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THE INTERACTION PATTERNS OF KNOWLEDGE SHARING IN DESIGN FORUMS

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Abstract

In online forums or virtual communities, the interactive relationships among members are similar to actual interpersonal social networks. Each member's position in the social network affects the individual's ability to resources for data or organized information. The position of members in networks also considerably affects the degree of opportunity to engage in activities that share individual knowledge. Therefore, beginning with the perspective of social network theory, this study uses social network analysis (SNA) to investigate the relationship between networks' structures of forum and knowledge sharing as well as the interaction pattern among forum members.

The results of this study show that network size closely relates to a member's centrality in the network. The larger the network is, the lower the member's centrality. A member with high centrality is likely to be either initiator of the discussion thread or expert in the forum's subject. Observations of members' in-centrality and out-centrality positions distinguish between these two potential roles.

Keywords: Forum, Knowledge Sharing, Social Network Analysis

1 INTRODUCTION

In the past, professionals were the primary sources for knowledge. To acquire knowledge from the Internet, online users could only unilaterally search, filter or select information according to specific topic. However, after the appearance of Web 2.0 technology changed the Internet's environment, professional sources were no longer the sole sources for knowledge, but collective participation of, and input from, users created new resources. The users, originally stressed as recipients of sites' contents changed to sites' content driven by users. One-way information transmission became two-way communication. As a result, more and more various virtual communities are formed. The social network derived from connections between professionals and general online users has then become the research focus in academia.

Social network structure of virtual communities may be presented in different ways based on interactions between members, and a network's structure will vary according to the number of the participants in a discussion. The frequency of interactions among members influences the strength of relationships among members (Haythornthwaite 2005). A highly connected network not only increases the efficiency of knowledge sharing, but also elevates the members' knowledge application ability, including creativity (Gray et al. 2011). A closer position to the centre of the network results in more efficient acquisition of knowledge and resources from other members (Burt 1995; Scott 2002). Apparently then, the position a member occupies in the network closely relates to knowledge sharing and provides the motivation for this study to assess the significance of the bearing networks' structures for administrators of communities or enterprises. Therefore, this study, beginning from the perspective of social network theory and establishing commonly encountered communities of knowledge, i.e., online forums as this study's targets, investigates the relationship between network structure and knowledge sharing, and further explores the commercial values implied in the interactional patterns of the members.

2 LITERATURE REVIEW

From the perspective of social network theory, the structure of a society is a social network of interpersonal relationships. A network consists of "nodes" and "lines," in which a "node" is a person or a group of people and a "line" is the relationship between one person and another. Chiu et al. (2011) identified social network analysis (SNA) as an effective tool to analyze the exchange of information or resources among individuals, groups, or organizations. Common social network indicators, such as size, density, and centrality, are:

- Size: The number of the nodes in the social network, that is, the number of actors (participants).
- Density: An indicator measuring the tightness among the actors in the network, and defined as the ratio between the actual number of the linkage lines in the network and the greatest number of linkage lines possible. The higher the density is, the more linkage lines are present in the network, and indicating tightly connected actors (Cañon Jones et al. 2010; Scott 2002).
- Centralities: A measure of the linkage between an actor and others and detector for the relative importance of the actor in the network (Cañon Jones et al. 2010; Cho et al. 2007; Kim et al. 2011). The more central a member's position is, the greater that individual's social status, power, and fame, leading to that person' enjoying greater social resources (Burt 2005, 2010; Knoke & Kuklinski 1982; Knoke & Yang 2008; Scott 2000, 2002). Centrality encompasses three aspects: degree, closeness, and betweenness.

In summary, of the indicators, establishing SNA as quantifying the invisible relationships among actors into data is not difficult. The subsequent task is to use the data to measure the tightness among actors and assess the significance and influence of actors in the network. Therefore, this study applies SNA to online forums, and adopting interaction of the forum members to represent knowledge sharing

as the basis for the social network's relationship. By quantifying the interactive relationship among forum members through the use of social network indicators, this study investigates interaction patterns of members' knowledge sharing activities.

3 RESEARCH METHODOLOGY

This study considers a variety of forums on the Internet, and seeks to enhance inferences for future research. Since the available number of online forums for inclusion in the dataset is astronomical, a limitation targeting those forums of "multimedia design," especially 3D animation design, which is regarded as having low entry-level in the job market, but requiring a certain level of techniques for becoming professionals becomes the scope of this study. The online forum members of 3D animation design usually have different kinds of interactive activities for acquiring the professional techniques. This limitation identifies the noted, 3D animated forum, CGSOCIETY (<http://forums.cgsociety.org/>), as this study field. Within this forum, collected data represents the two leading discussion threads, "Autodesk Maya" and "Autodesk 3ds max," from among the posting related to 3D animation design software. During a period of three months, from February 1 to April 30 of 2011, all the articles published on the discussion boards became the source for this study's collected data.

For the purposes of the current study, the interactive relationship among the CGSOCIETY forum's members represents the network of social relationships. SNA, using SNA software, UCINET6, explores the interactional patterns among members. First, observations note participants' interactive relationships in articles' discussion threads according to strings and contextually related content. Second, a matrix of interactive relationships charts the interactions among the poster and individual respondents. Finally, entering the values of the matrix of interaction, or called adjacency matrix, into UCINET calculates indicators of the social network's size, density, centralities (including the degree centrality, closeness centrality, and betweenness centrality).

All the participants of the discussion (including the poster and the respondents) are actors in the social network. In other words, a discussion thread is a network, and forms the basis for a matrix of interaction. If the unit for the analysis extends to the entire discussion board, then greater-scaled social networks and matrices of interactions emerge reflecting the vast number of participants in the discussion. When extending the unit for analysis further to the 3D software discussion board (taking both discussion boards for Autodesk Maya and Autodesk 3ds max as one unit for analysis), the interaction matrix becomes enormous and complex compared to the previous two individual levels. This current study conducts SNA social network analysis based on three units: 1) The 3D software discussion board is the initial unit for network analysis, which explores the situation of interaction in that discussion board. 2) A single discussion board is the unit for analysis to approach the overall situation of the discussion on that board. 3) Adopting a single discussion thread creates the unit for network analysis to investigate the discussion of each thread in the forum and to gain insight into the interactive relationship and structure among forum members.

4 RESULTS AND DISCUSSION

According to the results from the data collection, Autodesk Maya and Autodesk 3ds max had the maximum 780 and 819 discussion threads, respectively, posted on the forum during February 1 to April 30 of 2011, with a monthly average of more than 250 discussion threads generated.

First, with the 3D software forum as the unit for the network analysis: This network (i.e., the two software discussion boards, Autodesk Maya and Autodesk 3ds max) consisted of 1,599 (780 plus 819) discussion threads, producing a network size of 1,505, meaning that a total of 1,505 forum members published discussion articles during the period of investigation. The network density is 0.0025 (range:

0-1) , a very low value due to this network's constituting two software discussion boards, Autodesk Maya and Autodesk 3ds max. Some members of the network only participated in one discussion board instead of both. Table 1 shows the centrality of the software forum, and Figure 1 shows a scatter plot of the degree centrality of the 1,505 forum members, the vast majority of whom have both in-degree and out-degree centralities within 0.1. Consequently, the majority of members had numbers of response articles from others (In-degree Centrality) and numbers of response articles to others (Out-degree Centrality) below 150 times $((1505-1) \times 0.1)$. Figure 2 shows a scatter plot of the closeness centrality of the forum's 1,505 members. The figure indicates that the members' out-closeness centrality concentrates in the vicinities of 0.066 and 0.247, and their in-closeness centralities locate in the vicinity of 0.066 and 0.22. Among them, the ratio of the large value to the small value is approximately 2:1 (1049:456), which shows that among the forum's 1,505 members, approximately two-thirds actively participated in discussions, frequently published articles, or responded to articles and were able to quickly receive responses from other members. On the other hand, the other members, representing one-third were less actively involved in discussion activities. Perhaps, these members were novices or silent spectators. Figure 3 shows a scatter plot of the betweenness centrality of the forum's 1,505 members. Approximately 94% have a betweenness centrality of less than 0.5, which suggest that the remaining 6% (approximately 90 members) are the core members of the forum, in comparison with other members, had sufficient influence to guide the flow of resources and sufficient ability to transmit information.

Centrality	Degree Centrality		Closeness Centrality		Betweenness Centrality
	Out	In	Out	In	
Mean	0.023	0.023	0.192	0.177	0.125
Std Dev	0.058	0.046	0.083	0.067	0.534
Variance	0.003	0.002	288.334	266.687	0.286
Minimum	0	0	0.007	0.004	0
Maximum	0.882	0.629	65.484	54.008	8.984

Table 1. Social network centrality

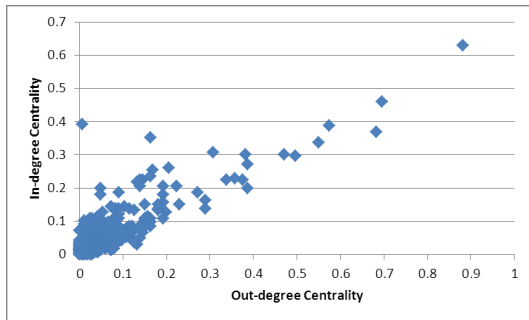


Figure 1. Scatter plot of degree centrality

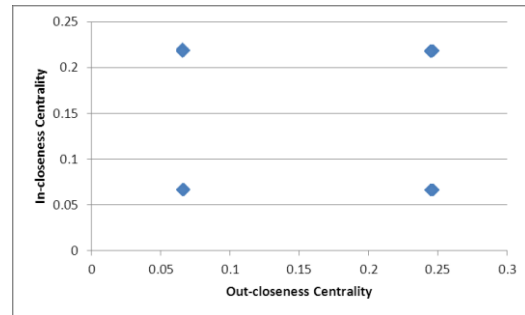


Figure 2. Scatter plot of closeness centrality

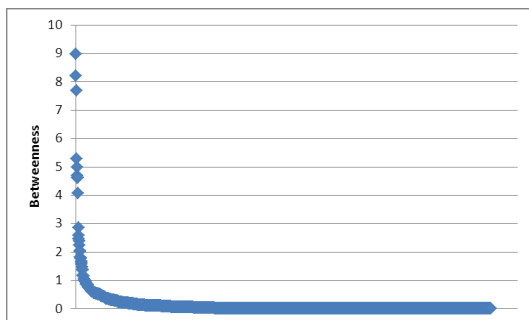


Figure 3. Scatter plot of betweenness centrality

Next, with a single discussion board as the unit for network analysis, the Autodesk Maya network consisted of 780 discussion threads, with a network size of 806 and a density at 0.0043. The centrality appears in Table 2. The Autodesk 3ds max network consisted of 819 discussion threads, with a network size of 738 and a density at 0.0055. Table 3 shows the centrality. On average, the two networks of Autodesk Maya and Autodesk 3ds max did not show a significant difference in centrality, because they were the top two discussion boards of 3D animation design software in CGSOCIETY. However, notably, 39 members appeared repeatedly in these two networks, indicating that these 39 members were both involved in the two software discussion boards.

Centrality	Degree Centrality		Closeness Centrality		Betweenness Centrality
	Out	In	Out	In	
Mean	0.043	0.043	0.35	0.32	0.186
Std Dev	0.12	0.087	0.152	0.119	0.824
Variance	0.014	0.008	281.948	257.822	0.679
Minimum	0	0	0.023	0.014	0
Maximum	1.814	1.292	117.306	93.927	13.493

Table 2. Social network centrality of the Autodesk Maya network

Centrality	Degree Centrality		Closeness Centrality		Betweenness Centrality
	Out	In	Out	In	
Mean	0.05	0.05	0.381	0.368	0.202
Std Dev	0.115	0.097	0.158	0.144	0.643
Variance	0.013	0.009	281.519	271.63	0.414
Minimum	0	0	0.025	0.021	0
Maximum	1.394	0.802	125.859	115.222	8.49

Table 3. Social network centrality of the Autodesk 3ds max network

Finally, using single threads as the unit of network analysis, the Autodesk Maya discussion board had a total of 780 discussion threads, and thus a total of 780 networks. The frequency distribution of its network size appears in Table 4, and its average network size of 2.9 suggests approximately, on average, three members participated in a discussion thread. The average density of 0.72 indicates that every member established relationships with 72% of other members for every discussion thread. These established relationships are likely to be responses to other members, or receiving responds from other members. On the other hand, Autodesk 3ds max had 819 discussion threads, thereby forming 819 networks. Table 5 shows the frequency distribution of its network size; the average network size is 2.94 while the average density is 0.69.

Network Size	1	2	3	4	5	6	7	8	9	10	11	12	13	15	17	23
Frequency	174	260	167	76	39	19	6	8	13	6	4	1	1	3	2	1

Table 4. Frequency distribution of the social network size for Autodesk Maya

Network Size	1	2	3	4	5	6	7	8	9	10	11
Frequency	198	272	163	95	37	14	10	6	6	5	3
Network Size	12	14	15	16	18	20	23	33	58	20	
Frequency	1	1	1	1	1	1	1	1	1	1	

Table 5. Frequency distribution of the social network size for Autodesk 3ds max

5 CONCLUSION

According to the results in this study, network centrality of forum members is subject to the impact of the network's size. In general, the larger the network, the lower the network centrality is for its members. However, those members who have the highest centrality were generally the ones who initiated the discussion's threads. In contrast to the respondents, initiators' network centrality is higher because they receive more responses from other members. Meanwhile, if a member retains higher centrality in a large network, then determining whether or not that member is a knowledge expert within the network is a function of observations of the ratio between in-degree and out-degree centralities. A higher out-degree centrality suggests that the member possesses a high degree of expertise and often responds to the postings from others, and consequently, represent the most valuable core members in the forum.

From the aspect of social network centralities, no matter how much does the degree centrality, closeness centrality, or betweenness centrality, as the members with higher centrality they play central positions in the network. They can also be regarded as the experts of knowledge contributors, and hold most knowledge resources. However, they only occupy a small number of all members. Thus, forum operators are suggested to keep those experts as lifelong members in varied ways as long as they are willing to share knowledge in the network, for instance, to design a reward mechanism to encourage them spending more time on knowledge sharing and problem solving, to promote their membership, and to accumulate their prestige value. Furthermore, forum operators can establish a recommendation system to have knowledge seekers quickly locate an expert whom is familiar with their problems and can provide solutions to the problems effectively. The experts can feel of being needed, and may speed up the response time for knowledge seekers in any interaction opportunities in the knowledge forums.

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