35 EXPLORING STRUCTURAL CHANGES OF THE COMMUNICATIONS NETWORK DURING ORGANIZATIONAL CRISIS

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Abstract   *In this study, we explore patterns of organizational communication during normal state and crisis state using e-mail communications data. We apply social networks analysis (SNA) to understand the communication behavior and its structural changes during crisis from a real-world organization's communication data. By applying SNA, we first analyze the changes of social network structures from normal organizational state to crisis state. Second, we explore the changes of different positions or roles of the organizational communication networks during the crisis. Third, we apply measures of centrality (i.e., degree, betweenness, and closeness) for studying how different structural changes in social networks correlate to organizational hierarchy during normal and crisis state.*

Keywords   Organizational crisis, centrality measures, e-mail communications, SNA

1   INTRODUCTION AND BACKGROUND

E-mail communication is becoming an integral component of organizational communication networks. E-mail has also become one of the most popular methods of communication adopted by organizations today. Therefore, e-mail logs can serve as a useful resource for research in fields such as link analysis, social network analysis, and textual

analysis. In May 2002, the U.S. Federal Energy Regulatory Commission publicly released a large set of e-mail, the Enron corpus, which contains 619,446 e-mails belonging to 158 users over a period of 3.5 years. Shetty and Adibi (2004) created a MySQL database of this corpus. They also cleaned the database by removing a large number of duplicate e-mails, computer generated folders, junk data, invalid e-mail addresses, blank messages etc. The resulting dataset contains 252,759 messages from 151 employees distributed in about 3,000 user-defined folders. We have used this database to perform our study. We explore if the organizational crisis state reflects a different social network structure than the normal state of an organization. We argue that this type of dataset, representing actual communications behavior, is best suited to study the relationships between structural changes of communication networks and organizational crisis.

2   EXPLORING STRUCTURAL CHANGES
OF COMMUNICATIONS NETWORK

Diesner at el. (2005) argue that when an organization encounters crisis, the social network analysis (SNA) measures will change accordingly. Those changes, they contend, reflect the organizational structural changes. The exploration of those SNA measures corresponding to the crisis stage might support decision making on the prediction of any future crisis.

Centrality is the state or quality of being central in a network structure (Faust 1997). It is considered to be the structural attribute of nodes in a network, not an attribute of actors themselves, but of their structural position in the network. Centrality has been defined as a measure of the potential importance, influence, and prominence of an actor in a network (Borgatti et al. 2002; Freeman 1979). Freeman (1979) defined three measures of centrality and explained their structural implications: degree, betweenness, and closeness. Freeman stated that the degree of a point seemed to be an index of that position's potential for activity in the network. Betweenness is the extent to which a point falls between others on the shortest paths connecting them. It was taken to be an index of potential for control of communication. Closeness measures the distance of a point to all others. This was viewed as a measure of independence from control.

3   METHODS

We extracted data from the MySQL database by using PHP (hypertext preprocessor). The result contained the e-mail addresses suggesting who send e-mail to whom for every month. We converted our files to text files and then converted them into VNA format, supported by UCINET software (Borgatti et al. 2006). Using NETDRAW, we then drew the network diagram and calculated the centrality measures in terms of degree, betweenness, and closeness. We transferred the data in to MS Excel and plotted them as a chart, showing how every centrality measure goes from the normal organizational state to the organizational crisis state. We repeated the procedure in order to collect the data for every month. We tried to understand why the SNA measure changes followed that trend by reviewing the corresponding organizational context, and tried to give possible and reasonable explanation.

4 RESULTS AND ANALYSIS

This section displays the results containing the undirected centrality measures based on the organizational hierarchy and the overall view of the entire organization over time. Figure 1 contains the degrees based on the various organizational roles. The simple count of the degree measures for every organizational role indicates that every role in Enron was having more e-mail connections with others during the crisis period (2000 – 2001) than during the noncrisis period (pre-2000). We further observed the difference of degree measures' changes between the lower level positions and the higher level positions during crisis state. The increment of the degree measure of higher lever employees is found to be much more rapid than that of lower level employees as the organizational crisis intensifies. We also discovered that higher level employees had more absolute degrees than the lower ones during the organizational crisis. However, the lower level employees (e.g., employees and traders) had even more absolute connections than those of middle level employees (e.g., directors and managers). We argue that the middle level employees had less importance during the crisis time. We also found that the degree of lawyers was quite high, implying that the organization was facing many legal problems during the crisis state. Freeman (1979) suggested that the degree is a kind of index of communication activities. We can also conclude that during the crisis, both senior management and executive employees were having more communication activities than was middle management; while there is not much difference in the degree measure of all positions during the normal noncrisis state.

Figure 2 shows the betweenness measure based on the organizational hierarchy. Like the trend of the degree, the betweenness of almost all positions in the crisis period is far more than that of every position during the noncrisis period. During the crisis, we found that senior management had a high value of betweenness. Lower level employees had relatively higher betweenness value than middle management. The lawyers also had high betweenness values during the crisis period. Based on Freeman's explanation of
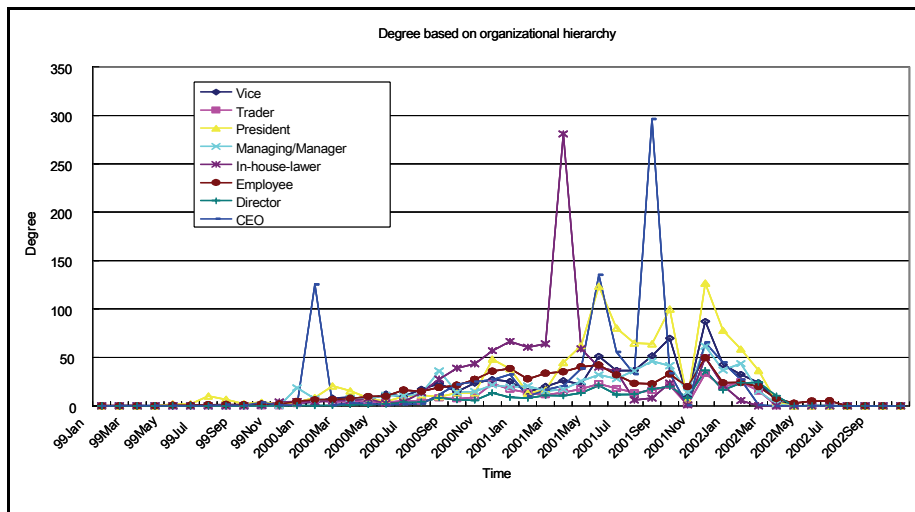

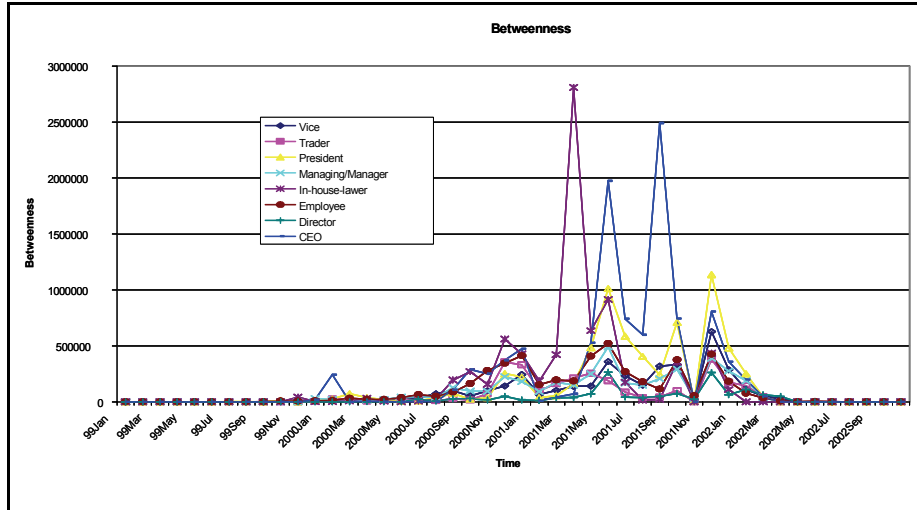**Figure 1.** Degree Measure Based on Organizational Hierarchy

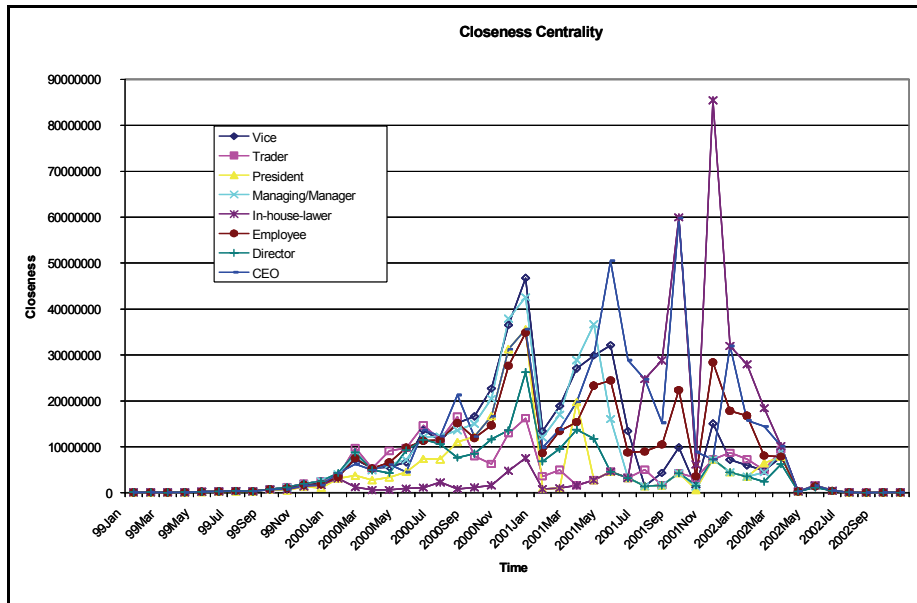*Figure 2.* **Betweenness Measure Based on Organizational Hierarchy**

Figure 3. **Closeness Measure Based on Organizational Hierarchy**

betweenness, we assumed that senior management and lower executive employees had more control of e-mail communications in the organization during crisis. In contrast, the middle management had less control of e-mail communications.

Figure 3 shows the closeness measure based on the organizational hierarchy. Generally, the value of closeness is higher overall during crisis state than during the

normal state. One of the interesting points is that middle management had higher close-ness value during most of the crisis period, whereas the lawyers had very low closeness value. This indicates that the lawyers did not have a very important role, which was close to many other employees. This lower closeness value is also observed with traders and even the president. Unlike lower degrees and the betweenness values, middle management had relatively higher closeness value during most of the crisis period. Overall, we conclude that the actors or groups (such as middle management) with fewer connections to others could be globally close to many others in the networks, a claim supported by Scott (2000). Although middle management have fewer communication activities, they are still in a position which is close to both senior management and lower level employees. The CEO and the vice president were still having very high closeness value, which is quite understandable in the sense that the CEO and vice president had high independency and efficiency, as Freeman pointed out in his literature review on centrality measures.

5   CONCLUSIONS

This study suggests that there are some relations between structural changes of the com-munications network and organizational crisis. We applied measures of network *centrality* to study the changes of communications network structure in both the normal state and the crisis state. Based on the assumptions of centrality measures, we compare the centrality measures in different organizational states so that we can discover and analyze the centralization and decentralization of organizational communication networks in both the normal organizational state and the crisis state. By exploring the Enron e-mail corpus dataset, we found that different organizational positions have different social network attributes during crisis. By exploring different centrality measures such as group degree, betweenness, and closeness, we discovered that the organizational communica-tion network becomes more decentralized during crisis. We further explored the relation-ship between formal organizational hierarchy and the changes in measures of centrality during crisis.

References

Borgatti, S. P., Everett, M. G., and Freeman, L. C. *UCINET6 for Windows Software for Social Network Analysis*, Harvard, MA: Analytic Technologies, 2002.

Diesner, J., Franz, T. L., and Carley, K. M. "Communication Networks from Enron Email Corpus: 'It's Always About the People. Enron is no Different,'" *Computational & Mathematical Organization Theory* (11), 2005, pp. 201-228

Faust, K. "Centrality in Affiliation Networks," *Social Networks* (19:2), 1997, pp. 157-191.

Freeman, L. C. "Centrality in Social Networks Conceptual Clarification," *Social Networks* (1), 1978/1979, pp. 215-239.

Scott, J. *Social Network Analysis: A Handbook*, London: SAGE Publications, 2000.

Shetty, J., and Adibi, J. "The Enron Dataset Database Schema and Brief Statistical Report," unpublished paper, 2004 (available online at   http://www.isi.edu/~adibi/Enron/ Enron_Dataset_Report.pdf).

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