure 2. Score distributions for performance, centrality and constraint.

Data Analysis

Data were analyzed through commercially available statistical software (SPSS). The statistic used to test the research hypotheses was multiple linear regression analysis. The dependent variable was performance. The primary independent, or predictor, variables were centrality (Two-step reach) and

constraint. Secondary independent variables were job grade, tenure (years of service), age, and education level.

Table 2
Correlations: Primary Predictors and Performance

Variable	Performance	Two-step Reach	Constraint
Service Years	-0.179	0.144	0.000
Age	-0.227	0.071	-0.016
Education	0.010	0.015	-0.022
Job Grade	0.253	0.131	0.020
Two-step Reach	0.014	1.000	-0.570
Constraint	0.068	-0.570	1.000

Table 3
Correlations: Secondary Predictors and Performance

Variable	Performance	Service Years	Age	Education	Job Grade
Service Years	-0.179	1.000	0.547	-0.079	0.217
Age	-0.227	0.547	1.000	0.096	0.213
Education	0.010	-0.079	0.096	1.000	0.221
Job Grade	0.253	0.217	0.213	0.221	1.000
Two-step Reach	0.014	0.144	0.071	0.015	0.131
Constraint	0.068	0.000	-0.016	-0.022	0.020

Tables 2 and 3 provide a review of the correlations between independent (predictor) and the dependent variable (performance). Consistent with theory

(Burt, 2005), there was a statistically significant negative relationship between centrality and constraint. Correlations between other predictor variables and performance were not statistically significant.

Table 4

Regression Summary of Predictors on Performance

	SS	<i>f</i>	MS	<i>F</i>	<i>R</i>	<i>R</i> ²	Adj <i>R</i> ²
<i>Model 1</i>							
Regression	27.79	5	5.559	13.509	0.406	0.165	0.153
Residual	140.72	342	0.411				
Total		347					
<i>Model 2</i>							
Regression	28.57	7	4.082	9.917	0.412	0.170	0.152
Residual	139.95	340	0.412				
Total	168.52	347					

Note. Model 1 Predictors: Education, Service Years, Job Grade, Age; Model 2 Predictors: Education, Service Years, Job Grade, Age, Two-step Reach & Constraint.

Note. *P* < .05.

Table 4 lists the summary regression analysis of the predictor variables on performance. The *F* value for both models 1 and 2 yielded a non-significant result at alpha = .05. The adjusted *R*² for model 1 (0.153) and model 2 (0.152) were not statistically significant. Utilizing a block modeling method, model 1 did not include the primary predictor variables of centrality (two-step reach) and constraint. For model 2, centrality and constraint were added. This block modeling approach enabled the researcher to isolate the effects of network position in relation to

other predictor variables. The change in R^2 from model 1 to model 2 was 0.005, showing virtually no difference of variance explained by centrality and constraint.

Squared structure coefficients were computed to assess the proportion of the variance that can be explained by the independent, or predictor, variables. Table 5 provides standardized beta coefficients, t values, probability, and squared structure coefficients for each predictor variable for Model 2 (including all independent variables). This analysis is provided to explain the difference, if any, of the individual predictors as well as provide the basis for testing each hypothesis. While beta coefficients indicate contribution toward the regression variate, squared structure coefficients provide further understanding. The squared structure coefficient, when multiplied by the adjusted R^2 , indicates the contribution of that predictor variable toward the explained portion of the dependent variable influence.

Table 5

Regression Analysis of Predictor Variables on Employee Performance

	Std. Beta	t	p	Structure Coeff.	Squared Structure Coeff.
Job Grade	0.343	6.404	0.000	0.614	0.377
Service Years	-0.136	-2.211	0.028	-0.434	0.188
Age	-0.220	-3.658	0.000	0.551	0.304
Education	-0.048	-0.926	0.355	0.024	0.001
Two-Step Reach	0.053	0.846	0.398	0.034	0.001
Constraint	0.084	1.375	0.170	0.165	0.027

H_1 : There is no significant relationship between centrality (Two-step Reach) and performance ratings.

Regression analysis performed for model 2, incorporating both primary independent variables of centrality and constraint, showed no statistically significant result at $p < .05$. The null hypothesis was not rejected. Centrality and constraint added only .005 additional variance to the model. For this study, centrality did not predict a statistically significant impact on employee performance ratings.

H_2 : There is no significant relationship between constraint and performance ratings.

Regression analysis performed for model 2, incorporating both primary independent variables of centrality and constraint, showed no statistically significant result at $p < .05$. The null hypothesis was not rejected. Centrality and constraint added only .005 additional variance to the full model. For this study, constraint did not predict a statistically significant impact on employee performance ratings.

H_3 : There is no significant relationship between job grade and performance ratings.

The t value for the job grade predictor variable of 6.404 resulted in a $p < .001$. The null hypothesis was rejected. The squared structure coefficient of .377 indicates a substantial contribution between the predictor variable (job grade) and \hat{y} (synthetic) scores. The squared structure coefficient indicates the proportion of \hat{y} (only the explained portion of y) variance explained by the

predictors (Thompson, 1992). Job grade was found to be a statistically significant predictor of higher performance ratings.

H₄: There is no significant relationship between education level and performance ratings.

The t value for the education predictor variable was -.926 and thus failed to yield a statistically significant result at $p < .05$. The null hypothesis failed to be rejected. The squared structure coefficient of .001 resulted in little contribution toward the explanation of known variance. Education level was not found to be a statistically significant predictor of higher performance ratings.

H₅: There is no significant relationship between tenure (years of service) and performance ratings.

The t value for the years of service predictor variable was -2.211, resulting in a $p < .05$. The null hypothesis was rejected. The squared structure coefficient of .188 resulted in a slight contribution toward the explanation of known variance. Tenure (years of service) was found to be a statistically significant predictor of higher performance ratings.

H₆: There is no significant relationship between age and performance ratings.

The t value for the age predictor variable was -3.658, resulting in a $p < .001$. The null hypothesis was rejected. The squared structure coefficient of .304 resulted in a contribution toward the explanation of known variance. Age was found to be a statistically significant predictor of higher performance ratings.

Summary

This chapter provided detailed findings of the study. Assessment of the data confirmed that the data set was complete and the individual and bivariate relationship frequencies met the assumptions of the statistic to be used (multiple regression). The overall model revealed 17% of variance explained. The primary predictors of network position, centrality and constraint, were not statistically significant predictors of performance ratings. Three variables, job grade, tenure and age, were found to be statistically significant predictors of employee performance. Additional analysis of squared structure coefficients found that job grade and age explained portions of the explainable variance. Chapter 5 includes a discussion of these findings, the significance to organizations, and recommendations for further research.

CHAPTER 5

DISCUSSIONS AND RECOMMENDATIONS

The purpose of this study was to determine whether a relationship existed between network position and employee performance. Secondary variables of education level, tenure (years of service) age, and job grade were also measured to determine potential relationships to performance. This chapter includes a discussion of the findings of this study, along with recommendations for further research.

Summary of the Study

Many tools, methods, and techniques have been implemented to improve employee performance. Research of social networks has revealed that certain components of network position can have an impact on organizational effectiveness, yet relatively little research has been conducted on network position and individual performance (Sparrowe, 2001; Mehra, et al., 2001; Flap & Volker, 2004).

This study attempted to add to the body of research of network analysis and performance. Isolating particular network variables as potential predictors of performance could prove influential in the development of performance improvement programs in organizations. In addition, non-network variables were analyzed in relation to performance, including job grade, tenure, education level, and age. Knowledge of potential relationships between these variables and

performance would contribute further to the body of knowledge of performance improvement and potential causal factors.

The participants in this study were employees of a large defense electronics company in an Information Technology (IT) department. These participants were part of a company-sponsored training program on leadership. Candidates for the training were nominated by company management. As part of the training, each employee completed a social network analysis web-based survey, where the data were obtained. This survey contained basic questions to determine an individual's position among a network of coworkers. The dependent variable of this study was employee performance ratings of each individual, comprised of a three-level rating scale of meets, exceeds or far exceeds expectations.

The overall model revealed 17% of variance explained. The primary predictors of network position, centrality and constraint, were not statistically significant predictors of performance ratings. Three variables, job grade, tenure and age, were found to be statistically significant predictors of employee performance.

Discussion of Findings

Data collected from the network analysis were analyzed to test the research hypotheses. Following is a discussion of the findings of each hypothesis in order.

H_1 : There is no significant relationship between employee network centrality and performance ratings.

A primary goal of the study was to determine potential relationships between network position and employee performance. One of the two primary network measures was centrality, measured by two-step reach. Findings of this study did not reveal statistically significant results. A potential explanation for this finding may be due to measurement of performance, the dependent variable. Performance ratings used in this study may or may not be an adequate measure of the dependent variable. Alternative measures of performance should be considered, including pay relative to peers (expressed as a normalized, standardized variable) or length of time since last promotion (Burt, 2005). Another alternative to measuring performance ratings would be to analyze the extremes of the performance index and the relationships with centrality, such as measuring only the very high or very low performance ratings obtained in the sample. However, while such a design may magnify differences between centrality and performance, this approach would decrease sample size and potentially impact the validity and reliability of the study.

Network density has been found to play a role with performance. A study of staff officers of a large financial organization found that individuals with less constrained networks had a significantly higher probability of receiving a higher performance evaluation (Burt, Jonatta & Mahoney, 1998). The key finding of this study revealed that the association between evaluations and network constraint was primarily a function of network density. Regression analysis revealed that there is a tendency for people with dense networks to receive lower evaluations

(Burt, 2000, p. 377). Analysis of network density could yield further insight into the relationship between network position and performance.

The size of the network in question can impact performance ratings as well. A large network with many contacts can enable the individual to access numerous others for information and other resources, but the benefits of a large network may be offset by the costs involved in maintaining a large number of relationships (Rook, 1984). People who interact with numerous others in organizations run the risk of running short of time and other resources necessary for work performance. Thus, people with large networks within the organization may not necessarily achieve the highest performance ratings (Mehra, et al., 2001, p. 131). They may be so busy maintaining ties at work that their work performance suffers. In considering how network position relates to work performance, the simultaneous examination of network size and performance should be considered (Mehra, et al., 2001). By looking at both measures, one can assess whether network size and centrality have independent relationships to work performance.

Another approach could be to pursue a different measure of network centrality rather than two-step reach, as used in this study. As a measure of the extent to which an individual occupies a structurally advantageous position, some analysts have focused on betweenness centrality, which takes into account both direct and indirect ties held by the individual within the network (Mehra, et al, 2001; Brass, 1984; & Krackhardt, 1992). Analyzing this measure of centrality may yield different results than obtained in this study.

H_2 : There is no significant relationship between network constraint and performance ratings.

In addition to centrality, constraint served as the primary network variable for this study. Regarding constraint and performance, the null hypothesis failed to be rejected. From the block modeling regression approach employed, only a small amount of variance (0.005) was explained by both centrality and constraint.

Other studies have yielded contrary results. Burt (2004) found a positive association between constraint and performance evaluations, taken from an ordinal logit equation and holding constant job rank, role in the supply chain, age, education, business unit and geographical location (p. 371). However, others (Mehra, et al., 2001) chose to measure betweenness centrality instead of constraint as the key measure of network position, since the measure takes into account both direct and indirect ties to the individual actor. Constraint focuses primarily on the direct ties in an individual's immediate circle of contacts. More local measures of the extent to which individuals span structural holes are useful when sampling from large populations for which whole network data are unavailable (Mehra, et al., 2001, p. 131).

The relatively high negative correlation between centrality and constraint suggests a potential problem with multicollinearity. However, a visual examination of source scores revealed greater variance among the scores of the source variable. While collinearity between these variables tends to inflate the standard errors of their regression coefficients (making it more difficult to obtain significant values) the inflation of standard errors does not affect the validity of

any significant results that are found. A significant value of the beta coefficient in a regression “is just as conclusive when collinearity is present as when it is absent” (Darlington, 1990, p. 130).

*H*₃: There is no significant relationship between job grade and performance ratings.

This study found a significant relationship between job grade and employee performance ratings, which is consistent with prior findings. Burt (2005) noted that on average, “people in higher job ranks manage across more structural holes,” with access to larger and less constrained networks with shorter path distances between individuals (p. 21). Befort & Hatstrup (2003) found that managerial experience was positively related to perceptions of the importance of contextual performance behaviors reflecting compliance and extra effort. The study indicated that experience had unique effects on ratings of compliance and extra effort after controlling for managerial role variables. The unique effects of role variables approached significance only after controlling for experience (Befort & Hatstrup, 2003).

Differences in formal rank are likely to influence patterns of interaction in organizations. High-ranking individuals, by virtue of their control over resources and their decision making authority, may be better positioned to emerge as central actors in social networks (Lincoln & Miller, 1979; Ibarra, 1993a, 1993b).

*H*₄: There is no significant relationship between education level and performance ratings.

This study did not reveal a statistically significant relationship between education level and performance ratings, while prior research has provided mixed results. Education level was not shown to be statistically significant in relation to performance in terms of reduced driver accidents (Nafukho & Hinton, 2003). Regarding police academy performance and cadet level of education, there was no relationship between prior military experience and performance in the academy (Scarfo, 2002). Yet another study of military academies showed a significant relationship between education level and performance (Aamodt & Flink, 2001). An additional study showed no relationship between education and job performance with educational officers (Robinson, Porporino & Simourd, 1997). This study provided additional knowledge on this apparently complex relationship between education level grade and performance.

H₅: There is no significant relationship between tenure (years of service) and performance ratings.

This study revealed a statistically significant relationship between tenure and performance ratings, which is consistent with prior research. Job performance has been correlated positively with tenure because performance should improve with experience (Hall & Mansfield, 1975; Hall & Hall, 1976; Schmidt, Hunter & Outerbridge, 1986). Hassan (2003) found that, with migrant workers, tenure did not interact with performance. Wright & Bonnett (2002) found that tenure had a very strong nonlinear moderating effect on a job commitment and performance correlation, with correlations tending to decrease exponentially with increasing tenure. Sparrow & Davies (1988) found a relatively small

relationship between age and tenure in relation to performance, with training moderating adverse effects.

The length of time a person has been with the company is also likely to affect the pattern of participation in social networks. Individuals who have been with the company longer may be more likely to occupy central positions in social networks (Mehra, et al., 2001, p. 14).

*H*₆: There is no significant relationship between age and performance ratings.

This study revealed a statistically significant relationship between age and performance ratings. However, it is widely believed that job productivity declines with age (Rhodes, 1983). The statistically significant findings of this study between age and performance do not support this assertion. Studies of industrial jobs using performance ratings suggest that although older workers are rated as highly as younger workers with respect to overall efficiency, they tend to receive lower ratings for speed of work and learning ability (Sparrow & Davies, 1988, p. 307). Waldman and Avolio (1986) concluded that the relationship between age and productivity was substantially different depending on the way that performance was evaluated. On the basis of supervisory ratings (as used in this study), age and performance were negatively correlated. In general, chronological age accounted for only a small percentage of variance in job performance. Studies that have examined the effects of age and length of service on job performance indicate that when length of service is controlled, age differences in performance may sometimes disappear entirely (Giniger, Dispenzieri, & Eisenberg, 1983; Schwab & Heneman, 1977), suggesting that the

effects of experience at the job may counteract the effects of age. Age differences that are often clear in laboratory or a small sample field setting may be masked by variables such as job complexity, training, and tenure in a large sample field setting (Sparrow & Davies, 1988, p. 312).

Implications for Organizations

The research findings from this study provide significant findings and implications for organizations when considering performance improvements. The population for this study varied in terms of demographics and individual characteristics. Although findings for this study may not be generalized to another specific organizational population, the following points are for consideration:

1. The lack of statistically significant findings of the independent variables of network position (centrality and constraint) in relation to the dependent variable, performance ratings, indicate that further research is required to ascertain potential relationships between these variables. The findings of this study do not support specific performance improvement initiatives that would emphasize enhancing such network variables. Alternative measures of performance could be considered when attempting to ascertain a relationship, such as pay, promotion, or the achievement of specific business objectives. Other network measures such as betweenness centrality, network density, and network size may yield different results in relation to performance.

2. The statistically significant findings of tenure and age in relation to performance ratings call for further replication in other studies. Supervisor ratings

equating performance with years of service call for a more extensive review of the performance appraisal process and analysis of performance effectiveness.

3. The statistically significant findings of job grade in relation to performance ratings deserve replication. Potential cultural factors may play a part in the relationship between job grade and performance ratings, that is, where particular job grades may have inherent value to supervisors due to reputation or past history, which in turn could influence performance ratings.

Areas of Further Research

Research design limitations included the inability to obtain more robust measures of employee performance. The performance variable for this study (supervisor ratings) has inherent limitations. Utilizing annual performance evaluations, one study found that outstanding evaluations tended to go to individuals with contacts in diverse groups and poor evaluations tended to go to officers in a closed network (Burt, 2005, p. 38). Mehra, et al. (2001) found that supervisors in a small technology firm gave higher performance evaluations to employees whose networks bridged otherwise disconnected parts of their organization.

Cross & Cummings (2004) also performed a study that utilized only a single, overall measure of each person's performance. This aggregate rating "restricted the ability to develop a nuanced view of relationships between individual networks and dimensions of performance. It also potentially introduced measurement bias" (p. 935). Future research should consider multiple observations of performance, where "ratings are not solely a product of one

person's feelings toward another but derived from peer evaluations, supervisor project ratings, and objective metrics such as billable hours" (p. 935).

Measurements of such performance improvements over time would yield more "hard" data in terms of the performance variable and provide more insight into the performance / network position relationship. This approach calls for a more sophisticated model of performance which anticipates how different network profiles might be associated with other dimensions of performance, such as efficiency, effectiveness, and innovation.

Indirect measures of performance could be analyzed, including likelihood of promotion, or rate of pay increases. Burt (2004) performed studies utilizing an ordinal logit equation that showed a close association between brokerage (measured by constraint) and promotion. Holding constant job rank, work role, age, education, business unit, and geographical location (p. 371), constraint still yielded a statistically significant relationship to performance. Managers who spanned structural holes enjoyed compensation higher than their peers and odds of promotion higher than their peers (Burt, 2004, p. 38). However, Burt found that "research on the brokerage association with compensation has been less compelling than the work on evaluation and promotion" (p. 41).

The research design of this study incorporated only two measures of network position: centrality and constraint. Further research would be beneficial to consider other measures, including betweenness centrality, network size, and density. Results have shown that when there is a low density of contacts in one's advice network, performance is enhanced (Flap & Volker, 2004, p. 187). With a

tenured position, a dense advice network has a positive effect on performance, whereas non-tenured workers perform better if they have a less dense network (Flap & Volker, 2004, p. 190). People with large networks may not necessarily achieve the highest performance ratings; they may be so busy maintaining ties at work that their work performance suffers (Burt & Ronchi, 1990). These findings illustrate that performance varies with organizational contexts, and these contexts are important in making social capital productive (Flap & Volker, 2004, p. 190). Performance evaluations have been shown to reveal a weak positive correlation with network size, as well as a weak negative effect with network hierarchy. There is a tendency for people with dense networks to receive lower performance evaluations (Burt, 2000, p. 377). Further research may reveal network density as a key variable in relation to performance.

Another limitation of the study included collecting performance data at a single point in time. The absence of longitudinal data calls for additional analysis to be performed with the existing sample, if possible, over an extended period of time to determine potential positive or negative trends in the data.

Consideration could also be given to the relationship between network centrality and cognition (Ahuja, et al., 2003). Network position was more important than function or product type in explaining differences in cognition (Walker, 1985). One explanation for the relationship between cognition and centrality can be found in social information theory, where proximity to those who control relevant resources and information (Pfeffer & Salancik, 1978) provides access to situational opportunities. Individuals in structurally central positions can

benefit from other's experiences and perceptions. Network links help construct and communicate social norms and expectations (Rogers & Kincaid, 1981).

Compelling studies have been performed that attempt to determine potential relationships between personality, social network position, and performance. One study found that individual self-monitoring and centrality in social networks independently predicted individuals' workplace performance (Mehra, et al., 2001). Another study found that proactive employees reap performance benefits by means of developing social networks that provide individuals the resources and latitude to pursue high-level initiatives (Thompson, 2005). Structural equation modeling suggested that the relationship between proactive personality and job performance is mediated by network building and initiative taken on the part of the employee. Further research between cognition, personality, network position and performance will yield insight into such relationships.

Conclusion

A primary goal of this study was to determine potential relationships between network position and performance. Findings from the study failed to reveal such relationships. However, these findings pointed towards limitations of the study. Prior research findings of network position as predictors of employee performance call for additional research and experimental designs. The statistically significant relationships between "secondary" variables and performance yielded additional insights that support prior research.

APPENDIX A
SOCIAL NETWORK SURVEY

We are asking each person in Enterprise Applications to complete a short network survey about your view of the social network of Enterprise Applications around you. The goal of this survey is to inform us about the informal network of our organization as well as our key connections to the Customer community.

Your response matters. We are striving for 100% participation. Each person's view is important.

Your responses are confidential. Your responses will be combined with others to produce our study, but your individual responses will remain confidential. The Director of the Enterprise Integration group will take responses from the website, aggregate the data into a network model, and summarize the results. We, like you, will only see summary results.

Thank you again for your help and cooperation. We believe the results of this study will help us better align our organization with our strategy, vision, value proposition and our customer community.

1. What is the first and last name by which you are most likely to be listed by colleagues citing you as someone with whom they work? (e.g., John Doe)	Your Name:
	<input type="text"/> (required)
	Your Email Address:
	<input type="text"/> (required)

2. What is your best idea to add value to Raytheon and its Customers through Enterprise Applications? (2000 characters max)	<input type="text"/>
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3. Who are the four or five key internal or external Customers with whom you do business on behalf of Enterprise Applications?	Name (enter full first and last name, e.g., John Doe)	Years Known	Overall Sense of Relationship
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>

4. Who are the four or five people that you turn to or will turn to in order to best accomplish your goals and objectives as a member of the Enterprise Applications team?	Name (enter full first and last name, e.g., John Doe)	Years Known	Overall Sense of Relationship
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>
	<input type="text"/>	<input type="text"/>	OK <input type="button" value="v"/>

APPENDIX B
AUTHORIZATION LETTER

May 9, 2007

University of North Texas
Institutional Review Board
c/o UNT Office of Research Services
P.O. Box 305250-5250
Denton, TX 76203
ATTN: Sheila Bourns

This letter will serve as authorization for the study of data obtained from Raytheon Company by Paul Burton, Principal Investigator, for the dissertation proposal: Dimensions of Social Networks as Predictors of Employee Performance. This proposal will be submitted to the University of North Texas as part of Paul's dissertation within the Department of Applied Technology, Training and Development at the University of North Texas.

This study was performed from archived data obtained from company records. Data was de-identified to protect employee privacy, with no names provided. Data will be analyzed by the Principal Investigator (Paul Burton) and housed on his work computer and/or internal company databases for research purposes.

The goal of this study was to determine if measures of employee network position could have an impact on employee performance. By revealing potential relationships, this information could prove beneficial for employee performance improvement programs, benefiting both the employee and the organization as a whole.

Sincerely,

Tracy Cox
Raytheon Professional Services

APPENDIX C
EMPLOYEE PERFORMANCE RATING DESCRIPTORS

Performance Descriptor: Meets Requirements

For a person to receive this performance descriptor they should have met their Performance Goals as defined. In addition, they:

- Meet performance requirements; complete work in a competent manner and produce acceptable work products.
- Complete assigned tasks on time and accurately.
- Occasionally take initiative to go beyond what is required and add value outside of the generally assigned responsibilities.
- Require some direction and coaching, need help assigning the right priorities and determining the right course of action.
- Incorporate leadership values in work products and team efforts.

This descriptor reflects that employees to meet all their accountabilities and responsibilities competently and as required. One would expect that most employees (50%-60%) will receive this performance descriptor. Employees must achieve most, if not all, their Performance Goals to the intended standard if this performance descriptor is to be given.

Example

Performance Goal: Capture all available incentive fees, representing \$40,000, by ensuring that A-17 project deliverables are made available to the customer on schedule, as specified in the approved project plan.

Results: All incentive fees for the fiscal year were awarded, resulting in \$40,000 in income and increased credibility with the customer.

Performance Data Collected

- The employee understood that this objective involved both financial and customer perception incentives, especially since we had captured only 75% of the fees the previous year, having missed an important milestone by 2 months. By holding better-organized and more frequent project status meetings that included an agenda and a brief report by each team member, she was able to stay on top of the deliverables and head off any delays before they impacted the schedule. The customer expressed pleasure in the process improvements and the results.
- The employee communicated with the customer by phone and followed up in writing to document the achievement of each on-time delivery. This made it easier for Finance to collect the incentive fees from the customer.

Performance Descriptor – Exceeds Requirements

For a person to receive this performance descriptor, they should have met or exceeded their Performance Goals. In addition, they:

- Frequently exceed performance requirements; complete assigned tasks/projects on time and the work is accurate, well organized, and effectively presented.
- Often go beyond the basic requirements and take on initiatives that add value.
- Work effectively with co-workers; participate fully and creatively on teams to achieve the desired result; are willing to help others.
- Require occasional direction or coaching.
- Demonstrate leadership competencies in both individual and team assignments.

Although there is some similarity on the language used in both Far Exceeds and Exceeds, the Exceeds descriptor reflects frequent behaviors that indicate excellent performance rather than consistent excellent performance and there is less initiative and innovation shown. One might expect about 25%-35% of employees to receive this performance descriptor.

Employees must have met or exceed all Performance Goals to the intended standard if this performance descriptor is to be given. The way in which these goals were met or exceeded helps to determine the actual performance descriptor.

Example

Performance Goal: Reduce overtime of support staff by 20% in the first two quarters of the fiscal year by identifying efficiencies and overlap and implementing a plan that does not disrupt department operations.

Results: 22% overtime reduction achieved four months into the fiscal year. Reduction achieved by centralizing certain support tasks and moving one administrator to second shift to be able to handle off-hours support requirements.

Performance Data Collected:

- The employee interviewed the support staff asking them the reasons they'd been requested to work overtime over the past year. Many of the requests related to supporting west coast operations, being available after hours to help employees who were traveling, and setting up meeting rooms for early morning meetings.
- Based on this input, the employee met with the support staff as a group and asked if there would be a benefit to moving one of the administrators to the second shift. They agreed it would address most of the issues and one of the administrators volunteered to change her work schedule which also allowed

her to accommodate some changes in her personal life. The solution has been well received by the entire team.

Performance Descriptor: Far Exceeds Requirements

For a person to receive this performance descriptor, they should have exceeded their Performance Goals. In addition, they:

- Consistently exceed performance requirements in the quality, timeliness, and quality of work completed.
- Have a reputation for consistently producing the highest quality of work.
- Take initiative whenever possible to add value to the organization based on real needs, and consistently take action above and beyond the basic requirements of the job.
- Are strong team players who are frequently sought out by associates for help and find time to assist a colleague.
- Are innovative and produce work that reflects creativity, with enhancements that truly improve the value of the work.
- Are self directed, working independently with minimal coaching; demonstrates technical, functional or managerial leadership within and beyond own area of responsibility.

The operative words in this definition are “consistently” and “frequently”. This employee demonstrates many behaviors that indicate performance excellence. Employees who Far Exceed performance really go beyond their area of responsibility and the confines of their job. For an individual to receive this performance descriptor, one might expect his or her performance to be in the top 5% - 10% of overall employee performance.

Employees must have exceeded all their Performance Goals at the intended standard if this performance descriptor is to be given. The way in which these goals are met or exceeded help to determine the actual performance descriptor.

Example

Performance Goal: Develop and implement a comprehensive business-wide EH&S plan with a goal of reducing TRIR and LDIR by 30% and hazardous waste by over 10% by year end.

Results: Reduced TRIR and LDIR by 45% by 12/31/01; hazardous waste reduced by 10% by 9/30/01 and another 3% by 12/31/01

Performance Data Collected:

- EH&S Plan and results came in on time and in the case of the hazardous waste reduction 3 months early.
- Put together a team of “experts” to develop the EH&S plan; all team members said they were “honored” to work on this project given the expertise present.
- An EH&S expert was brought in to provide strategic coaching when required.

- The customer involved expected the highest level of work from the team and this was realized, according to the customer contact.
- This plan and its execution were innovative in approach, according to the client and team members, which resulted in these significant reductions.

APPENDIX D
JOB GRADE CLASSIFICATIONS & CONVERSIONS

Table 6

Job Grade Description & Classifications

<i>Description</i>	<i>Classification</i>
Tech Analyst I	1
Tech Analyst II	2
Senior Analyst I	3
Senior Analyst II	4
Principal Analyst	5
Senior Principal Analyst	6
Senior Manager	7
Director	8
Vice President, Information Systems	9
Vice President, Information Technology	10
Information Systems Fellow	11
Vice President, Enterprise Applications	12
Chief Information Officer	13

APPENDIX E
EDUCATION LEVEL DESCRIPTIONS

Table 7

Education Level Descriptions, Classifications & Counts

<i>Description</i>	<i>Classification</i>	<i>Count</i>
Not indicated	0	17
High School graduate	1	17
Some college completed	2	22
Bachelor's Degree	3	192
Some graduate school completed	4	3
Master's degree	5	101
Doctorate (DDS, MD or JD)	6	3
Doctorate (Academic)	7	4
Engineering degree	8	2
Associate's Degree (2-year college)	9	9

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