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UNDERSTANDING COMMUNICATION NETWORK COHESIVENESS DURING ORGANIZATIONAL CRISIS: EFFECTS OF CLIQUE AND TRANSITIVITY

Completed Research Paper

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Abstract

Various terms such as organizational mortality, organizational death, bankruptcy, decline, retrenchment and failure have been used in the literature to characterize different forms and facets of organizational crisis. Communication network studies have typically focused on nodes (individuals or organizations), relationships between those nodes, and subsequent affects of these relationships upon the network as a whole. Email networks in contemporary organizations are fairly representative of the underlying communications networks. We show that changes in communication networks and its associated group cohesiveness have implications for studying organizational crisis. In this paper, we analyze the changing communication network structure at Enron Corporation during the period of its crisis (2000-2001). Our goal was to understand how communication patterns and structure were affected by organizational crisis. Drawing on communication network crisis and group cohesiveness theory, we tested several propositions using the Enron email corpus: (1) Number of cliques increases, and (2) Communication network becomes increasingly transitive as organizations experience crisis. The results of the tests and their implications are discussed in this paper.

Keywords: Communication network, organizational crisis, clique, transitivity

Introduction

A communication network is a personal or professional set of relationships between individuals or organizations. It is also described as patterns of contacts which are created due to the flow of messages among the participating actors (or communicators). The word 'message' encompasses everything that can flow from one point of contact to another within and between the networks, including data, information, knowledge, image and symbol. These communication networks could take various forms, such as, personal contact networks, work related contact networks, strategic alliances among various firms, global network of organizations etc. (Monge & Contractor, 2003).

In this research, we analyze the changing communications structure in order to investigate the patterns associated with the final stages of organizational crisis. Organizational crisis has been defined in many ways, by many different researchers, such as: organizational mortality, organizational death, organizational exit, bankruptcy, decline, retrenchment and failure to characterize various forms of organizational crisis (Mellahi et al., 2004). Although there is limited consensus among researchers on the precise definition of organizational crisis, there is evidence of shared meaning. Hermann (1972) defined crisis as a situation that threatens the goals of an organization, surprises the decision makers by its occurrences, put them under time pressure for appropriate responses and consequently engender high level of stress. Milburn (1983) identified several important elements of organizational crises, such as: crisis produces individual crisis; crisis can be associated with positive or negative conditions; crises can be situations having been precipitated quickly or suddenly or situations that have developed over time and are predictable etc. Weitzel and Johnson (1989) defined organizational crisis (or decline) as a state in which firms fail to anticipate, recognize, avoid, neutralize, or adapt to external or internal pressures that threaten the organization's long term survival. Sheppard (1994) defined crisis as 'a critical and irreversible loss by the system' and also posited that an organization dies when it stops performing the functions we would expect from it. A drastic form of critical loss occurs when firms moves into bankruptcy as in the case of Enron Corporation in the final quarter of 2001.

We draw on theoretical perspectives on organizational crisis proposed by network and other sociologists to test two key propositions on the changes in the network communication structure associated with organizational crisis. We analysed the Enron corpus, email communication log, released by Federal Energy Regulatory commission (FERC) in May, 2002.

Apart from a few studies (e.g. Tutzauer 1985, Krackhardt and Stern 1988, Loosemore and Hughes 2001), researches in the area of communication network behavior during crisis have been unusually scarce. While there are ample studies in the area of organizational crisis, we can't claim the same for communication network analysis during the organizational crisis. However, due to the highly publicized cases of various organizational crisis and subsequent disintegrations of many corporate giants (such as, Enron, Arthur Anderson, World Com), it is expected that network and organizational researchers will increasingly explore into the territory of organizational crisis and its effects on the organizational communication networks.

This paper is organized as follows: in the next section we discuss the premise that email networks do represent the communication network within organizations. Then a review of related research is presented. The theoretical background of the study is developed in the following section. An overview of Enron email corpus that we analyzed is described and the methods employed are included in the subsequent section. This is followed by a discussion of the results and their implications. We also revisit the extant theory based on our analysis of the Enron communications network during the period of its crisis.

E-mail communication networks: relevant studies

In this paper, we start with the premise that email networks constitute a useful proxy for the underlying communication networks within organizations. A study by Smith et al (2003) investigated how different age groups managed their personal networks and what types of technology-mediated communication tools they used. They found that people around their 30s (25-35 years) used email with most of their social network contacts (81%). The 60% of older age groups (50-60 years) also tended to keep in touch with their personal contacts primarily by using the email. As a modern and technologically advanced organization, we know that Enron employees used email as a significant medium of communication. Wellman (1996) has argued that computer supported social networks

(CSSNs) sustain strong, intermediate and weak ties that provide information and social support in both specialized and broadly-based relationships. CSSNs support and foster both formal and informal workplace communities. Guimera et al (2002) argued that email network provides an inexpensive but powerful alternative to traditional approach of survey which is expensive and time consuming. Indeed, they found that the exchange of email between individuals in organizations reveals how people interact and facilitates mapping the informal networks in a non-intrusive, objective, and quantitative way. Tyler et al (2003) described email communication network as a tantalizing medium for research which offers a promising resource for tapping into the dynamics of information within organizations and for extracting the hidden patterns of collaboration and leadership that are at the heart of informal communities of practice.

Eveland and Bikson (1986) analyzed the communication patterns that characterized the Rand Corporation's use of email system. They reported that, indeed, the barriers to communication among people with different disciplinary backgrounds were mitigated by emails. Gloor et al (2003) posited that analysis of email and other interaction logs of organizations will enable researchers to discern the structure of networks and identify core contributors. In their experiment, they were able to identify a group of leaders in the networks they analyzed.

Not many studies are being conducted in the area of communication network analysis and organizational crisis. In a study of crisis effects on intra-organizational computer based communication, Danowski and Edison-Swift (1985) identified that during crisis: amount of communication increased; number of communicators increased; messages became shorter; individual-level networks became less interlocking; and, the macro-level network became more grouped. Krackhardt & Stern (1988) found evidence that the structure of communication patterns in crisis situations was an important contributor to organizational success. Loosemore and Hughes (2001) argued that there is little understanding of social and communication structures during crisis and studied the appropriate pattern of social ties during crisis. They found that during the crisis period, efficient information flow is important to the reduction of uncertainty; which, in turn, is important to the reduction of misunderstanding, disagreement, tension and conflict. Some other findings from their study also include: during crisis, there are strong motives to pursue inappropriate structures; parties with similar interests tended to pool information to increase their powerbase; and, the contraction of responsibility.

Several researchers have carried out research using Enron corpus from a social network analytic perspective. Diesner et al (2005) explored the dynamics of the structure and properties of the organizational communication network, as well as the characteristics and patterns of communicative behavior of the employees from different organizational level. They reported preliminary results indicating that during the crisis period, the network density, centralization and connectedness increased as the crisis deepened (Diesner et al. 2005).

Theoretical background: Group cohesiveness in communication networks during crisis

There are two relevant bodies of literature in the area of organization crisis. The first one is in the area of group behavior during crisis period pursued by sociologists and organizational theorists. The other area is related to studies of communication networks during crisis.

Cohesive subgroups (such as cliques) as well as group cohesiveness (such as transitivity) have been a crucial link between individuals and organizations. Sociologists have argued that individuals are most strongly influenced by their primary groups – people with whom they frequently communicate. Organizational theorists have also argued that large organizations are composed of essentially non-overlapping subgroups which contain dense interactions (Frank, 1995). A series of studies with highly consistent results has identified the relationship between crisis and cohesiveness. In these studies, it was found that persons felt themselves to be more powerful together than alone. Researchers have also found that the higher the group's cohesiveness, the less the group members felt threatened (e.g. Bernert & Ikle (1952); Torrance (1954); Pepitone & Reichling (1955); Stotland (1959); Cohen (1959). Mulder & Stemerding (1963) argued that the casual relationship between threat and the tendency of the human beings to associate may be hypothesized and this hypothesis has found support in a number of studies (e.g. Sherif & Sherif (1953); Pepitone & Kleiner (1957); Berkowitz *et al.* (1957)).

Lanzetta (1955) found that there is an increase in positive, group oriented behaviors such as cooperativeness, friendliness, group discussion, integrating acts, etc., under increased stress. He interpreted these behaviors as

indication of members' perception of groups as a source of security in the face of external threat. Similar to these findings, Weller (1963) also argued that "cohesiveness will be greater under conditions of high anxiety, where the need to affiliate presumably has been aroused".

The impact of changes to communication networks and cohesion on organization crisis is discussed in this section. The association of structural changes, such as clique formation and transitivity, with organizational crisis and vice versa has been of great interest to the researchers in the area of social network analysis. However, substantive empirical research to explore specific theoretical propositions has been sparse, primarily due to the difficulties in gathering appropriate data.

Cliques and organizational crisis

One of the long accepted and well researched hypotheses related to group behavior is that external threat draws group members together and increases group cohesiveness. Much of the research supporting this conjecture comes from studies of inter-group conflict. For example, Lanzetta's (1955) study suggested that as stress increases there is a decrease in interpersonal friction and an increase in collaboration and cooperation. Simmel (1955) argued that conflicts lead to cohesion because the exigencies of conflict require centralization and conformity. He also noted that external conflict can bring together people who would otherwise have nothing to do each other. Pepitone and Kleiner (1957) studied the effects of threat and frustration on cohesiveness. Their results show that cohesion (in other words, interpersonal attraction) increases as threat and frustration are reduced. One of the best known and one of the earliest illustrations of the effect of threat on cohesiveness was Sherif's boys' camp studies (Sherif, 1953; Sherif, 1961). All of Sherif's (1966) field studies seem to support the hypothesis that conflict between two groups tends to produce solidarity albeit within factions and groups.

Social support theory (Kadushin, 1983; Lin & Ensel, 1989) can be used to describe theoretical mechanisms behind clique formations within a communication network during crisis. Lin and Ensel (1989) has defined social support as the perception or reception of individual by which resources in the social structure are brought together to meet the functional needs during routine and crisis situation. They argued that closer relations with others (or, in terms of more email exchanges between various individuals) whom one might confide and receive various forms of feedback from may significantly affect one's well-being. Some researchers argued that this effect is direct and independent of life events. Others have suggested that social support mediates or buffers the effect of life events on psychological illnesses. Kadushin (1983) argued that many societies and communities that create crisis and stressful situations also provide social structure to alleviate the reactions to these crises and situations. He explained that Simmel's cross-cutting circle, where a single circle includes persons with widely differing characteristics. But, they do have something in common – they care a great deal about some issue, social role and attributes. This wide spectrum of various other interests gives the circle (e.g. group of individuals or cliques) the kind of 'objectivity' which individual bring to the system may have enormous potential in combating against crisis induced stress by "(1) conveying immunity though leading the members to a better understanding of their problems, (2) being a resource for help, or (3) mobilizing resources" (Kadushin, 1983, p.191). In general, this theory of social support has received strong confirmation from various researchers (Kadushin, 1966; Dean & Lin, 1977; Henderson, 1980; Leavy, 1983; Berkman, 1984; House & Kahn, 1985; Wethington & Kessler, 1986; Cohen & Wills, 1985).

In an interesting theoretical study of organization disintegration in communication networks, Tutzauer (1985) showed that as an organization dissolves, its communication network tends to be increasingly stratified, marked by a large number of tightly-knit cliques and factions. He suggested that number of cliques increases when organization is closer to dissolution. Or, in other words, consider two communication nets with the same number of members and links. If one has more cliques than the other, it is likely to be closer to dissolution; because communication links in this type of network structure are concentrated among small groups (cliques) rather than across the larger community. This leads to our first proposition:

Proposition 1: Number of cliques increases in a communication network as organizations are going through crisis

Transitivity and organizational crisis

Three actors (say A, B & C) are transitive if whenever A is linked to B and B is linked to C, then C is also linked to A. This concept of transitivity has striking resemblance to the concept of Balance Theory. Heider's (1958) Balance Theory posited that if two individuals are friends they could have similar evaluations of an 'object'. This concept was extended and mathematically formulated by many authors, like, Cartwright & Harary (1956); Harary, Norman & Cartwright (1965) and by Davis & Leinhardt (1972). They argued that the third 'object' could be a third person in a communication network. If two individuals do not consistently evaluate the third person, there is a possibility of state of discomfort among them and they would try to reduce this inconsistency by evaluating their evaluation of either the third party or their own friendship. Heider's explanation of Balance theory was confined to a maximum of three entities. The generalization of Balance theory by others, such as Cartwright & Harary (1956), by using the concept of graph theory, contains no such limitation. It includes any finite number of entities and any type of relations.

Holland and Leinhardt (1971) used graph theory to illustrate various organizational patterns which may result after the condition of transitivity is satisfied. They indicated that transitivity can result in stratification as well as clustering. They also posited that if transitivity is considered to be a generalization of Balance theory, then balance can lead to the development of hierarchies as well as cliques. Heider (1958) proposed that, from psychological perspective, the case of three positive relations may be considered as transitive. Besides, triads other than the positive ones also tend to form a balanced state. Likewise, people also prefer balanced structure in their day to day lives. If the structure is not balanced people experience various psychological effects such as "strain" and "tension". Heider (1946) argued that these negative psychological cues eventually generate forces towards balanced structures. As the organizations go through the state of crisis, people also experience "strain" and "stresses", which will ultimately lead the actors to form a balanced state within the communication structure. As described earlier, crisis will lead to increased group cohesion. This increased cohesion will prompt the actors to reach a balanced state, thus increasing the network transitivity of the whole network. This leads to our last proposition:

Proposition 2: Organizational communication network becomes increasingly transitive as organizations experience crisis.

Enron Dataset

In this section, we describe the Enron dataset that is used for our study. We also describe the various thresholds we applied in the dataset to retrieve our required information.

Dataset

In order to fully understand the context of this corpus we need to understand the Enron's organizational downfall, mostly instigated by the unethical business practices of its senior management and overall organizational culture (Fox, 2003). Founded in 1985 at Texas, within a decade, Enron became a global player and a symbol of innovative and progressive business conglomerate that also became actively involved in the area of metals, pulps and paper, broadband assets, water plants and financial markets internationally (Healy et al., 2003). They became so successful that, in 2000, Enron's annual revenue was \$101 billion which made it the seventh largest company in the United States, bigger than IBM or Sony (Fox, 2003). However, during the later part of 2001, it became slowly evident that with the help of Arthur Andersen (Enron's auditor since 1985), Enron had been grossly overstating its profits and understating debts for the previous 5 years. On October 16, 2001, Enron disclosed that it had lost \$618 million in third quarter earnings. On December 2, 2001, Enron filed for chapter 11 bankruptcy protection in a New York Bankruptcy court. With \$62 billion in assets, this was the largest bankruptcy in the history of the US up to that time. By January 2002, Enron stock lost 99% of its value. Stockholders lost tens of billions of dollars and many of the company's 20,000 employees lost their retirement savings pensions and jobs (Fox, 2003; Healy et al., 2003; Hamilton, 2006). Since filing for bankruptcy on December 2, 2001, the Justice Department has conducted an ongoing criminal investigation into fall of Enron which has resulted in a number of criminal charges being filed against several top executives, including fraud, conspiracy and insider trading.

In May 2002, the US Federal Energy Regulatory Commission (FERC) publicly released a large set of email

messages, the Enron corpus. The corpus contains 619,446 email messages belonging to 158 users over a period of 3.5 years. Shetty and Adibi (2004) of University of Southern California created a MySQL database of this corpus. They also cleaned the database by removing a large number of duplicate emails, computer generated folders, junk data, invalid email addresses, blank messages etc. The resulting dataset contains 252,759 messages from 151 employees distributed in and around 3000 user defined folders. We use this database to perform our experiment. In the area of organizational science and social networking research, the Enron corpus is of great value because it allows the academic to conduct research on real-life organization over a number of years.

Data cleaning

Since the process for creating MySQL database by using the Enron e-mail corpus introduced by Shetty and Adibi (2004) has been well documented we decided to use this dataset. In retrieving data we imposed some thresholds on the data.

- First, we only considered the 151 Enron employees who sent emails during the year 2001. Even though we had the data of prior to and after the year 2001, we considered the year 2001 only as the organizational crises was at its peak during this period which resulted in the bankruptcy declaration during the first week of December 2001.
- Second, in retrieving cliques, we considered only the reciprocated ties during each month of the year 2001. The definition of cliques originally proposed by Luce (Luce, 1950) required that all ties between the pairs of nodes in a clique be reciprocated. In order to be considered as a relationship, we applied a threshold of 6 or more emails exchanges that had to have taken place between the two actors over a period of 1 months. After identifying the reciprocated ties, we excluded self addressed emails from our dataset. We also deleted many emails that seem to have contained invalid email addresses, e.g. addresses like 'noaddress@enron.com'; system generated emails etc.
- Third, for calculating the transitivity of the network, we considered the emails sent during each week of year 2001.

We use UCINET software (Borgatti et al., 2005) to draw the network diagram and calculated two measures: number of cliques and transitivity scores of the network.

Measures of communication network

In this section we discuss two measures of communication networks – cliques and transitivity. First, we define these attributes of the network and then we discuss how these attributes are measured for the purpose of this study.

Cliques

A clique consists of some number of actors (more than two) having all possible ties present among themselves. It can be argued that the so called 'strict' definition of cliques (maximal, fully connected subgroup) rarely meets the criteria in a real-life dataset. As a result, "clique" definition has been "relaxed" by researchers (Wasserman & Faust, 1994) in two major ways to make it more general and helpful: based on distances within group (*n-clique*, *n-clans* and *n-clubs*); and the next one is based on density/number of ties present (*k-plex*). In this paper, we only consider clique and *n-clique*.

n-clique allows an actor to be a member of a clique even if they do not have ties to every other member within the clique so long as they have ties to some members and no further than *n* steps from all members of the clique. A value of $n=2$ is often used by researchers as cut-off value. 2-cliques are subgroups in which all the group members are not required to be adjacent, but all of them would be reachable through at most one intermediary (Wasserman & Faust, 1994). Scott (2005) described this definition of 2-cliques to be much closer to people's everyday

understanding of the word ‘clique’.

The definition of a clique implies that in order for a group to be considered as clique there should be at least 3 nodes in the group. The condition of at least 3 nodes is included to exclude mutual dyads from the cliques (Wasserman & Faust, 1994). In our analysis, we have also considered at least 3 nodes while extracting cliques from the dataset.

Transitivity

Three actors are transitive if whenever A is linked to B and B is linked to C, then C is also linked to A. Transitivity is the total number of transitive triples divided by the number of potential transitive triples. There are a number of different ways in which we could try to norm this count so that it becomes more meaningful. One approach is to divide the number of transitive triads by the total number of triads of all kinds. Another approach is to norm the number of transitive triads by the number of cases where a single link could complete the triad. That is, norm the number of {AB, BC, AC} triads by the number of {AB, BC, ANYTHING} triads (Hanneman & Riddle, 2005). In this study, we have used the first approach for transitivity score, i.e. the number of transitive triads / the total number of triads of all kinds.

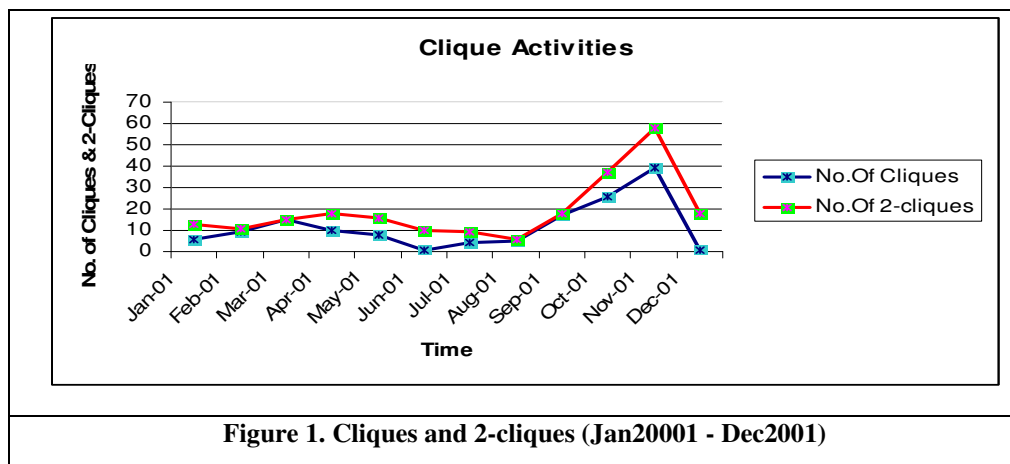
Results

In this section, we present the results of the social network analysis of the Enron email corpus using the measures discussed in the earlier section. These highlight the relationships between the group cohesiveness in the communications network and organizational crisis.

Cliques

We identified the number of cliques and 2-cliques by applying our threshold (minimum of 6 email exchanges between the reciprocated actors within a month). Adjusted number of cliques and 2-cliques were also identified after correcting for the total number of actors participating in the exchange of email communications. Clique relationships also existed during 1999 and 2000. However, we have not included the results in figure below as we only concentrated on the final stages of Enron’s crisis period, throughout the year 2001.

Figure 1 provides us with an overview of clique formation pattern.



From figure 1, we can see that there is a sharp increase in the number of cliques and 2-cliques formed as the organization moves towards the peak crisis period. Although the trend is not monotonically increasing (e.g. there are fewer cliques in June 01 than May 01), the dramatic increases in the cliques of both kinds (cliques and 2-cliques) during September, October and November of 2001 is significant. It is important to note that this was the time during which Enron was in complete turmoil. Jeff Skilling resigned as CEO on the August, 14 2001. After some time, during mid October, the company revealed that, it lost \$618 Million dollars in the 3rd quarter earnings, eventually leading to the bankruptcy declaration on December 2, 2001. Due to the bankruptcy declaration, and subsequent departure of many employees lead to the reduction in the number of cliques in December. The observed pattern of an increasing number of cliques while the organization goes through the period of acute crisis lends support for the proposition even though we cannot make any causal claims.

Table 1 shows the number of actors joining the cliques and 2-cliques compared to all the actors in the network.

Table 1: Number of actors joining cliques			
Time	No. of actors joining cliques	No. of actors joining 2-cliques	Total no. of actors
Jan01	9	52	75
Feb01	10	61	67
Mar01	27	87	88
Apr01	19	96	110
May01	12	100	111
Jun01	3	44	62
Jul01	8	48	50
Aug01	8	29	37
Sep01	26	88	92
Oct01	88	277	323
Nov01	56	218	257
Dec01	3	64	74

Again we observe a sharp increase during September-December 2001, when the disintegration of Enron was at its height. Overall, our results point to heightened clique activity and participation in cliques during acute organizational crisis.

Transitivity

Figure 2 plots a graph of transitivity score of the network during the period of Jan – Dec, 2001.

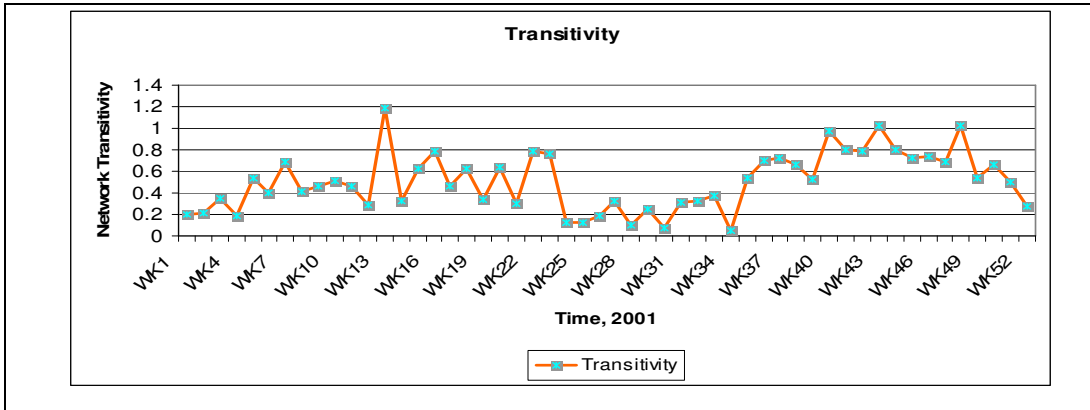


Figure 2: Transitivity within Enron email network (Jan2001 – Dec2001)

This graph does not show a consistent pattern of transitivity scores throughout the year 2001. However, if we look at some of the significant events that generated crises within the organization, we observe some similarities in patterns in terms of transitivity. One of the CEOs of Enron resigned on the 15 August, 2001 (Week 33), leading to some sort of crises. If we look at the transitivity scores during that period, we see that there is a sharp decrease in transitivity on the week 34, immediately after the resignation of the CEO (on week 33). However, transitivity increased significantly on week 35 again. Another example of decreased transitivity scores is related to the period of final crisis period which eventually lead to the disintegration of the organization. During week 48 (02 Dec, 2001), Enron declared bankruptcy. The following week, week 49, the transitivity scores decreased significantly. Although, the score increased slightly during the week 50, it decreased again on subsequent weeks. So, there seems to be a consistent pattern of decreased transitivity during the organizational crisis period. However, it is not possible to make any definitive conclusion. Let's look at the transitivity score of week 42, during which period Enron announced (for the first time) a net loss of \$618 million and people became aware of the accounting irregularities practised within Enron. Immediately after this crisis broke out, on the week 43, transitivity score, actually, increased prompting us not to have any definitive conclusion about the correlation of crisis and transitivity scores.

We also conducted time series analysis for the year 2001. The result is depicted in the following figure.

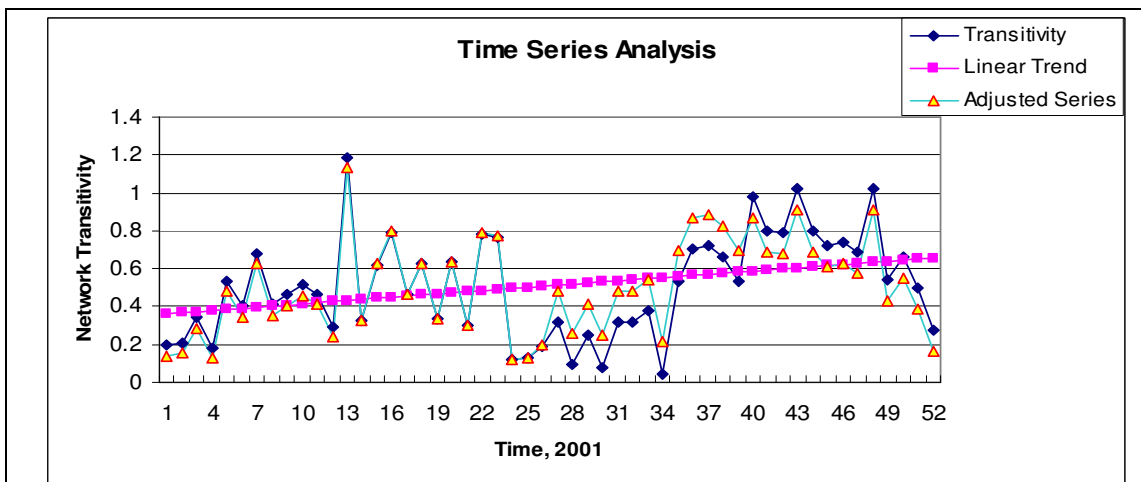


Figure 3: Time series analysis (Jan2001 – Dec2001)

The adjusted series is the series after adjusting time effect. Normally, time adjusted series follows the linear trend curve. However, we can see from figure 3 that the trend does not follow the linear curve. This indicates that something different had happened during the period (i.e. 2001), which support our transitivity proposition.

A detailed discussion about the transitivity and organizational crisis is provided in the discussion section. We also compared the results of clique activities and transitivity in the discussion section.

Discussion

In this section, we discuss the implications of the results obtained from our research in relation to cliques activity and transitivity during organizational crisis.

Cliques and organizational crisis

As Enron approached disintegration during the last part of 2001 (the peak crisis period), evidence suggests that more people appear to communicate with people with whom they have not communicated with before. As a result, the number of communications increased as well as the number of communicators as indicated by Danowski and Edison-Swift (1985). During this peak crisis period, there was a jump in the number of cliques as well as in the clique participants at Enron which lends credence to our proposition 1.

Previous research carried out by Mulder and Stemerding (1963) and Weller (1963) have found that people seek the company of others when they feel threatened as in the case of Enron crisis. The reasons generally given for this behavior during crisis are: (1) cliques provide anxiety reduction and the comfort of being with others, and (2) they allow self-evaluation through comparison with others (Stein, 1976). Loosemore and Hughes (2001) argued that people with similar interests form groups (or cliques) during crisis for various reasons. One of the reasons is to increase the power base of the groups during negotiations at times characterized by scarce resources. Another reason is the contraction of responsibility during the crisis.

Transitivity and organizational crisis

It is necessary to compare the results we obtained for transitivity with the results of proposition 1, in relation to 2-cliques. Figure 4 plots the graph of transitivity and number of 2-cliques throughout the year 2001.

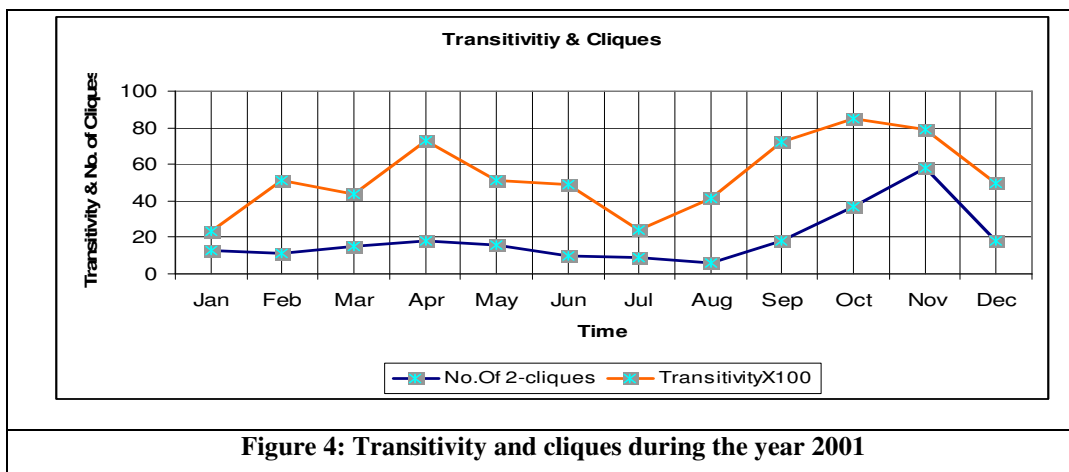


Figure 4: Transitivity and cliques during the year 2001

From January 2001 to December 2001 we observe a pattern of increasing transitivity correlating to the increase clique numbers, as transitivity increases or decreases clique numbers also increases and decreases accordingly. However, there are some exceptions to this overall observation. For example, during the period of July to August, the transitivity scores increased whereas the number of cliques decreased. In similar pattern, from October to November, during the peak crisis period, the transitivity score decreased, but the number of cliques increased, as expected. Transitivity scores also decreased during the final months of 2001, when the organization declared bankruptcy. Number of cliques also decreased during this period as there seems to be a withdrawal behavior of the participating actors during this period. So, in general, during this period transitivity doesn't appear to play a significant role in roping off subgroups as predicted by Tutzauer (1985) and our proposition 2.

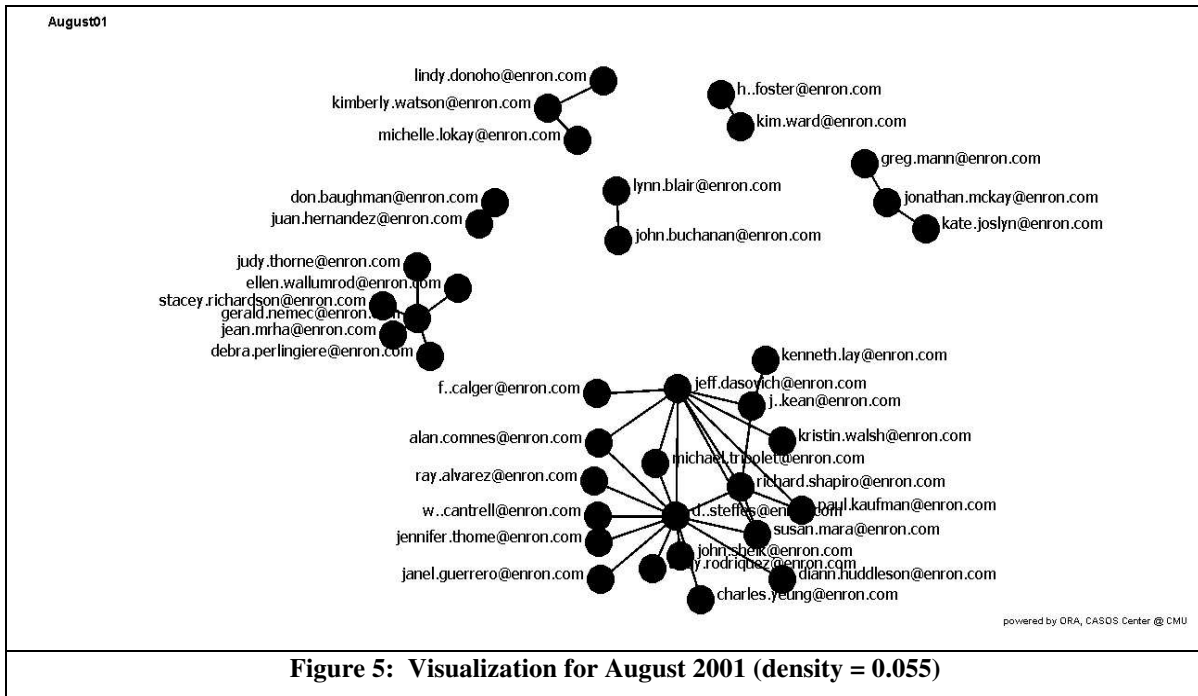
Increased transitivity is not a unique feature of crisis effect. Morrissette (1958) tested two hypotheses, derived from the refinement of Heider's Balance theory. One of the hypotheses was related to tension and its subsequent effect on balance: the magnitude of tension created by a system is inversely related to the degree of balance of that system. From his experiment, Morrissette found support for this hypothesis, as the tension increases within a network (or system) the balance decreases, so is the transitivity.

The most interesting phenomenon we observe in relation to transitivity is that, overall, the transitivity score of the network is quite low. This relatively lower transitivity of the Enron email communication network may be attributed to the fact that the organization went through a period of unethical business practices exercised by some of its senior management employees (the dataset we studied encompasses many of the senior management staffers, including CEO, Chief Financial Officers, various vice presidents, directors and other senior management staff). Brass et al. (1998) argued that the need for balance among three people can influence the likelihood of unethical behavior. According to Balance theory, when two strong ties exist in a triad the possibility of a third strong tie is much greater than when two strong ties do not exist. When all three parties are connected by strong ties, it is referred to as Simmelian triad (Krackhardt, 1992). Brass et al. (1998) provided two examples where there are three strong ties of the Simmelian triad and the two weak ties and a missing third link of a structural hole – represent extreme but frequent interaction patterns within a communication network. According to Granovetter (1973), various other combinations of strong and weak ties are less frequent. Brass et al. (1998) suggested that as the overall strength of the triad increases (from weak-tie structural hole to strong-tie Simmelian triad) the likelihood of unethical behavior will decrease. This is due to the fact that there is a potential loss of 'reputation' and relationship within the triad if it is affected by unethical behavior. One of the main reasons of Enron's spectacular demise was due to a number of senior managers' unethical conducts in relation to its accounting practices. So, it is not surprising that the network displays a relatively less transitivity as the organization was going through crisis.

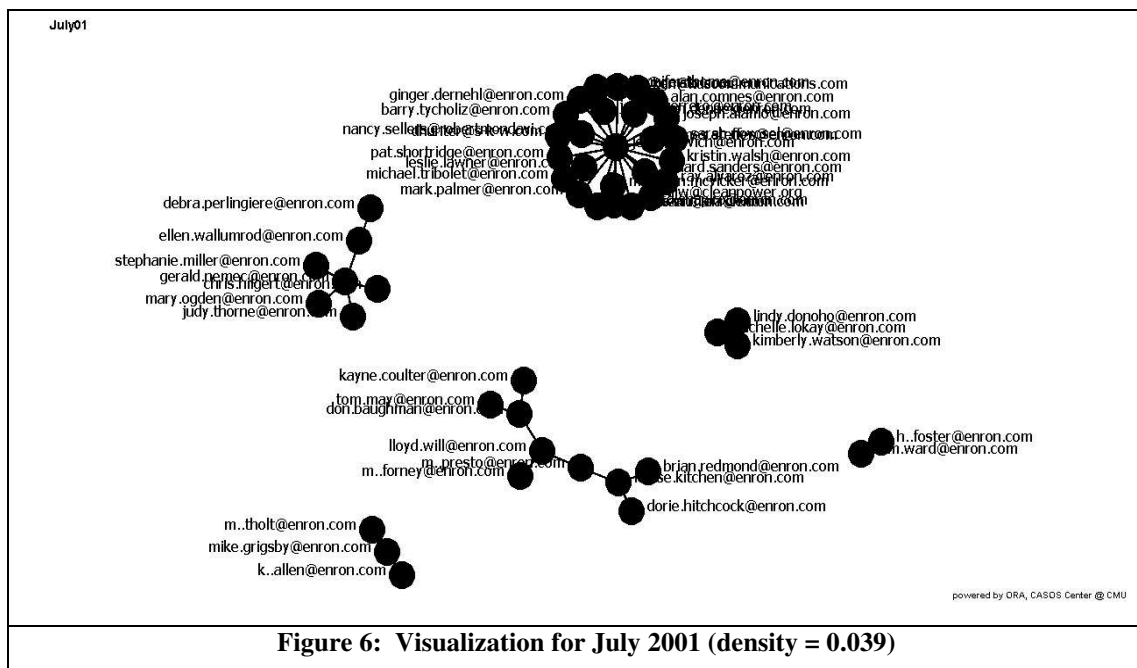
Tutzauer (1985) posited that transitivity exerted the most profound influence and was totally deleterious in terms of the network's cohesion. He argued that it might initially seem that transitivity will decrease system dissolution because one way to achieving transitivity is by adding links to the existing network (transitive closure). But other, more subtle situations can also result. Even though links may (or may not) be added, transitivity implies a roping off of groups, eliminate bridges and liaisons, creating completely isolated factions, and totally stratifies the network. Transitivity creates two or more completely separated but highly cohesive social subgroups. He also suggested that in the advanced stages of crisis, communication among group members increase within subgroups, but decrease between subgroups. The whole network may disintegrate into several warring factions. He also used graph theory to prove that such behavior results from transitivity. To examine this phenomenon we compare the density value for each monthly network over the year 2001. We find that Enron's monthly network (of 2001) is not well connected. For example, the highest density found is 0.055 (for August, 2001). Second highest density is found for July, 2001 (density is 0.039). The average monthly density value is 0.0261. All these density values are far smaller than the density value of a completed graph (which is 1).

To further reinforce this phenomenon we provide the network visualization for the month of August and July 2001, as these two months possess the highest and the second highest density value

- Agent : size 37
- Agent x Agent



- Agent : size 50
- Agent x Agent



From figure 5 and 6, we see that various smaller cohesive subgroups are being formed due to less connectedness within the network.

Conclusion

As a corporation, Enron was widely acclaimed as a paragon of economic and organizational innovation only to be pilloried after its collapse. Numerous analyses on Enron crisis have commented on Enron's culture of individualized self-enrichment. Enron celebrated a culture of accelerated performance coupled with the pressure to innovate at speed. The highly individualistic, winner-takes-all culture was so powerful that it led some senior employees to blur the line between legal and illegal activity, through corrupt and unethical exploitation of law and regulations. This type of egregious behavior paid off for a while. When it did, "successful" employees were indulged with bonuses, share options and grandiose self-enrichment schemes (Roberts et al., 2006). These opportunities for huge bonuses led Enron employees to act in their own interests rather than Enron's. It has been suggested that Enron's "...obsession with continuous transformation, with newly deregulated markets, innovation and continuous opening and closing of new business units at different spatial scales and relocation and departure of employees, led not only to a lack of institutional memory but also to faulty decision making, employee role confusion, managerial unaccountability, and an over-reliance on younger employees lacking in managerial experience" (Roberts et al., 2006, pp.574).

The presence of cliques does not in itself necessarily produce disintegration in groups or organisations. Stogdill (1959) suggested that group integration will be "high when the subgroups are well integrated, when their norms support the structure and objectives of the larger group, and when activities of the subgroups are well coordinated". Subgroups or cliques may contribute positively to maintenance of the group or organisation as a whole, in that, they "provide escape from unpleasant organisational pressures, strengthen the confirmation of value systems, and often reinforce the identification of members within the larger groups" (Stogdill, 1959).

While cohesion is commonly observed in crisis situations, it is by no means universal. Bettelheim (1943) showed that prisoners acted alone in concentration camps. Quarantelli (1954) found that people panic when they fear possible entrapment, when they feel the collective action is powerless to deal with the situation, and when they feel alone in that they must act and depend on their individual selves to find a way to safety. Wolfenstein (1957) argued that crisis and disasters can bring about best and worst in a human being. She posited that feelings of abandonment lead to a rise in affiliation needs, and on the other hand the worst in people is brought out in a situation where the competition for the means of survival is fierce. Foreman (1963) suggested that there is a third possible reaction to cohesive behavior and panic, namely, resignation. He argued that resignation occurs when people do not know what to do or when they believe that any action is futile. Hermann (1963) argued that increased stress on authority due to crisis will increase the probability of conflicts between the authority units and other units. He also argued that as conflict increases within an organization, there is a greater tendency towards withdrawal behavior among the organization members. Alexander Mintz's theory of non-adaptive group behavior demonstrated that when the reward for co-operative behavior became uncertain in a threatening situation, competitive behavior occurred with each person attempting to withdraw and act independently of the group (Mintz, 1951). Hamblin (1958) suggested that in every crisis situation he studied there was a likely solution to the crisis – a solution that requires the cooperation of all or most of the members of the groups involved even though this may not apply to Enron. He went on to set up an experiment in which no likely solution to the crisis was available. Based on the results of the experiment, he suggested that group integration decreases during a crisis if a likely solution to the crisis problem is unavailable. (Hamblin, 1958).

The results of our study of Enron crisis using the email communication corpus clearly point to high levels of clique activity in response to the enveloping crisis during the final months of 2001. This finding further reinforces a tendency that has been predicted based on theory and empirically observed in previous research. However, we found weak support for the proposition that transitivity will increase as the organization is going through crisis. As noted in the foregoing, this anomalous result could be an artefact of the particular nature of the crisis that unfolded at Enron. From a theoretical standpoint, this suggests that this proposition needs to be reconsidered by taking into account the specific contingencies associated with the crisis.

There has been strong evidence that, recently, many sociologists, organizational researchers and social scientists are using network analysis tools and techniques to increase their understandings of various organizational phenomena during crisis period. This study also highlights the importance of studying (or exploring) organizational communication network structure during acute crisis period. As organizations are complex and cooperative systems, the network structure that exists within it may either hinder or facilitate cooperation during crisis period. Managers should pay more attention in developing and nurturing informal subunits that concentrates on exchanging communications between the subunits, in oppose to within the subunits, during crisis period. Managers can also take targeted actions to encourage and promote connectivity. So, effective communication structure should be designed consciously.

This research was conducted using email communication data from a single organization. Hence any claims of generalizability are problematic. Field studies involving data from more organizations are needed before we can arrive at more definitive conclusions. Further research should compare actual face-to-face communications, telephone communications, letters, and memoranda along with electronic mail.

The methodological contribution of this study is worthy of note. This study builds on an emerging stream of research area that applies social network analysis to organisational interaction data (especially, the email interaction) to study various questions related to organisational change and disintegration. With increasing popularity of email as an interaction medium and increased popularity of social network analysis methods and tools, it is expected that we will be able to develop a deeper understanding of the various social and organisational phenomena, specially, interaction and communication patterns (both formal and informal), widely observed within contemporary organisations.

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