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Recommended Citation

Davis, Joseph; Hossain, Liaquat; and Murshed, Shahriar Hasan, "Social Network Analysis and Organizational Disintegration: The Case of Enron Corporation" (2007). *ICIS 2007 Proceedings*. 5.
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SOCIAL NETWORK ANALYSIS AND ORGANIZATIONAL DISINTEGRATION: THE CASE OF ENRON CORPORATION

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Abstract

Email networks in contemporary organizations are fairly representative of the underlying communications networks. We show that changes in communication networks have implications for studying organization disintegration. In this paper, we analyzed the changing communication network structure at Enron Corporation during the period of its disintegration (2000-2001). Our goal was to understand how communication patterns and structure were affected by organizational disintegration. Drawing on (social) network disintegration theory, we tested several propositions using the Enron email corpus: (1) Number of cliques increases (2) Communication network becomes increasingly centralized, and (3) Connectedness among the top management executives increases, as organizations move towards disintegration. The results of the tests and their implications are discussed.

Keywords: Social Networks, Cliques, Connectedness, Centralization, Organization Disintegration

Introduction

A social network is a personal or professional set of relationships (e.g. friendships, trusts, hates, email exchanges, trade, financial exchanges etc.) between individuals or organizations. Social 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. Social network analysis (SNA) has been employed since the mid-1930s to advance research in the area of social and behavioral sciences, but progressed slowly until the end of last century (Carrington et al., 2005). Along the way, SNA has developed procedures for detecting structural patterns, seeing how patterns of various relationships interrelate, analyzing the implications of the structural patterns for the behavior of nodes, and studying the impact of social ties and relationships on structural characteristics of the networks (Wellman, 1996).

In this paper, we attempt to analyze the changing communications structure in order to investigate the patterns associated with the final stage of organizational disintegration. This study is made possible by the fact that Enron Corporation went through the final phase of disintegration during the period early 2000 to late 2001 and the entire set of email communications exchanged by Enron employees during this period was made available for research by the Federal Energy Regulatory Commission (FERC). Various terms such as organizational mortality, organizational death, organizational exit, bankruptcy, decline, retrenchment and failure have been used interchangeably in the literature characterize different forms and facets of organizational disintegration (Mellahi & Wilkinson, 2004). Although there is limited consensus among researchers on the precise definition of organizational disintegration, there is evidence of shared meaning. Weitzel and Johnson (1989) defined disintegration 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 disintegration 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 move into bankruptcy as in the case of Enron Corporation in the final quarter of 2001. During bankruptcy, the control of the firm shifts to the courts and to a group of managers and creditors. More importantly, in a bankruptcy, none of the stakeholders (stockholders, creditors, workers, etc.) are able to achieve their goals.

We start with the premise that email networks constitute a useful proxy for the underlying communication networks in contemporary 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. In a subsequent work, he also reported that work groups in organizations using computer mediated communications tend to achieve higher levels of communication than those who do not, although this may reduce the use of face-to-face communication. Moreover, "forward-and-copy" feature of email communication (which is also inexpensive to maintain) provides indirect connections between previously disconnected people and organizations and promote weak ties. Some of the examples include: work teams that spans boundaries, inter-organizational coordination of joint projects, linking of buyers and sellers in different organizations etc (Wellman, 1997).

Guimera et al (2002) argued that while formal chart of an organization is intended to prescribe how employees interact, a wide range of informal ties between individuals outside the mandated structure exist for various reasons (e.g. personal, political, and cultural). A good understanding of the formation and structure of such informal networks (the hidden network structure behind the formal chart) is critical for successfully managing the organization. They argued that the traditional approach to investigating these networks within organizations usually consisted of conducting surveys using questionnaires which may be expensive in terms of time, energy and money. The email network provides an inexpensive but powerful alternative to this traditional approach. Indeed, the exchange of emails between individuals in organizations reveals how people interact and facilitates mapping the informal networks in a non-intrusive, objective, and quantitative way (Guimera et al., 2002). 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 communities of practice (the informal networks of collaboration that naturally grow and coalesce within organizations).

We draw on theoretical perspectives on organizational disintegration proposed by network theorists and sociologists to test three key propositions on the changes in the network communication structure associated with organizational disintegration. These propositions relate to changes in clique activity, degree of centralization, and connectedness within the top management team.

This paper is organized as follows: a review of related research is presented in the next section. The theoretical background of the study is developed in the following section. An overview of Enron Corporation and the email corpus that we analyzed is described and the methods employed are included in the subsequent two sections. 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 the organization's disintegration.

Related Research

Eveland and Bikson (1986) analyzed the communication patterns that characterized the Rand Corporation's use of email system. Their goal was to explore and assess the development of electronic messaging networks in the context of their expanding use. Overall, they included 69,219 messages sent from the relevant host machines during a period of nearly 18 months among more than 800 network participants. In their experiment, they measured several dimensions of communications structures such as density, centralization, reciprocity and linkage distance (the length of communication chains within the network, usually measured as the number of intervening people a message must pass through to move from one individual to another). They reported that the barriers to communication among people with different disciplinary backgrounds were mitigated by emails. Electronic links enhanced existing interactions rather than initiating interactions patterns that are formerly not evident. As well, the asynchronous nature of electronic mail appeared to be used by the participants overcome time-based barriers to communication.

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, just as Google is very effective at finding pertinent documents based on linking patterns. In their experiment, they analyzed the mailing list archives of three World Wide Web Consortium (W3C) working groups. They used several metrics developed in SNA research to compare the three W3C working groups: density, betweenness centrality, and group degree centrality. From the communication patterns, they were able to identify a group of leaders in the networks they analyzed. They also identified a contributor who had assumed leadership roles without having been officially appointed.

Tyler et al (2003) used a betweenness centrality (a measure of the extent to which a node links others which are not directly connected to each other) algorithm that could rapidly find communities within a graph representing information flows. They applied this algorithm to an email corpus of one million messages collected over a two-month period. They showed that the method was effective in identifying true communities and leadership roles within the communities.

Adamic and Adar (2005) analyzed the question of how participants in a small world experiment (the observation that any two people in the world are most likely linked by a short chain of acquaintances) were able to find short paths in a social network using only local information about their immediate contacts. They simulated this experiment on a network of actual email contacts within HP Labs as well as on a student social networking website.

In a study of crisis effects on intra-organizational computer based communication, Danowski and Edison-Swift (1985) discovered that during crisis: a) amount of communication increased; b) number of communicators increased; c) messages became shorter; d) individual-level networks became less interlocking; individuals developed more radial networks. They communicated more with individuals who did not themselves communicate; and, e) the macro-level network became more grouped.

The availability of the Enron email corpus has emerged as an important resource for studying a range of organizational dimensions as impacted by the changing communication network structure. The fact that the company went through a spectacular collapse during the period 2000-2001 after being among the top ten most admired corporations in the USA enables us to analyze the changes in communication network structure associated with such dramatic decline. Several researchers have carried out research using this 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 have shown that the analysis of the frequency and direction of email communications reveal communication patterns that correspond with the organizational life span. They reported preliminary results indicating that during the crisis period, the network density, centralization and connectedness increased as the crisis deepened. They also noted that (a) communication among employees become more diverse with respect to formal roles, (b) previously disconnected employees began to engage in mutual communication, and (c) interpersonal communication intensified and spread more widely throughout the network (Diesner et al. 2005).

Chapanond et al (2005) analyzed the Enron corpus to discover the structure within the organization. Their analysis was based on constructing an email graph and studying its properties using both graph theoretical and spectral analysis techniques. Based on the graph metrics they observed that: (a) the connectivity between communities of practice in the Enron email graph was dense, and (b) some communities had a high number of links while other communities had a small number of links. Furthermore, the visualization of the email graph showed that it matched the hierarchy of the organization in some ways (with respect to salary structure).

Theoretical Background

There are two relevant bodies of literature in the area of organization disintegration. 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 disintegration.

The impact of changes to social networks and cohesion on organization disintegration is discussed in this section. The association of structural changes, such as clique formation and centralization, with organization disintegration 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 the difficulties in gathering appropriate data.

Cliques and organization disintegration

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.

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 (or cohesive subgroups) and factions. He also showed that by varying some quantitative aspects (such as level of connectedness, distribution of communication links, large increase in communication activity in certain part of the network) and qualitative aspects (liaisons, bridges, transitivity etc.) of communication relation, one can determine how communication influences (or influenced by) disintegration of the network.

Tutzauer (1985) 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 move towards disintegration.

Centralization and organization disintegration

During the crisis period, organizations look to the leader for solutions (Lanzetta, 1955). Hamblin (1958b) initiated a laboratory investigation (consisting of 24 groups) of two hypotheses relating to leadership during crises. One of them was that leaders tend to have more influence during crisis than during non-crisis period. Data from observational studies lend support to this hypothesis. Janowitz (1959) found that when military personnel face crisis, the more feasible it became for officer personnel to claim that new problems were outside their jurisdiction and therefore required directives from higher authorities. Hermann (1963) posited that the most critical and direct effect of a crisis stimulus may be the contraction of authority. By “contraction” he meant one of the several alternatives: “(a) the shifting of authority activities to higher levels in a hierarchical structure, (2) a reduction in the number of persons and units participating in the exercise of authority without reference to a hierarchy, and (3) an increase in the number of occasions for the exercise of authority” (Hermann, 1963, p.70). A case study of a declining firm (Starbuck et al 1978), Rubin’s (1977) research on responses to budget cutbacks in universities, and Khandwalla’s (1972) research on organizational response to malevolent environments have all shown increasing centralization during crisis period compared to non-crisis period. Staw et al (1981) posited that greater centralization of authority in response to crisis is the most widely acknowledged aspect of mechanistic shift within organizations.

We should, however, note that the trajectory of Enron’s crisis and disintegration is somewhat different from the scenarios in much of the previous research. Enron collapse was not the result of an external threat; it was more of an implosion arising from systematic financial manipulation over an extended period of time the details of which came to be known only in 2001. It is possible that the centralization patterns in the Enron situation could be different. In any case, based on previous research we propose:

Proposition 2: Communication network becomes increasingly centralized as organizations move towards disintegration.

Connectedness and organization disintegration

Network connectedness (or density) is a measure of the incidence of direct relations among the possible pairs of a network. Network density indicates how nearly a network is complete – a state in which each member is connected directly with every other member (Harary et al., 1965). The implication here is that when the relationships among a group of people are dense, that is, when a large proportion of the members of the network know each other, then the network as a whole is relatively compact and relatively few links between the persons need to be used to reach majority (Mitchell, 1969). Kephart (1950) suggested that network density is an indicator of group cohesion. Barnes (1969) used network density as an indicator of the extent to which a network is ‘closely-knit’. Blau (1977) suggested that network density reflects group cohesion and intra-group bonds. When organizations move towards disintegration, the previously cited studies suggest greater cohesion among the group members. This leads to our next proposition:

Proposition 3: Connectedness among top management executives increases as organizations move towards disintegration

Enron Email Corpus

Organization disintegration can be studied from a number of perspectives, especially, economic, political, and social. In this study, we have adopted the social disintegration aspect of an organization. The social network approach will enable us to understand how the network structure of an organization reflects and is reflected by the state of disintegration.

Overview of Enron Disintegration

Enron was founded in 1985 through the merger of an Omaha-based natural gas pipeline company (InterNorth) and a Texas pipeline company (Houston Natural Gas). Within a decade, Enron had evolved beyond energy trading, become a conglomerate that was also actively involved in the area of metals, pulps and paper, broadband assets, water plants internationally and also traded extensively in financial markets for the same products and services (Healy & Palepu, 2003). This massive expansion generated revenues of \$4.6 billion in 1990, to revenues of \$101 billion in 2000. That, in turn, made Enron the seventh largest company in the United States, bigger than IBM or Sony. Enron executives landed on the covers of business magazines, and the company was hailed as a model for success and innovation (Fox, 2003).

In 1999, Enron's senior management began to separate losses from equity and derivatives and traded into "special purpose entities" (SPE); SPE's were special legal partnerships that were excluded from company's primary financial report. The systematic omission of negative balance sheets from SPE's in Enron's reports resulted in an off-balance-sheet-financing system. The SPEs are just one example of Enron's controversial ethics deemed as illegal accounting (Diesner et al., 2005).

On August 14, 2001 Jeff Skilling resigned as CEO and was replaced by Kenneth Lay, the founder. During the same month, Sherron Watkins, an Enron vice president, wrote an anonymous letter to Kenneth Lay expressing concerns about firm's accounting, such as the SPE's accounting practices. 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 November 28, 2001 major credit rating agencies downgraded Enron's debt to junk bond status, making the firm liable for retiring \$4 billion of its \$13 billion debt. 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 & Palepu, 2003; Hamilton, 2006). Since filing for bankruptcy on December 2, 2001, the Justice Department has conducted an ongoing criminal investigation into fall of Enron. This investigation has resulted in a number of criminal charges being filed against several top executives, including fraud, conspiracy and insider trading. Under a reorganization plan, approved by a Judge in 2004, most Enron assets have been auctioned off for cash and distributed to the creditors. Subsequently, the sole remnants of Enron have been bundled into one company, Prisma Energy, whose stock shares will also be distributed to creditors (Hamilton, 2006).

Dataset

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. Researchers at Carnegie Mellon University (CMU) cleaned the corpus resulting in a total of 2,00,399 messages written by 158 users. 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 2,52,759 messages from 151 employees distributed in and around 3000 user defined folders. We will be using 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.

Methodology

In this section the data cleaning techniques and approaches have been discussed. Various measures cliques, connectedness and centralization have also been discussed in this section.

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 have decided to use it. In retrieving data we have imposed some thresholds on the data:

- (a) Only the email addresses that contained '@enron.com' as their domain names have been included, assuming that they represent only Enron employees, essentially excluding a large number of emails that might have come from several 'outside' sources;
- (b) To establish relationship, only reciprocated ties were taken into account; i.e., if Darren has sent emails to Sara, Sara is also required to send emails to Darren in order to be regarded as a relationship between the two actors. The definition of cliques originally proposed by Luce (Luce, 1950) required that all ties between the pairs of nodes in a clique be reciprocated
- (c) In order to be considered as a relationship, we applied a threshold of 20 or more emails exchanges that had to have taken place between the two actors over a period of 4 months; i.e., if Darren has sent 20 emails (or more) to Sara, Sara had to have sent 20 (or more) emails to Darren in order for a

relationship to be posited between the two. We have also measured the strength of the relationship by counting number of emails actors have exchanged. For example, if Sara has sent 20 emails to Darren, then the strength of relationship was counted as one (1), if 40 emails then the strength is 2 and so on.

(d) After identifying the reciprocated ties, we have excluded self addressed emails from our dataset; i.e. if Darren has been found to send emails to Darren, himself, we have excluded those emails.

Once we have identified all the reciprocated ties, by using UCINET software (Borgatti et al., 2005), we then draw the network diagram. Figure 1 and Figure 2 represent two such diagrams.

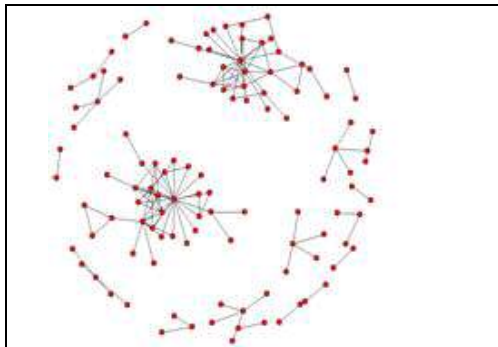


Figure 1. Network diagram for Sep2000 – Dec2000 (based on the threshold of 20 email exchanges)

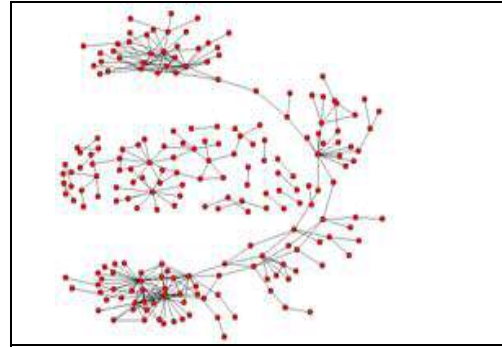


Figure 2. Network diagram for Sep2001- Dec2001 (based on the threshold of 20 email exchanges)

Measures for studying network disintegration

Cliques

A clique consists of some number of actors (more than two) having all possible ties present among themselves. Cliques may overlap; the same node or set of nodes might belong to more than one clique (Wasserman & Faust, 1994). The so called ‘strict’ definition of cliques (maximal fully connected sub-graph) rarely meets the criteria in a real-life dataset. As a result, “clique” definition has been “relaxed” in two major ways to make it more general and helpful:

- a. based on distances within group (*n-clique, n-clans and n-clubs*)
- b. based on density/number of ties present (*k-plex*)

We will only discuss clique and n-clique in this paper. For a detailed description of various types of cliques please refer to Wasserman & Faust (1994).

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 cutoff 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).

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. To analyze cliques, we used UCINET software (Borgatti et al., 2005).

The definition of n-clique implies that a value of $n=2$ is often used by researchers as cutoff for identifying n-cliques. 2-cliques are referred to as subgroups in which all the group members would be reachable through at most one intermediary. Scott (2005) described this definition of 2-cliques to be much closer to people’s everyday understanding of the word ‘clique’.

Centralization

Freeman (1978) posited that the star network (as in figure 3) is the most centralized or most unequal possible network for any number of actors.

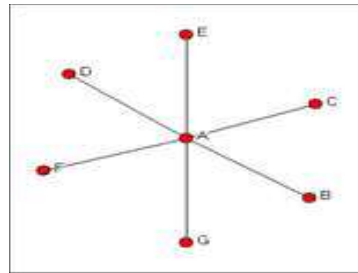


Figure 3. Star Network

In the star network, all the actors but one has degree of one, and the "star" has degree of the number of actors, less one. Freeman felt that it would be useful to express the degree of variability in the degrees of actors in our observed network as a percentage of that in a star network of the same size. So, Freeman's graph centralization measures can be expressed as the degree of inequality or variance in a network as a percentage of that of a perfect star network of the same size (Hanneman & Riddle, 2005).

Connectedness

Network connectedness is a measure of the ratio of the number of adjacencies that are present divided by the number of pairs – what proportion of all possible dyadic connections are actually present. Measuring the connectedness of a network gives us a ready index of the degree of dyadic connection in a population. With valued data, connectedness is usually defined as the average strength of ties across all possible (not actual) ties. For symmetric (or undirected) data, connectedness is calculated relative to the number of unique pairs $((n*n-1)/2)$. For directed data, connectedness is calculated across the total number of pairs (Hanneman & Riddle, 2005).

Social Network Analysis of Enron E-mail Corpus: Results

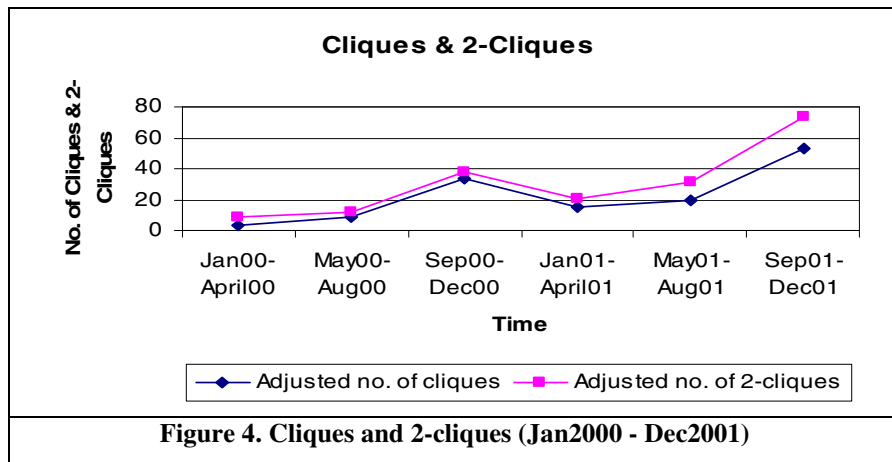
In this section, we present the results of the social network analysis of the Enron email corpus using the measures discussed in the earlier section. These highlight the relationships between the structural changes in the communications network and organizational disintegration.

Cliques

We identified the number of cliques and 2-cliques by applying our threshold (minimum 20 email exchanges between the reciprocated actors within a trimester). A list of cliques and 2-cliques identified in different trimesters during 2000 and 2001 is shown in Table 1. 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. However, we have not included the results in the table below since the number of cliques was negligible compared to the six trimesters of 2000 and 2001.

Table 1: No. of Cliques and 2-Cliques				
Time	No. of Cliques	Adjusted no. of cliques	No. of 2 cliques	Adjusted no. of 2-cliques
Jan00-April00	3	3	9	9
May00-Aug00	6	9	8	12
Sep00-Dec00	20	33	23	38
Jan01-April01	15	15	22	21
May01-Aug01	14	19	22	31
Sep01-Dec01	47	53	66	74

Figure 4 provides us with an overview of clique formation pattern from 2000 to 2001.



From figure 4, 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 first and second trimester of 2001 than in the third trimester of 2000), the dramatic increases in the cliques of both kinds (cliques and 2-cliques) between the last two trimesters of 2001 is significant. It is important to note that this was the time during which Enron was in complete turmoil, resulting in the bankruptcy declaration on December 2, 2001. 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 2 shows the number of actors joining the cliques and 2-cliques compared to all the actors in the network (by applying the threshold). Again we observe a sharp increase during September-December 2001 trimester 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.

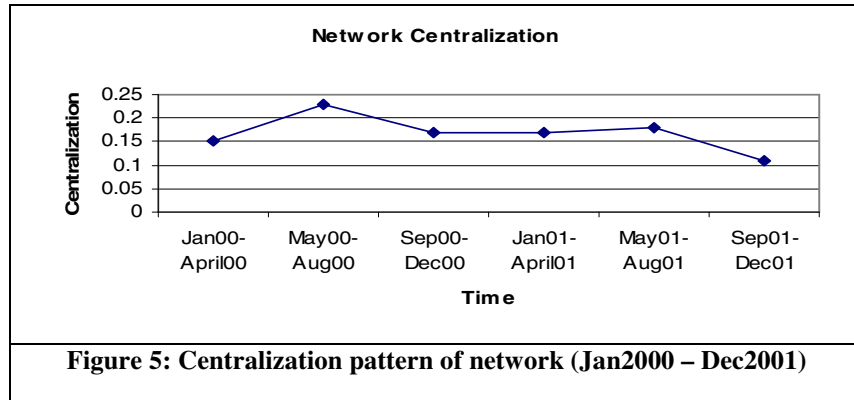
Time	No. of actors joining cliques	No. of actors joining 2-cliques	Total no. of actors in cliques
Jan00-April00	6	28	30
May00-Aug00	9	31	47
Sep00-Dec00	33	94	112
Jan01-April01	27	97	103
May01-Aug01	19	60	78
Sep01-Dec01	63	182	208

Centralization

The centralization scores for the Enron corpus are listed in Table 3. These scores were calculated by using Freeman's centralization measure included in UCINET.

Time	Centralization
Jan00-April00	0.15
May00-Aug00	0.23
Sep00-Dec00	0.17
Jan01-April01	0.17
May01-Aug01	0.18
Sep01-Dec01	0.11
Jan02-April02	0.09

Figure 5 shows the centralization pattern of the network during the two year period 2000-2001.



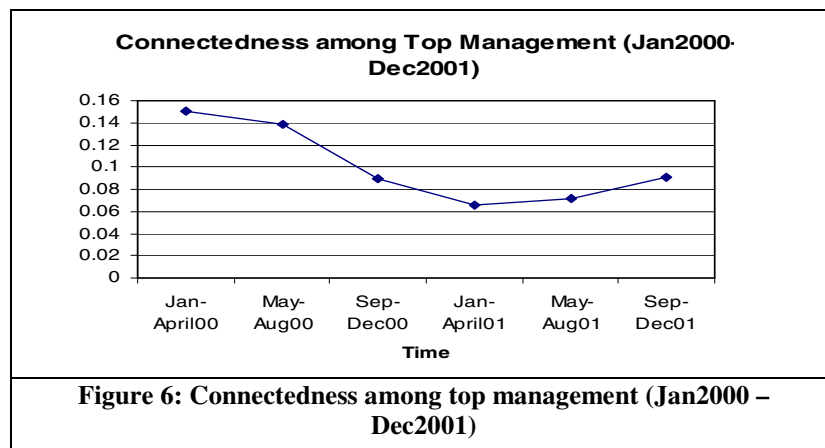
Centralization score of the network did not vary significantly except in the last two trimesters. As well, the scores were relatively low throughout the two-year period. During the peak crisis period (from September 2001 to December 2001), centralization score actually decreased. Overall, there is a downward tendency in centralization score as the organization was moving towards disintegration. In other words, the organization was getting more decentralized during the crisis state compared to non-crisis state. This result contradicts our proposition based on extant theory and previous research regarding the patterns of centralization of the network in response to disintegration.

Connectedness

The connectedness scores for the network of senior executives (President, Vice-Presidents, CEOs, Managing Directors, and Directors only) within the Enron corpus are presented in Table 4. These scores were calculated by applying threshold of 6 or more email exchanges between the two nodes (top management executives) over blocks of four months.

Time	Connectedness
Jan00-April00	0.15
May00-Aug00	0.1389
Sep00-Dec00	0.0897
Jan01-April01	0.0654
May01-Aug01	0.0714
Sep01-Dec01	0.0907

Figure 6 presents a plot of the connectedness scores among the top management executives during the period 2000-2001.



While the results indicate a steady decrease in connectedness prior to the peak of the crisis, there is a sharp increase during the period when the crisis actually unfolded in the latter part of 2001. This is

generally consistent with proposition 3. While connectedness among the top management team actually declined in the period leading up to the crisis, connectedness and by implication, cohesion, actually rose sharply while the crisis was in full swing. These results need to be interpreted against the backdrop of a fair degree of turnover at Enron during the last two trimesters of 2001.

Discussion

Cliques and organization disintegration:

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 behaviour 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.

As Enron approached disintegration during the third trimester 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.

Centralization and organization disintegration

Figure 5 clearly shows that the centralization score of the Enron email network decreased during the disintegration period (especially during May01 – Dec01 period). This result contradicts our proposition 2.

This lack of support for the theoretical proposition is not particularly surprising when one scrutinizes some the Enron-specific particularisms at play. The theoretical prediction is largely based on the notion of a critical external threat which obliges the top management to respond forcefully by centralizing communications and decision making. The Enron crisis was of a very different order; several of the very senior managers like Mr. Skilling, Mr. Fastow, and even Mr. Lay among others were deeply implicated in the financial skullduggery and were faced with serious credibility problems. Under such circumstances, a shift towards higher levels of centralization in communications may not be the most likely outcome. This result suggests that the movement in the network centralization scores may be dependent on the nature of the organizational crisis. It appears that during an organizational implosion caused by financial manipulation and fraud, the more likely outcome is increased decentralization. This conclusion is both tentative and speculative and more research is needed before we can provide definitive answers.

Connectedness and organization disintegration

From figure 6 we note that the value of connectedness is generally low though organization disintegration has some effect on the density of the network. This result is supportive of our proposition 3. The network connectedness score actually increased from 0.06 to 0.09 during the last two trimesters of 2001 suggesting enhanced cohesion among the remaining top management team. Based on the studies by Mulder and Stemerding (1963), it appears that group cohesion provided comfort at a time of deep sense of insecurity and fear created by the unfolding process of disintegration. Overall, our results provide some indication that Enron senior management was attempting to close ranks to a limited extent when faced with the monumental crisis.

It maybe necessary to interpret the results we obtained for proposition 3 against the backdrop of our results for the first proposition. It is possible that the higher connectedness mirrors the greater clique activity observed at Enron during the same period. Friedken (1981) warned that network density could be a misleading indicator of structural cohesion when a group has subgroups. Network density can be viewed as a useful indicator of structural cohesion only when it can be assumed that a group lacks subgroups. It is difficult to argue that the latter condition was met in our study in light of the results we obtained in the test of proposition 1.

Limitations

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. Enron had more than 20,000 employees before it went into bankruptcy. Of this large employee base, we have only considered email communications of a few hundred employees. Although employees included in the study constitute almost all the senior and middle level managements, it eventually excluded thousands of other employees. Again, this might be problematic as regards any claims of generalizability.

Conclusion

As a corporation, Enron was widely acclaimed as a paragon of economic and organizational innovation only to be pilloried after its collapse. Numerous post-mortem studies 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 accounting regulations. This type of egregious behaviour 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) In 2000, for example, Enron paid employees \$US750 million in cash bonuses, an amount approaching the company's reported profit (Behr et al., 2002). US Senator Levin noted the excessive use of bonuses at the US Senate hearing following Enron's collapse:

"Enron's management handed out bonuses like candy at Halloween. Employees were given huge bonuses for closing deals, many of these deals proved damaging to Enron. For instance, two executives closed a deal on a power project in India, which is now a financial disaster, got the bonuses in the range of \$50 million. The head of one Enron division who was moved out of the company walked away with more than \$250 million in the year that he was shown the door. The temptation to self-enrichment at Enron was overwhelming" (US Senate, 7 May, 2002, p.5).

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). 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 behaviour 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 behaviour among the organization members. Alexander Mintz's theory of non-adaptive group behavior demonstrated that when the reward for co-operative behaviour became uncertain in a threatening situation, competitive behavior occurred with each person attempting to withdraw and act independently of the group (Mintz, 1951). Hamblin (1958a) 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, 1958a).

Stogdill (1959) argued that role confusion and role conflict reduces a member's ability to perform decisively and increases his/her level of dissatisfaction with the organization. Indecision, conflict, and lowered satisfaction tend to reduce a member's contribution to the group cohesiveness. When cliques are formed in an organization with unclear role structure which provides uncertain expectations and demands, integration is expected to suffer. There is clear evidence of this pattern of organizational disintegration in the Enron case.

The results of our study of Enron disintegration 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 a tendency toward greater decentralization as opposed to the increased centralization that extant organizational sociological theory and previous research suggests as a response to major crisis. As noted in the foregoing, this anomalous result could be an artifact 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. We also found weak support for the proposition that organizational disintegration leads to limited increase in connectedness among the top management executives.

The methodological contributions of this study are worthy of note. It builds on an emerging stream of research that applies social network analysis to organizational email communication data in order to research important questions on organizational change. With the increasing popularity of electronic communications, more widespread availability of such corpora, the increasing popularity of social network analysis and the growing sophistication of SNA tools, it is to be expected we can develop deeper insights into a wide range of organizational phenomena.

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