A STUDY ON THE EXPLORATION OF OPINION LEADERS AND OPINION MEDIATORS ON SOCIAL MEDIA: FOCUSED ON THE NUCLEAR POWER RELATED TWEETS

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Abstract- This study explores the opinion leaders who produce important information and opinions that affects to other users, and opinion mediators who maximize information diffusion in social media, especially Twitter on the nuclear power subject. In addition, we examine their networks characteristics and influence, and compare the differences between writing patterns through analysis of their tweets. For this study, we have utilized nuclear tweets written in 2009-2013 which includes the "nuclear accident" event in Japan. To identify opinion leaders and mediators, we use centrality measures of social network analysis. This study reveals the possibility to explore and predict opinion leaders and to identify and analyze information diffusion path on social media.

Index Terms- opinion leaders, opinion mediators, social media, social network analysis

I. INTRODUCTION

As the use of social media proliferates with the development of information and communication technology, information produced in the social media based communication channels is delivered to a large number of people. Thereby it has become an important means to form the public opinion and attract attention of new technologies or products. Also it has caused the possibility of significant social change by the communication of opinions among users and the real-time diffusion of social issues. In these social media, Users perform major role for information diffusion. They influence on agenda setting and form public opinion by active retweets based on reciprocity of powerful network.

This study aims to identify Twitter users who are working as main agents of spreading information in Twitter, which is one of the most representative social media. Especially, as an example of tweeters on social issues, we focus on the nuclear related tweeters. In addition, it tries to clarify characteristics of those people by analyzing the frequencies of their activities, tweet writings, their jobs and so on.

II. RELATED WORKS

A. Online Opinion leader and Mediator

Those who are spread information to citizens by actively providing information which is achieved from mass media with clear their own opinions are defined as "opinion leaders."[1]. The information from those group of people has great influence on general citizens[1].

These opinion leaders play pivotal roles in spreading various major social issues, and their importance has been highlighted with current development of various online communication channels. Studies on receptiveness of information receivers have also proven that opinions of opinion leaders have greater influences than mass media in changing people's behavior[2].

This study aims to investigate opinion leaders based on information spreading relationship structures among users of Twitter. In Twitter, the problems of generating incorrect information caused by anonymity of users are minimized by opening of user's information. Therefore, information of tweeters is highly credible, thus we take advantage of the tweeter to find the opinion leaders in the center of the information flow.

B. Social Network Analysis

Social network analysis which is based on graph theory, focuses on the connections between nodes[3]. It aims to measures structural characteristics of social networks and to visualize the network structures.

In social network analysis, centrality measures are representative indicators to quantify the importance of nodes in networks. Degree centrality, betweenness centrality and closeness centrality are three most representative centrality measures. Degree centrality is defined as the number of links that the node is connected to, and closeness centrality aims to to measure how close one node with others on average. Betweenness centrality measures brokerage role of a node by considering how many times it is included in shortest paths between two other nodes [4].

III. RESEARCH METHOD

C. Analysis Data

This study investigates opinion leaders and opinion mediators, focusing on tweeters by collecting tweets related to nuclear power issues from 2009 to 2013. In fact, we collect tweets which include "nuclear" or

"nuclear power" in Korean. Those who are central to diffuse information are recognized as opinion leaders, and those who are delivering generated information to other users are defined as opinion mediators. In order to grasp flow and diffusion of information, this study utilizes information of re-tweets, mentions, and replies relationships among tweeters. As act such as re-tweet, mention, and reply as motion of transferring information, it is regarded as means of delivering information and utilized in this study.

The data initially collected was 15,467 tweets written by 4,931 users, but only 3,358 tweets that contain information on re-tweet, mention, and reply relationships are used in this study. 2,382 users who performed re-tweet, mention, and reply are selected as final subject of this study. To identify opinion leaders and opinion mediators, social network analysis is utilized, and degree centrality and betweenness centrality are calculated.

D. Experimental Approach

Opinion leaders are those who exert influences by actively receiving information and delivering information that reflected their own ideas to other receivers. These people are central nodes on the network and sources of information that connect to various other nodes. So, as degree centrality fits well with the concept, it was used as proxy measure of opinion leaders.

On the other hands, opinion mediators can be defined as those who play the role of central nodes to deliver and spread important information generated by opinion leaders. Such opinion mediators should have high betweenness centrality, which measures mediation role of certain nodes among many other nodes[2].

Therefore, tweeters who have high degree and betweenness centrality were explored, and such centralities are visualized in network diagrams. The network includes nodes which are denoted by IDs of tweeters, and edges are relationships constructed by their re-tweets, mentions and replies relationships. To calculate centrality measures and visualize, NodeXL* is used.

IV. EXPERIMENTAL RESULTS

E. Opinion leader and Opinion Mediator

This study uses re-tweet, mention, and reply relationships as a means to identify opinion leaders and opinion mediators. By regarding them as flows of information, this research identifies how the user opinion as a root of information is diffused among other users in Twitter. Figure 1 shows a network for the spread of tweets related to nuclear power. That is, Figure 1 illustrates how tweets posted by users are delivered to the other users.

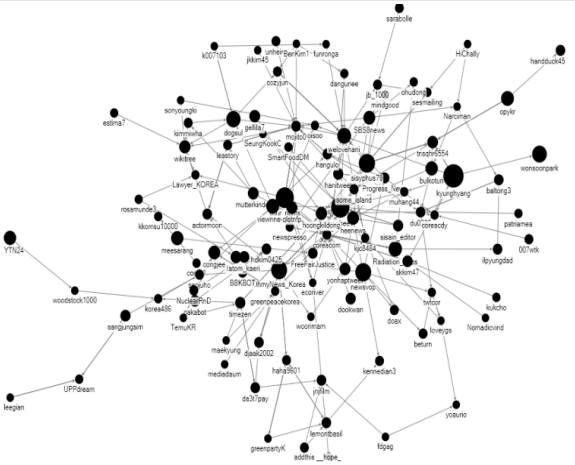

Fig. 1 Network based on degree centrality of tweeters

In Table 1, users who have high degree centrality in relation of tweets related to nuclear have relatively public reputation and their jobs are mainly media, reporter, politicians, etc. Their tweets are spread to many users, and they are actively involved in tweet writing activities, but their re-tweet activities are relatively low.

Table. 1 Twitter users with high degree centrality

Rank	ID	Job
1	Ky**	mass media
2	Jo**	blogger
3	Yo**	member of the National Assembly, lawyer
4	Si**	broadcaster
5	Ne**	mass media
6	Oh**	mass media
7	Wo**	local government head
8	Do**	reporter
9	We**	reporter
10	An**	intelligence agency
11	Ra**	sysop of online social group
12	Op**	imprecision
13	Vi**	mass media
14	Me**	account suspension
15	YT**	mass media
16	Ti**	literary person
17	Bu**	chief editor
18	He**	ex-member of the National Assembly
19	SB**	mass media
20	Co**	novelist

The role of opinion mediators is more focused on delivering important information to other users than generating information. Figure 2 shows the network in which the size of nodes is defined based on betweenness centrality to identify mediating role of tweeters.

* http://nodexl.codeplex.com/

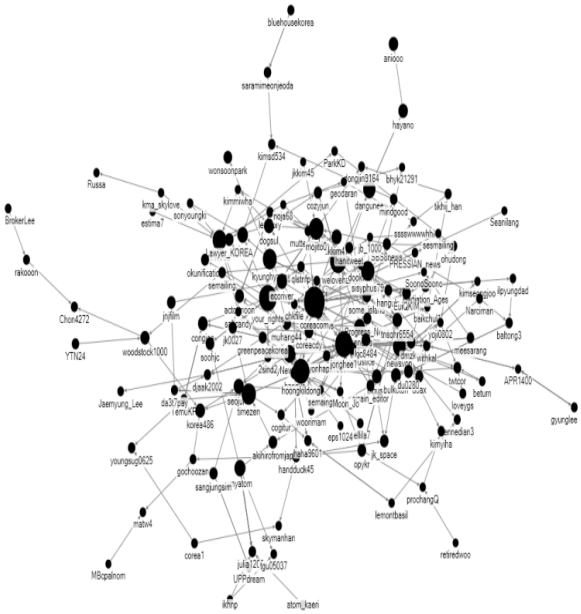

Fig. 2 Network based on betweenness centrality of tweeters

In Table 2, betweenness centrality measure identifies that opinion mediators are composed of individuals with more various jobs other than works related to media. On the other hand, they performed many re-tweet activities than those who have high degree centrality.

Table. 2 Twitter users with high betweenness centrality

Rank	ID	Job
1	Co**	photographer
2	Yo**	member of the National Assembly, lawyer
3	Jo**	blogger
4	Ho**	volunteer
5	We**	reporter
6	Mo**	imprecision
7	Ti**	philosopher
8	Ky**	mass media
9	Wi**	mass media
10	Si**	scenario writer, broadcaster
11	Ne**	mass media
12	Da**	no jobs
13	Oh**	mass media
14	An**	intelligence agency
15	He**	ex-member of the National Assembly
16	Oi**	novelist
17	Ec**	sociologist
18	Se**	office worker
19	Sk**	professor
20	Do**	reporter

In addition, the number of tweets and re-tweets of opinion leaders and opinion mediators, as previously identified, is counted. 'Tweet' is the number of tweets written by the users and 'Re-tweet' is the number of tweets reposted by others. Then the "Ratio" of tweets being re-tweeted by other users is calculated. It is calculated as Re-tweet divided by Tweet. As shown in Table 3, the average ratio of the users who are identified as top 20 opinion leaders is 0.673. That is, tweets posted by top 20 users with high degree centrality are re-tweeted in probability of 67.3% on average. There is a case that the number of re-tweets appears even if the number of original tweet is 0. This is because that the posting date of the tweet is before the data collection period (2009~2013) of this research, being re-tweeted after 2009. In addition, due to the user's account suspension, we could not count the tweets written by the user. When the number of tweet is 0, making the "ratio" 0 as well, the value is excluded from the average result of the experiment.

Table. 3 Acts of tweeters with high degree centrality

Rank	ID	Degree centrality	Tweet	Re-tweet &Mention	Ratio(%)
1	Ky**	33	156	41	.263
2	Jo**	27	91	33	.363
3	Yo**	26	246	32	.130
4	Si**	21	11	26	2.364
5	Ne**	20	74	24	.324
6	Oh**	20	111	28	.252
7	Wo**	17	33	18	.545
8	Do**	16	32	18	.563
9	We**	15	57	16	.281
10	An**	14	26	118	4.538
11	Ra**	14	287	25	.087
12	Op**	13	0	15	0
13	Vi**	13	18	16	.889
14	Me**	12	0	12	0
15	YT**	12	364	12	.033
16	Ti**	12	65	12	.185
17	Bu**	12	135	15	.111
18	He**	11	27	12	.444
19	SB**	11	282	11	.039
20	Co**	11	17	12	.706
average			-	-	0.673

The Table 4 shows the number of tweets posted by top 20 users with high betweenness centrality and the number of re-tweets by others. The ratio of re-tweets to tweets is shown as .453, much lower than that of users with high degree centrality. In other words, the probability of tweets being re-tweeted by others is approximately 39.4%.

Table. 4 Acts of tweeters with high betweenness centrality

Rank	ID	Betweenness centrality	Tweet	Re-tweet &Mention	Ratio(%)
1	Co**	457288.767	68	6	.088
2	Yo**	326016.721	246	32	.130
3	Jo**	317125.562	91	33	.363
4	Ho**	294865.914	34	10	.294
5	We**	273477.723	57	16	.281
6	Mo**	219681.414	33	7	.212
7	Ti**	207431.305	107	9	.084
8	Ky**	193762.419	156	41	.263
9	Wi**	190037.542	190	12	.063
10	Si**	177906.007	11	26	2.364
11	Ne**	161111.941	74	24	.324
12	Da**	147594.066	151	5	.033
13	Oh**	137697.768	111	28	.252
14	An**	117777.610	747	118	.158
15	He**	110503.699	27	12	.444
16	Oi**	105882.619	12	19	1.583
17	Ec**	100952.401	36	4	.111
18	Se**	97822.576	156	7	.045
19	Sk**	94188.114	49	11	.224
20	Do**	93488.444	32	18	.563
average-			-		.394

F. Social and personal aspects of the nuclear issue

Collected tweets can be classified into the social and personal dimensions based on their contents. Tweets about social issues are related to the national policy, corruption or environment, and tweets about personal issues include problems directly related to life such as health and safety. To this end, collected data are classified into tweets including social issues and tweets including personal issues. Then the information flow network of the user based on classified tweets generated, and degree centrality is calculated. It is identified that opinion leaders are different according to the differences of these issues. Table- 5 and Table 6 show the results as follows. In social content network, users are mostly press related people such as media or journalist. On the other hand, individuals with various occupations are included in the personal content network.

Table. 5 Opinion leaders of social content related network

Rank	ID	Job
1	Ne**	mass media
2	Jo**	blogger
3	Ky**	mass media
4	Do**	reporter
5	He**	ex-member of the National Assembly
6	Yo**	member of the National Assembly, lawyer
7	Ge**	office worker
8	Me**	account suspension
9	Oh**	mass media
10	Vi**	mass media
11	Bu**	chief editor
12	Bi**	reporter
13	Se**	government employee
14	Le**	professor, former government employee
15	We**	reporter
16	Ku**	professor
17	Do**	ex-local government head, ex-ministers
18	Mo**	imprecision
19	Ko**	mass media
20	Be**	imprecision

Table. 6 Opinion leaders of personal content related network

Rank	ID	Job
1	Yo**	member of the National Assembly, lawyer
2	Op**	imprecision
3	Oh**	mass media
4	Ti**	literary person
5	Jo**	blogger
6	Ga**	withdrawal
7	YT**	mass media
8	Bu**	chief editor
9	Ra**	sysop of online social group
10	Ky**	mass media
11	Si**	broadcaster
12	SB**	mass media
13	Gl**	imprecision
14	Sk**	professor
15	An**	nuclear related organization
16	BB**	withdrawal
17	Ba**	member of social organization
18	Ki**	comedian
19	Kk**	cartoonist
20	Vi**	mass media

CONCLUSION

This research identifies opinion leaders and opinion mediators on a particular social issue using nuclear related tweets collected from Twitter. The differences and characteristics of opinion leaders and opinion mediators are also investigated. In order to do this, opinion leaders and opinion mediators are recognized by social network analysis. Overall, information is produced and disseminated by tweeters with public reputation and awareness. Also, the ratio of re-tweets to tweets of opinion leader group is higher than that of opinion mediator group. From this result, the proportion of tweets being re-tweeted is not associated with the number of tweets posted. Therefore, it is necessary to conduct an additional experiment focusing on the contents of tweet posted by opinion leader and opinion mediator.

It is expected that the traits of opinion leaders are more clearly understood if factors such as length of tweets, characteristic of sentence, number of followers, and

followings are considered in further study. Also, it is necessary to checks the change of opinion leaders according to the issues by studying tweets about issues in fields other than the nuclear accident.

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