Predicting the Influence of Network Structure on Trust in Knowledge Communities: Addressing the Interconnectedness of Four Network Principles and Trust

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Abstract: The goal of this paper is to explore the emergence of trusting relationships within Communities of Practice. It has been argued that trust can be viewed as an organizing principle (McEvily, Perrone, and Zaheer, 2003). However, the focus of this paper is on the view that trust is an essential pre-condition for the sharing of knowledge. The goal of the paper is to discuss possible connections between social networking principles, network structure, and trust within Communities of Practice.

This paper will define and subsequently analyze the concept of trust and develop arguments relating to the existence and strength of trusting relationships within Communities of Practice. The theoretical arguments propose relationships between the characteristics of trusting relationships and four network characteristics: homophily; closure; brokerage; and the small-world problem. The general research question that underpins this paper is:

> To what extent do network principles determine the level of trust among members within a social network (i.e. a Community of Practice)?

The analysis focuses on a specific type of social network which has been termed a Community of Practice. Communities of Practice have been argued to be critical elements in the creation, refinement and sharing of knowledge (Dugid, 2005; Wenger, 1998; Wenger, McDermott, and Snyder, 2002).

Keywords: network structure, trust, knowledge communities, knowledge sharing, homophily, closure, small worlds, brokerage

1. Introduction

The goal of this paper is to develop theoretical arguments addressing possible relationships between social networking principles, network structure, and trust within a special type of social network. This paper will consider trust to be an emergent property, which is likely to be contingent on a social network's structure and management. The paper defines and examines the concept of trust and develops arguments concerning the development of trusting relationships within a specific type of social network called a Community of Practice. Arguments addressing the interconnectedness of trust and Communities of Practice will be derived from four network principles: homophily, closure, brokerage and the small world problem (commonly known as six degrees of separation). Using these network principles, this paper will propose that the strength of trusting relationships can be predicted by looking at network structure and agent characteristics. The principal research question posed by this paper is:

> *Can network structure or network principles be used to determine levels of trust among members within and around a knowledge community (i.e. Community of Practice)?*

2. Social network

Following Wasserman and Faust's (1995) definition, a social network consists of "a finite set or sets of actors and the relation or relations defined on them" (p.20). The target or sample social network used to develop the arguments in this paper is called a Community of Practice. Relationships examined within this social network will span Community of Practice members as well as their respective organizational units (for a network representation see Figure 5). The paper maintains a structural network view as opposed to a dyadic view, which exclusively examines networks from a dual actor/node perspective.

3. Communities of practice

Wenger, McDermott, and Snyder (2002), define a Community of Practice (COP) as "groups of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis" (p.4). COPs are based on a social theory of learning where social practices and group interaction results in collective learning. These social practices reflect the pursuit of the community's enterprises and the attendant social relations (Wenger, 1998).

A Community of Practice is initiated through the collective development of a mutually negotiated shared practice (Wenger, 1998). For example, this might be a set of employees gathering to share information, giving and receiving advice, or trying to solve a job or industry related problem (Wenger, McDermott, and Snyder, 2002; Wenger 1998, Orr, 1996). Through continuous interactions the COP develops its own practices, routines, rituals, artifacts, symbols, conventions, stories and histories (Wenger, 1998). The community also acts as, "a context in which the meaning of objects, problems, events and artifacts gets constructed and negotiated, and in which people live, work, communicate, and understand the environment and themselves" (Choo, 2006, p. 166). Through these interactions, developed practices and created artifacts, a COP represents a true knowledge creating and sharing community.

COPs will usually self organize and tend to originate on their own[1] (Choo, 2006). A person might be inclined to join because they might have something valuable to contribute, have something to learn, or both. As opposed to other 'project teams' or workgroups, COPs do not work together on a daily basis. Instead, they meet only when they find value in doing so (Wenger, McDermott, and Snyder, 2002). COPs are not self contained entities (Choo, 2006) and are not static.

Communities of Practice are valuable to their participants and their corresponding organizations because over time a common meaning and shared repository for their work is developed (Choo, 2006; Gherardi, 2001). An example of this may be seen by reviewing Orr's work with copier technicians (Orr, 1996). This socially developed 'common meaning' represents, "a unique perspective of their topic, common knowledge, practices, and approaches" (Wenger, McDermott, and Snyder, 2002, p. 5). Membership in the COP provides form, content, and context to this knowledge. Many times this is referred to as collective, accumulated or situated knowledge. It is this type of knowledge which is said to be produced, and resides in the group community. Therefore, the first stated benefit of studying a COP is that they create and facilitate the dissemination of knowledge (Duguid, 2005; Seely Brown and Duguid, 1998; Nonaka, 2002; Tsoukas, 2005a; Van De Ven and Johnson, 2006; Boer, van Baalen, and Kumar, 2002; Gherardi, 2001; Wenger, McDermott, and Snyder, 2002; Wenger, 1998; Choo, 2006).

Another similar benefit to acquiring or sharing new knowledge associated with COPs is the creation of a learning environment. Some organizational theorists (Blackler, 2002; Leonard and Sensiper, 2002; Wenger, McDermott, and Snyder 2002; Wenger, 1998) have argued that COPs are conducive of learning and the acquisition of new skills. Wenger (1998) refers to Communities of Practice as "shared histories of learning" (p. 73). The learning that takes place within the COP is closely related to actually becoming a practitioner; this includes associating contextual meaning, understanding the social structure of the practice, negotiating power relations, as well as finding implicit ways of working together. In return, the community becomes informally bounded by the value participants create through learning from each other (Wenger, McDermott, and Snyder 2002). From an organizational perspective, facilitating and sustaining such communities "creates a learning environment which raises the effectiveness and value of the organization (Wenger, 1998 p.45).

Other benefits of Communities of Practice include the development of personal relationships, a common sense of identity, and accepted ways of interacting (Wenger, McDermott, and Snyder 2002). What makes COPs unique and interesting to study is that the relationships and work practices are not reflected by nor are reflected in formal policies, methodologies, organizational charts, and job descriptions; instead the actual practice and learning is informal, socially constructed, and quite impromptu (Wenger, 1998; Choo, 2006). Unlike organizationally structured project teams, COPs have no formal authoritative control measures. Instead, members of the community govern their interactions through self constructed and agreed upon norms and sanctions. Acts relating to information hoarding, falsification of data, or any other malicious actions toward the community are primarily dealt with within the community. Sanctions for such actions may include the development of a bad reputation, exclusion from accessing information, or even expulsion from the community. For this reason, trust is formative to the success of a COP, especially when knowledge is created and disseminated.

4. Trust

The emergence of self-directed teams and a reliance on empowered workers greatly increase the importance of the concept of trust (Golembiewski and McConkie, 1975; Larson and LaFasto, 1989) as control mechanisms are reduced or removed and interaction increases.

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[1] Without the intervention of a governing or authoritative body such as an organization

> *In the use of self-directed teams, trust must take the place of supervision because direct observation of employees becomes impractical. (Mayer, Davis, and Schoorman, 1998 p.709)*

Having trust in any workgroup, especially one without authoritative control, is vital to the groups' success. When trust exists among members in a Community of Practice, efforts needed for information search and processing are minimized since the receiving party does not have to scrutinize the quality or veracity of the information (Zaheer, McEvily and Perrone, 1998). In turn, the existence of trusting relationships reassures the sender that the receiver will not misappropriate the information entrusted to them (Zaheer, McEvily and Perrone, 1998). In this example, trust reduces monitoring and safeguarding behaviors (or transaction costs) and conserves cognitive resources (Uzzi, 1997), leading to more 'openness' in the exchange (Zaheer, McEvily and Perrone, 1998). Additional benefits of trust include timely access to information and referrals (Burt, 1992) as well as an enhanced ability to draw distinctions and come to decisions which are essential activities in constructing knowledge (Tsoukas 2005a, 2005b).

> *A group within which there is extensive trustworthiness and extensive trust is able to accomplish more than a comparable group without the trustworthiness and trust. (Coleman, 1988 p. S101)*

To explore the above relationships further it is important to understand the factors underlying why a trustor would trust a trustee. To do this Mayer, Davis, and Schoorman's (1995) model of organizational trust will be used (See Figure 1). Mayer et al. (1995) define trust as,

> *the willingness of a party to be vulnerable[2] to the actions of another party based on the expectation that the other will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party. (p. 712)*

Mayer et al. (1995) further argue that it is individual traits or characteristics of the trusting parties which determine the level of trust that may be achieved between them. For instance, in order for a trustor to exhibit trust toward a trustee, the trustor must first have the 'propensity to trust[3]' (p.715) that particular trustee. In return the trustee must have *ability[4], benevolence[5], and integrity*[6] which together help the trustor determine the trustee's *trustworthiness*. Ability, benevolence, and integrity are all important factors for trust, yet each can vary independently. If all three are perceived as high by the trustor then the trustee is deemed trustworthy. It is also important to note that trustworthiness is a continuous variable. As the three characteristics vary, the level of trustworthiness can be said to move along a continuum. The extent to which one person is willing to trust another is determined by both the trustor's 'propensity to trust' as well as the trustor's overall judgment of the trustee's ability, benevolence, and integrity.

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[2] Making oneself vulnerable implies something important may be lost. Trust is the willingness to take a risk. The level of trust directly relates to the level of perceived risk (Mayer, Davis and Schoorman, 1995; Zaheer, McEvily and Perrone, 1998)

[3] Propensity is defined as "the general willingness to trust others" (Mayer, Davis and Schoorman, 1995, p. 715)

[4] Ability is defined as the skills, competencies, and characteristics necessary to have influence in a specific domain. (Mayer, Davis and Schoorman, 1995, p. 717)

[5] Benevolence is defined as the extent to which a trustor believes the trustee wants to do good to the trustor. Act in a way that is not egocentric. (Mayer, Davis and Schoorman, 1995, p. 718)

[6] Integrity is determined by the trustor by making an assessment as to whether or not the trustee will adhere to an acceptable (to the trustor) set of principles. (Mayer, Davis and Schoorman, 1995, p. 719)
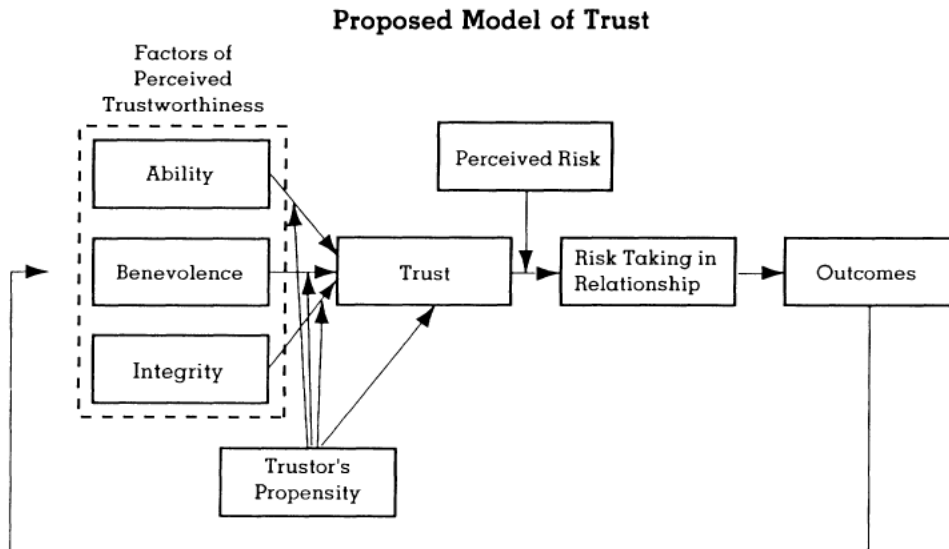
Proposed Model of Trust

Figure 1: Mayer, Davis and Schoorman (1995) proposed model of trust

Mayer et al.'s (1995) model is appropriate for use in this paper because it is specifically formulated for use within an organizational setting. The only significant concern with this model is that it only considers an interpersonal dyadic (trustor/trustee) relationship and does not allow for an actor to treat a collective entity such as an organization as an object of trust[7]. To correct for this, a secondary model developed by Zaheer, McEvily and Perrone (1998) will be added (See Figure 2). The latter model allows for an actor to have interpersonal trust for another actor and inter-organizational trust for a collective entity (the supplier organization in Figure 2). In the case of inter-organizational trust, trust created by the actor is unidirectional since the collective entity may not exhibit trusting behavior. In the case of two agents (interpersonal trust), the perceived trust of one agent on the other may be reciprocated.
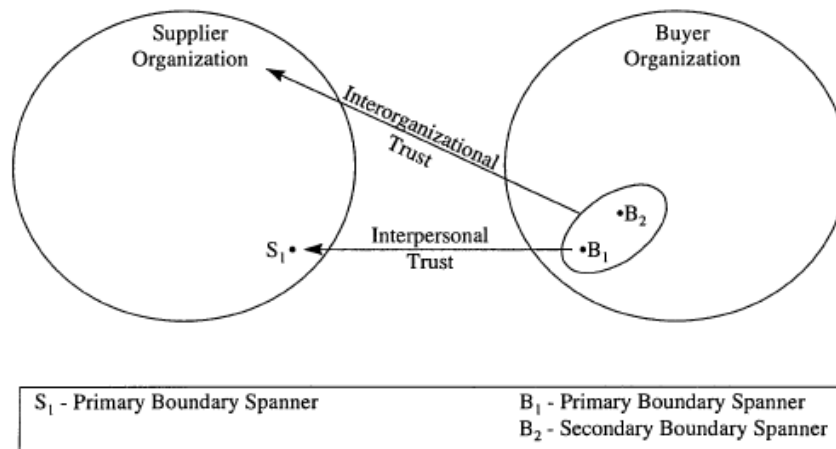

Figure 2: McEvily, Perrone and Zaheer's (1998) Inter-organizational and Interpersonal Trust Model

5. Predicting trust

The most relevant benefit of trust to any organization is the enhancement of knowledge sharing and innovation. Faced with a reduction in its ability to share knowledge and innovate an organization loses its competitive advantage and becomes vulnerable to competitors. Since trust can act as both a motivating and inhibiting factor for knowledge sharing, organizations should work toward building a better understanding of the levels of trust between their workgroup members. One method by which to determine these trust levels is by using one of many empirical instruments to measure trust relationships. In their intensive review, McEvily and Tortoriello (2007) identify a total of 156 such measures and subsequently narrow them down to five

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[7] Though a collective entity may be an object of trust it may not be the source of trust (McEvily, Perrone and Zaheer, 1998; McEvily, 2007)

based on an extensive review of their construct validity. McEvily and Tortoriello (2007) provide an explanation for their approach:

> *The five measures share a common emphasis on confirmatory factor analysis involving the testing of a theoretically derived measurement model and the estimation and evaluation of competing measurement models (p.20)*

Of the five (See Figure 3) only three (McAllister, 1995; Cummings and Bromiley, 1996; and Mayer and Davis, 1999) were found to be replicated by other researchers/studies.

Authors	*Measurement Instrument*
McAllister (1995)	Managerial Interpersonal Trust
Currall & Judge (1995)	Boundary Role Persons' Trust
Cummings & Bromiley (1996)	Organizational Trust Inventory
Mayer & Davis (1999)	Organizational Trust
Gillespie (2003)	Behavioral Trust Inventory

Figure 3: Noteworthy measures of trust (McEvily and Tortoriello, 2007 p.20)

From the organization's perspective, administering these instruments and conducting such studies is quite tedious and expensive. Organizational research can assist firms in trying to determine if there are more effective ways to predict levels of trust among group members without the use of such complicated and costly instruments. One possible method of gaining insight into these trusting relationships is by looking at agent characteristics, group composition and network structure. These types of data are readily available to the organization or at the very least, relatively inexpensive to attain.

In an approach to discover a method for predicting trust in organizations, the following sections summarize four network principles; constructing arguments linking network structure and agent characteristics to trust among members within and around a Community of Practice.

The network principles discussed in relation to trust are summarized in Table 1:

Network Principles			
Homophily	Closure	Brokerage	The Small World Problem
* Similarity Principle	* Obligations and Expectations	* Information and Referral Benefits	* Six Degrees of Separation
	* Norms and Sanctions	* Control Benefits	
		* Uniting Benefits / Tertius Iungens	

Table 1: Summary of network principles discussed in the paper

6. Homophily/similarity principle

McPherson, Smith-Lovin and Cook, (2001, p.416) define homophily as, "the principle that contact between similar people occurs at a higher rate than among dissimilar people. ([i.e.] …cultural, behavioral, genetic, or material information that flows through networks will tend to be localized)." According to the authors, there are two distinct types of homophily: *status homophily*[8] and *value homophily*[9]. Noted causes of homophily include geography[10], family ties[11], organizational foci[12], isomorphic sources[13], and cognitive processes[14] (McPherson, Smith-Lovin and Cook, 2001). The authors found that race creates the largest divide though sex, age, religion, and education also 'strongly' structure relationships.

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[8] Status Homophily is based on informal, formal and ascribed status. Includes ascribed characteristics (race, ethnicity, sex, age) and acquired characteristics (religion, education, occupation, behavior patterns)

[9] Value Homophily is based on values, attitudes, and beliefs

[10] Geography relates to geographic distance. More likely to have contact with those that are closer

[11] Family Ties refers to a family relation (biological tie). Likely to be the same race, ethnicity, and religion

[12] Organizational Foci relates to a focused activity which fosters the relationship (ex. school, work or voluntary organizations)

[13] Isomorphic Sources relates to occupied positions or roles (ex. workplace roles (status, seniority, functional division), family roles (wives), or political roles (senators))

[14] Cognitive Processes refers to perceived similarity (e.g. people who share similar knowledge domains)

In network terms, homophily implies that there is a positive relationship between the degree of similarity of two nodes and the strength of the tie between them. In other words, social characteristics determine network distance. Research also found that patterns of homophily get stronger as more types of relationships exist between two agents and that ties of one characteristic may influence homophily on other characteristics (McPherson, Smith-Lovin and Cook, 2001). Another notable network effect of homophily is 'selective tie dissolution' which argues for a negative correlation between homophily and the likelihood a tie will dissolve or decay. For example, low homophily within a group will result in a high probability for the group dissolving or decaying over time.

Though strength of attachment does not directly relate to trust or trustworthiness it can be argued that there is a connection between homophily and a trustor's 'propensity to trust' a trustee. Another possible connection exists between homophily and perceived trustworthiness of a trustee by a trustor. In his work, Burt (1992) establishes a direct connection between homophily and trust, arguing that similar[15] agents are more likely to trust each other than those that are dissimilar. In Burt's (1992, p. 16) words, "the operational guide to the formation of close, trusting relations seems to be that a person more like me is less likely to betray me."

Using the previous findings on homophily, network structure, and trust, certain arguments may be made in relation to Communities of Practice. First, it may be argued that higher levels of trust will be exhibited *between*[16] members of a Community of Practice if they share status and/or value homophily. Since higher levels of trust within the Communities benefits the organization (knowledge dissemination, learning environment, etc) it is in their best interest to asses it. To make this assessment an organization would need to identify the members of the Community and gather certain information on them through observation, archival records, and short surveys. Identifying and gathering ascribed and acquired characteristics for status homophily should be quick and inexpensive. Value homophily is more challenging, requiring a judgment to be made on perceived vs. actual values, attitudes, and beliefs.

From a structural network view it may be argued that Communities of Practice whose members share status and perceived value homophily will have a higher measure of overall trust[17] then Communities of Practice whose members do not. This argument is different from the previous because it focuses on a measure of overall trust within a subgroup as opposed to interpersonal trust between two members. Nevertheless, assessments of status and perceived homophily may be gathered in similar fashion.

Previously, this paper argued that trust is necessary for effective information seeking/retrieving behaviors. Assuming the former is true the principle of homophily may also be extended to information and knowledge dissemination. From this perspective, it may be argued that Communities of Practice whose members share status homophily or perceived value homophily will be more effective in their information seeking/retrieving behavior than Communities of Practice whose members do not share such characteristics. If these members are more effective in their information seeking and retrieving behavior than it may be further argued that Communities of Practice whose members share status homophily or perceived value homophily will be more effective at knowledge dissemination than Communities of Practice whose members do not share such characteristics. If this is true then there is a direct connection between homophily and knowledge dissemination.

Before completing the discussion on homophily, it is worthwhile to note two complications that arise with the homophily principle. First, homophily varies in transparency, meaning that certain types of characteristics are easier to spot than others. For example, it is much easier to determine someone's sex than their religion. Even more difficult to determine are value homophily items; that require one to guess at values and beliefs. A second notable difficulty with the homophily principle is that similarity is often associated with redundant information (Burt, 1992; Granovetter, 1973); Groupthink; and lack of creative abrasion and hence creativity (Leonard, 1995; Leonard and Swap, 1999).

7. Social network closure

The second network principle discussed in this paper was introduced by James Coleman (1988) at the University of Chicago and is based on observations of activity within a closed network structure. Network closure may be viewed as the degree to which everyone knows everyone else in a network. In a closed

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[15] Similar agents is defined as two agents who display high homophily
[16] Where the modeling unit is a dyad
[17] Assumes a non-dyadic view where the modeling unit is a subgroup (i.e. one COP vs. another)

network all the agents will know each other. A simplistic example of a network with and without closure is presented in Figure 4:
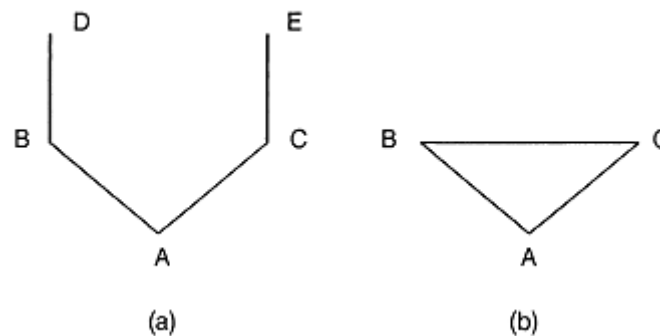

Figure 4: Coleman's (1988) network without (a) and with (b) closure (p.S106)

Coleman (1988) argued that agents in a closed network structure were more likely to trust one another than agents in an open structure. He also claimed that in cases where trust is violated, a closed network structure provides the ideal environment for instituting sanctions and having effective norms.

Coleman (1988) believed that trustworthiness could be judged by whether or not obligations were reciprocated. He argued that in a closed structure, obligations and expectations would be repaid because a high number of outstanding obligations by one member could easily be transparent to the rest of the group. If the rest of the group felt as if that member was not reciprocating they would become less likely to trust them or continue to extend favors. The closed network structure creates an environment where reciprocity is encouraged and to some extent enforced. Since all the actors in a closed network can see and judge the actions of their colleagues, members can develop reputations and accounts of trustworthiness over time.

> "Closure of a social structure…is important [for] the trustworthiness of social structures that allows the proliferation of obligations and expectations" (Coleman, 1988 p. S107)

Another network benefit of a closed structure discussed by Coleman (1988) is the ability to institute effective norms and sanctions. Norms are set in place as an attempt to encourage positive behavior and/or limit negative behavior. Sanctions are implemented to monitor or guide behavior or actions. Effective norms can only exist because agents know that sanctions may be instituted if the norms are violated (consequences). Therefore, effective norms may not exist in anything but a closed structure because in a closed structure group members can combine to enforce a collective sanction against the violating member (Coleman, 1988). "The consequence of closure is…a set of effective sanctions that can monitor and guide behavior." (Coleman, 1988, p. S107)

Extending Coleman's (1988) theoretical framework and findings on network closure and trust onto Communities of Practice adds a number of other interesting arguments. First of all, from a structural network perspective[18] one could argue that overall levels of trust will be greater in a closed social structure than in an open one, since obligations and expectations may be created and enforced. Looking at the Community of Practice example network (see Figure 5) this means that the sum of the overall trust of (A,B,C,D) should greater than the overall sum trust of (F,B,A,G).

With respect to sanctions it may be argued that there is an inverse relationship between trust and the number of sanctions imposed; whereas the trustworthiness of a member decreases as the number of sanctions imposed on that member increases. This would seem logical as trusted members of a Community would not be exposed to consequential behaviors (sanctions) unless they violated the trust of the group by breaking effective norms.

In addition to an inverse relationship between trust and the number of sanctions imposed there is also an inverse relationship between network closure and the number of sanctions imposed. As discussed earlier, sanctions and effective norms may not be maintained effectively in an open network because they can only be effectively imposed in closed networks since members' actions are transparent to the whole group. If one member takes advantage of the group (hoards information, doesn't reciprocate, etc.) it would not take too long before the group becomes aware of the member's actions and, as a result, takes appropriate negative actions (in the form of sanctions) against the member.

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[18] Where the modeling unit is a subgroup not a dyad

An additional argument may be made with regards to reciprocity in a closed network. Reciprocity is one of the key ways to build human capital within a closed network. A closed network both encourages and enforces reciprocity since members can see and judge the action of their colleagues. Since these actions, over time, result in the development of reputations it may be argued that low levels of perceived or actual reciprocity by members of a closed network will correspond with low levels of trust between those members and the non-reciprocating member(s). Extended periods of low level perceived or actual reciprocity in a closed network may even lead to its destruction or 'opening'.

Expanding on Coleman's (1988) idea of network closure to information and knowledge sharing allows for the argument of a couple more interesting points. If, as mentioned earlier, low levels of reciprocity lead to low levels of trust, which is necessary for information and knowledge sharing than it would follow that low levels of perceived or actual reciprocity will correspond to high levels of information hoarding. Additionally, if the number of sanctions imposed on a group is high, then it would follow that levels of trust within the group are low. If trust is low than knowledge dissemination is unlikely, therefore a high number of sanctions would correspond with a low amount of knowledge sharing. In other words, the number of sanctions imposed on a group and knowledge sharing within the group are inversely related.
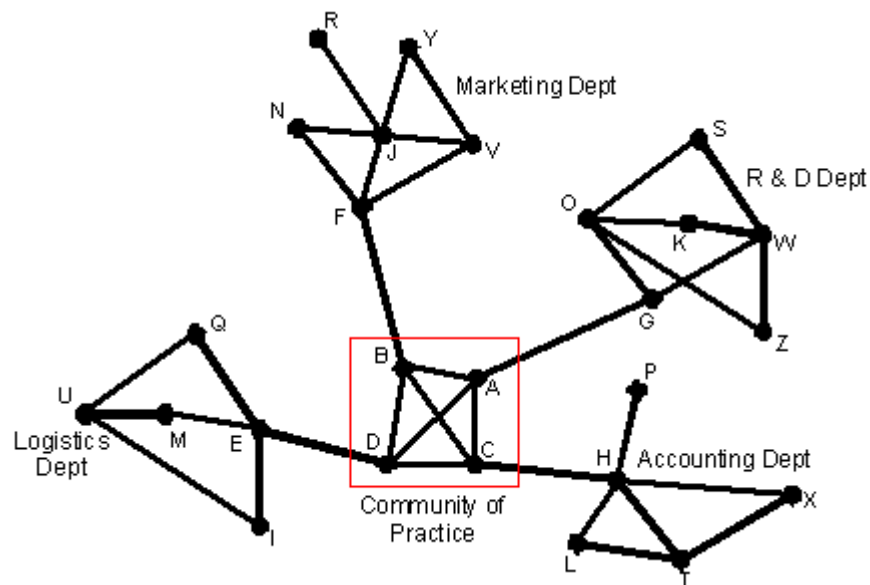

Figure 5: Community of practice example network

Prior to completing the discussion on closure it is noteworthy to mention that information within a closed structure tends to be redundant (Burt, 1992; Granovetter, 1973). Using redundant information can lead to the same types of problems as those mentioned in the closing section of homophily (i.e. lack of innovation, lack of knowledge creation, lack of exposure to opportunities, and lack of exposure to referrals).

8. Brokerage

The concepts of closure and brokerage seem as if they are in diametric contradiction to each other, though if a social network is structured effectively both principles may be utilized in order to gain a competitive advantage. Interestingly enough, members in Communities of Practice are positioned well to potentially draw advantages from both principles. First, the Community of Practice and its members reap the previously discussed benefits of a closed structure (A, B, C, D in Figure 5). Additionally, each member brokers a relationship between the collective entity (COP) and their other organizationally determined functional unit (A-G, B-F, C-H, and D-E in Figure 5). As a broker, each member fills what Burt (1992) calls a structural hole[19]. Being in a situation to fill these structural holes puts the broker in a position of power and provides him/her with three distinct types of benefits: *Information and Referral Benefits* (Burt, 1992); *Control Benefits/Tertius Gaudens* (Burt, 1992); and *Uniting Benefits/Tertius Iungens* (Obstfeld, 2005). Which benefit or strategy the broker chooses ultimately is likely to determine the level of trust within the COP and across

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[19] Burt (1992) defines a structural hole as a "separation between non-redundant contacts [or a] relationship of non-redundancy between two contacts"(p.18)

the functional units. The choice for strategy likely also has an impact on the groups' productivity and greater the overall performance of the organization of which the group is a part.

8.1 Information and referral benefits

It has been previously argued that homophily and closed structures can lead to redundancy[20] since these characteristics are likely to result in people having the same access to the same types of information. Conversely, non-redundant contacts offer a higher exposure to diverse sources of information (Burt, 1992; Granovetter, 1973). Following this logic reveals the first benefit of brokerage, where potential access to a larger more diverse network provides opportunities for greater access to valuable non-redundant information and referrals (Burt, 1992).

> *Players with a network optimally structured to provide these [information] benefits enjoy higher rates of return to their investments, because such players know about, and have a hand in, more rewarding opportunities. (Burt, 1992 p.13)*

The information and referral benefits achieved by each broker and their respective Community(ies) of Practice are high because each individual member (A, B, C, or D in Figure 5) has outside contacts that are non-redundant to the group (E, F, G, H in Figure 5) who posses timely new information and referrals[21]. Given that all the members truthfully share this information, the collective entity (A-B-C-D) is then able to harness the information benefits of the greater sparse network (A through Z). The information benefits achieved by the entire community (access to 26 sources) greatly outweigh the cost of maintaining the limited number of relationships (4 for each COP member). In network terms, yield per primary contact is high, while still taking advantage of the total number of contacts in the network (high total yield).

In order to be a source of these information and referral benefits, trust must exist between the sender and receiver. Trust or a sense of trustworthiness is much harder to access in this type of network structure because there is not social closure. There are fewer direct consequences (sanctions) against an actor who hoards or distorts information and there is very little opportunity for any individual to develop a reputation over time (Coleman, 1988). This creates additional difficulties because for information to be useable, it must, at least, be deemed to be credible to some extent. In a non-redundant network information is much harder to confirm. Information can be considered credible only if the source (sender) is considered credible by the receiver. For this to occur, the receiver must deem the source (sender) as trustworthy (Burt, 1992). The same is true from the sender's perspective where they must trust the receiver or deem them as trustworthy (in that they will not misuse the information given) for the receiver to gain timely access to the information or referral (Burt, 1992). For the receiver, this trust translates into a reduced effort with respect to finding non-redundant referrals and information; two essential elements in knowledge creation and innovation.

> *With a trustworthy primary contact, there is little loss in information benefits from the cluster and a gain in the reduced effort needed to maintain the cluster in the network (Burt, 1992, p.21)*

Extending the former arguments and findings on the information and referral benefits of brokerage and trust onto Communities of Practice adds a number of other interesting arguments. First, Communities of Practice will be more effective in their information seeking/retrieving behavior when their members exhibit high levels of trust with their respective functional units. If members of the COP exhibit high levels of trust with their respective functional units, than they should have increased access to the information and referrals from that information source. If each Community member shares the new information they acquired with the Community, the Community as a whole and all of its members benefit from the increased yield. Looking at the example provided in Figure 5 network trust can therefore make the difference between access to information and referrals from 4 people (closed or distrusting network) to 26 people (where each COP member has full access to all members in their respective functional unit).

In the previous example, trust is used to predict information benefits, but the same principle should be true if one were to look at it from the reverse perspective (at predicting trust through information benefits or number of referrals). In other words, high information benefits achieved by members of the Community of Practice (or a high number of referrals) will correspond to high levels of trust between the benefiting member and their corresponding external functional unit. To rephrase using the example network (Figure 5): high information

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[20] Redundancy is described in terms of network benefits. For example: similar contacts for referrals and information for decision making

[21] Each cluster in the example network (i.e. Marketing Dept., Logistics Dept., etc.) should be considered as one source of information and referrals since the information and referrals the members are likely to have (within each cluster) is the same (with few exceptions)

benefits (or referrals) achieved by A, B, C, or D will correspond to high levels of trust between A-G, B-F, D-E, or C-H.

8.2 Control benefits/tertius gaudens

A second class of benefit (*control*[22]) identified by Burt is based on the work of Georg Simmel who identified the tertius (third) role in relationships. Specifically, Burt (1992) discusses being in the position of a tertius gaudens or 'the third who benefits'. Tertius gaudens "describes an individual who profits from the disunion of others" (Burt, 1992 p. 31) and is traditionally based on a 'divide and conquer' mentality. In his work, Burt (1992) presents two tertius strategies, both of which create control benefits for the broker.

The first control (tertius gaudens) strategy is being the third agent between two or more actors after the same relationship (Burt, 1992). This view is similar to a standard economic view of competition or two people bargaining for the same thing. This type of control strategy can best be framed by Porter's (1979) supplier power[23] where two or more buyers bid against each other, benefiting the seller.

The second control strategy involves being the third agent between actors in two or more relationships with conflicting or opposing demands (Burt, 1992). In this type of brokerage, the tertius agent looks to create tension and conflict between the other actors in the relationship, in order to gain an advantage. This tension is brought upon by the broker creating uncertainty.

> *Where there is any uncertainty about whose preferences should dominate a relationship, there is an opportunity for the tertius to broker the negotiation for control by playing demands against one another. (Burt, 1992, p. 33)*

Community of Practice relationships are naturally structured in a way where members are given an opportunity to exploit these strategies for control benefits and personal gain (i.e. creating conflict between COP member requests and those from their own organizationally assigned functional unit). The problem is that these control benefits potentially enrich the tertius member more than the COP or the organization as a whole.

To reap the benefits the tertius broker might play parties against each other or exploit the network for control through the monitoring, filtering or hoarding of information. The situation may end badly for the tertius broker if the disunited agents, who are being played off of each other, become aware of their predicament. If this becomes the case, the jaded agents can combine efforts to force the tertius broker to agree to their demands. The discovery of the tertius gaudens behavior by the two disunited or exploited agents will also lead to a decrease in the trust between these agents and the tertius broker. Control benefits exhibited by a member of the COP should be frowned upon by the organization since the types of benefits achieved do not benefit the communities' members or the organization as a whole.

With respect to predicting trust in Communities of practice it may be argued that high control benefits achieved by members of the COP will correspond with low levels or decreasing levels of trust between the benefiting member and their corresponding external functional unit. To rephrase using the example network (Figure 5): high control benefits achieved by A, B, C, or D will correspond to low levels of trust between A-G, B-F, D-E, or C-H.

8.3 Uniting benefits/tertius Iungens

The last benefit of brokerage discussed in this paper was argued by Obstfeld (2005) and is called tertius iungens (YUNG-gains); meaning "to unite" or "to form". "The tertius iungens orientation is a strategic, behavioral orientation toward connecting people in one's social network by either introducing disconnected individuals or facilitating new coordination between connected individuals" (Obstfeld, 2005, p.102). The best way to explain tertius iungens (or uniting benefit) is to describe it as a strategy that directly contradicts or opposes Burt's arguments for tertius gaudens (control benefit).

To illustrate this point, control benefits encourage a buyer to play sellers against one another for the best price. Uniting benefits, on the other hand, enable buyers and sellers to find each other to create a mutually

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[22] Control benefits and information benefits are closely related. For example, screening information exhibits control of that information. Also, having more control puts one in a position where they can access and yield more information (Burt, 1992).

[23] Porter's (1979) buyer power can represent a similar relationship where two or more sellers bid against each other benefiting the buyer.

beneficial exchange. In a tertius iungens situation the non-partisan broker creating the connection only produces an agreement between the two new parties and then withdraws. The broker acts as only an arbitrator or a referral mediator.

Unlike control benefits, which tend to benefit only the tertius, uniting benefits can be advantageous for the entire social network. From a broker's perspective, the uniting behavior creates an opportunity for delayed reciprocity on the part of the benefiting parties. An act of arbitration, mediation or referral on the part of the tertius may create an outstanding obligation on the part of the benefiting participants. Also, actors with high tertius iungens orientations were found to be more likely involved in innovation (Obstfeld, 2005), an activity often conducted in COPs. For the Community of Practice and the organization, uniting behavior creates new ties and fills structural holes (Obstfeld, 2005) which open information channels and create opportunities for knowledge exchange, innovation, and other determinants of competitive advantage.

Obstfeld's arguments on the uniting benefits (tertius iungens) of brokerage produces two last brokerage related arguments with respect to trust. First, those agents with high terius iungens orientations will be rated as more trustworthy by their network peers than those with a terius gaudens orientation and second that high levels of overall trust must be present (both among members in the COP and their external contacts) for terius iungens activities to take place.

9. The small-world problem: Six degrees of separation

The final network principle discussed in this paper is based on Milgram's (1967) small world experiment conducted at Harvard, which looked to examine the interconnectedness of humans in the world. In the study, Milgram sought out to answer the question of what the probability was that any two people, selected at random, would know each other. Even though the study (Milgram, 1967) suffered from both selection and non-response bias, Milgram did present two interesting viewpoints on what he called the *"small-world problem"* (also known as *six degrees of separation*). The first says that:

> *Any two people in the world, no matter how remote from each other, can be linked in terms of intermediate acquaintances, and that the number of such intermediate links is relatively small [about six degrees of separation]*

> *The second view holds that there are unbridgeable gaps between various groups and that therefore, given any two people in the world, they will never link up because people have circles of acquaintances which do not necessarily intersect. (Milgram, 1967, p.63)*

In a similar follow-up study conducted by Dodds, Muhamad and Watts (2003) of 60,000 email users, the authors concluded that even though it may be true that a connection exists between targets there is little guarantee that the information finds its intended source. This is true because remote agents do not have sufficient incentive or motivation to continue on the chain. In order to be motivated they must trust the person making the request. Trusting a person becomes increasingly more difficult when degrees of separation increase, especially after the third degree (Dodds, Muhamad and Watts, 2003). Therefore, even though you can reach the person there is no guarantee they will fulfill your request. In cases where there is incentive or motivation the remote agent may also not be able to continue the chain because they simply do not have the ability (i.e. do not know anyone that can come closer to the target).

Extending the findings of Milgram (1967) and Dodds, Muhamad and Watts (2003) toward predicting trust produces the papers final arguments. First, that there will be an inverse relationship between levels of trust and degrees of separation. And second, after the third degree of separation trust between two contacts in a network will decline significantly.

10. Conclusion

This paper has applied four network principles (*homophily, closure, brokerage, and six degrees*) in an effort to make theoretic connections between trust relationships in and across a particular type of social network called a Community of Practice. With respect to trust, Communities of Practice are particularly interesting because their lack of authoritative control (from the organization) creates an environment that is heavily dependent on trust to survive. From a network perspective, Communities of Practice are ideal case studies because their members fill structural holes and operate in both closed (within the COP) and open (across the COP to the functional unit) social structures. This allows for a high benefits per contact as well as high total network benefits. This type of network is also an ideal environment to test the arguments proposed in a single case study/setting.

Testing the arguments discussed in this paper can create feasible[24] ways for organizations to reach conclusions about the trust relationships of their employees. If, for example, looking at network structure and individual actor characteristics can shed some light on the level of trust within and across the network, then organizations can use this information to make sure their employees trust each other, share information and knowledge and better position themselves for the organization to have a competitive advantage.

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[24] Feasibility is determined in comparison to conducting trust measurement surveys on all network members

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