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User's Decision-making Model on the Spread of Retweet Messages

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Citizen communication during disasters are increasingly relies on online environment. Not only for generating and sharing of information, social media such as Twitter also facilitates the spreading of inaccurate information which increase information overload in already tense situation. With the raising issue of misinformation spread through Twitter aftermath The Great East Japan Earthquake on 2011, this paper present our preliminary model of user's decision making of retweet messages in Twitter. We conducted a user survey using questionnaire and perform factor analysis for the model development. The results of the survey provide an insight to understand how user reacts towards retweet messages and factors influenced user's decision making on retweeting behaviour towards the spread messages in social media stream. Implication of these findings assists in understanding misinformation distribution through social media which may affect the effective use of social media for emergency management.

1. Introduction

In recent years, communication during catastrophic events such as Haiti Earthquake [1], The Hurricane Sandy [2], Deepwater Horizon 2010 [3] and The Great East Japan Earthquake [4] are heavily relied on social media technologies. Even before the increasing use of these services, citizen utilized Flickr, Wikipedia, MMS videos, and post messages on web-based discussion sites where the terms of "citizen reporter" [5] and "citizen-to-citizen communication" [6] emerged. These terms referred to citizen who can be anybody; the one who directly affected or not by the disaster, which use online platform to generate and share their real experience, feelings, and information they get or to communicate with others.

Although the user-generated information provided by citizens proved to be useful in coordinating humanitarian relief and contribute to the public awareness during and aftermath the disaster, information overload raised an important issue. In the case of The Great East Japan Earthquake on 2011, Twitter was flooded with various kind of information reporting self-experience, warning, fact, safety status and even rumor and hoax messages [4,7,8]. The misinformation spread through social media such as Twitter raised an issue to be concern [4,9] because of the wide spread of information through social media may lead to more serious problem not only to the victims and emergency professional, but to the whole society in general.

Technology is always important; however the social aspect of people who utilized the technology is also a crucial part to be understood. Previous literature studies user online behavior through two approaches. First, model the behavior from data captured from social media archive, for example Twitter API [7]. Second, conduct user survey and experimental setting, for example use the real tweets as stimuli to collect responds from user [9,10]. In our study, we use the second approach to understand user behavior of information diffusion online. We apply the Twitter environment and analyze the misinformation tweets spread during the catastrophic disaster happened on 2011, The Great East Japan earthquake as the background in this research [11]. This paper will presented the results of factor analysis to answer the questions of user's action and decision making towards online spread messages in Twitter environment.

The rest of the paper is organized as follows. Section 2 explains the background of the study. Next, in section 3, we describe about the user survey. In section 4, we elaborate the analysis findings. Section 5 presents the discussion and future work. Finally, we conclude our work in section 6.

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2. Background of the study

2.1 Disaster Communication

Disaster communication is a part of emergency management which refers to immediate in dealing with real incident [12]. The use of Facebook, Twitter, LINE, Google+ or any other online platform similar in terms of it allows information to reach wide audience in few minutes. Although one will generate and disseminate information first in their own network, other people who share or retweet it will continue the information flows in their own network and this is how the information get spread. During disasters, people urge for updated information where the use of social media allows the affected people to update their own state which in turns promotes awareness for others to decide how they should response. As noted by Jung [13], the centrality of mass media increases as the ambiguity in social environment increases.

There are four phases of emergency management cycle which are: mitigation, preparedness, response and recovery. There is no doubt that social media is beneficial during preparedness and response phase in emergency [14]. Thus, previous studies focused on the utilization of social media for mass collaboration in response and rescue for emergency management professional during emergencies [14,15]. Not only to the professional crisis management, ordinary citizen utilize social media for not only to seek for information or help but also generating, evaluating and spreading it which has implications on response activities [6]. One of the reasons on why people are motivated to use social media during disaster is because of the desire to help [5]. When crises occur, the frequency of interpersonal communications are increasing where in online context, people

will use their everyday tools, such as social media for seeking and disseminate disaster-related information [3].

During and aftermath 2011 The Great East Japan earthquake, the government agencies and public organizations opened their own Twitter account as a mean of disaster communication channels [16]. The amounts of tweets are increasing just after the earthquake and 1.8 times larger than usual [13]. Since Twitter is the top social media used in Japan on previous catastrophic event, we further review what kind of disaster-related information people post in Twitter during and aftermath the 2011 catastrophic earthquake which trigger tsunami and nuclear crisis in Japan.

2.2 Disaster Information

The classical meaning of information by Shannon and Weaver [22] is "*a measure of one`s freedom of choice when one selects a message*" while communication is "*all of the procedure by which one mind may affect another*". The basic meaning of information then evolves with consideration of meaning and related to the receiver's background knowledge which may produce belief by Fred Dretske (1981) [23]. In terms of disaster information in our context, we consider the disaster-related tweets posted and retweeted as information; as it conveys meaning to the receiver in a way that it affected one choice to accept the information and continue to spread it within their network, specifically, in online network.

In disaster situation, people post early warning tweets to create awareness, anxiety-level messages for example fear, angry and worry feelings, report their self-experience, opinion and sharing advice, safety status, fact or informative messages from the government or organization and help request in Twitter [7,8]. These kind of disaster-related information are undeniable useful at disaster preparedness and response phase during emergencies. It makes the emergency response team to prepare for the worse case and help ordinary people to make better decision on how to respond with the situation. However, among these information, misinformation, rumor and hoax messages occur. Surprisingly, the misinformation tweets got high number of retweet by users [11]. Consequently, if the inaccurate information is widely circulated, it may influence people to change their belief and opinion [9].

2.3 Misinformation

After the 2011 Great East Japan Earthquake disaster, some hoaxes information regarding radiation, toxic rain, bogus fund-raising and death news spread. Although some of the misinformation have no basis, because of the lack of information and unstable emotions create a situation where it becomes easy for people to believe and re-distribute it, most probably to help others. From rumor psychology literature, rumor arises in contexts of ambiguity, danger or potential threat that help people to make sense and manage risk [19]. Because social media can facilitate the rumor spreading faster than traditional word-of-mouth method, several studies from psychology background examined the between important, anxiety-provoking, familiar, fluency of the message, distance and feelings with the likelihood to share disaster information in social media platform [9,10].

In Twitter, the act of spreading or forwarding the tweets can be easily done using retweet function. Although we do not follow the original tweet creator, the tweet that has been retweeted by our following list users can be viewed and we can continue the information flowing by retweeting it in our network. Hence, not only the tweet content, but the one who create and retweet the tweets may influence us to make decision to retweet. Therefore, with the highlighted issue of misinformation spread in Twittersphere, we develop a questionnaire to investigate two main questions as elaborate more in the next section.

3. The Survey

3.1 The Questionnaire Design

The main purpose of this questionnaire is to understand one retweet behavior. We design the questionnaire considering all possibilities of actions user will take towards retweet messages, together with Twitter functions such as "Favorite" function and the availability of URL link in the tweet [11]. It is developed in Japanese language with 48 question items is designed in three parts with 7-likert scale answer. The first part related to the questions of whether one sees retweet messages and take any action on it or not. Meanwhile, the second part related to the questions of user's possible actions such as the use of favorite function, URL access and others. The third part of the questions related to the questions of whether one perform retweet or not, on the spread message.

We also collect respondent's demographic information on their Twitter usage and basic information such as gender, age, and faculty for the survey. In this survey, our focus is to measure one action and decision making after they read the spread message (the message that has been retweeted by others). We focus our investigation on what makes user decide to perform retweet on the spread message, or in Twitter, the retweet message that has been retweeted by others and circulated. For example, user C saw retweet message that was retweeted by user B, although user C do not "follow" user A (the original tweet author) directly. In this questionnaire, we investigate user C action and decision making he/she want to perform retweet or not towards the spread message from their Twitter timeline. Figure 1 illustrates the design of the questionnaire used in this survey.

3.2 The Demographic Information

We conduct the survey on 10 and 11 December, 2012 with total number of respondents, 133 students from Iwate Prefectural University, Japan. The respondents consist of 94 male, and 39 female with mean age = 20.5. They are given explanation on the survey purpose and Twitter terms use in the questionnaire. All respondents are Twitter users from Japan and most of them, 67.7% use Twitter for more than 5 times per day and 37.6% of them have the number of current tweets up to 10,000 until the particular survey date. Thus, we can say that most of the respondents in this survey are active Twitter users. More than half of our respondents used Twitter before and on March 2011. However, we do not distinguish respondents who

are affected directly or not on 3/11 disaster in this survey, as long as they have Twitter account and utilized it.

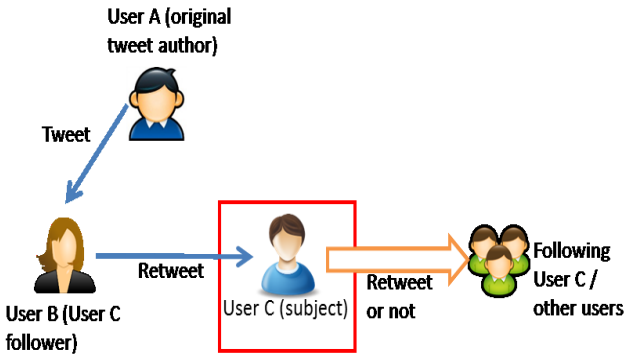

Figure 1. The questionnaire design

3.3 Analysis

We conducted factor analysis for this questionnaire to confirm the factors on user's actions and decision making towards spread messages. We want to identify the factors on what action user will take after they read spread messages, and what makes people decide to retweet. First, we perform Exploratory Factor Analysis (EFA) with maximum likelihood method using SPSS. Factor Analysis is a data reduction technique to group a large set of intercorrelated variables under a small set of underlying variables called factor. Cronbach alpha is the most commonly used of reliability test to measure the internal consistency of the answers. From the reliability test, we eliminate question items that have problems with ceiling and floor effect, low communalities, Cronbach alpha value, and questions that are not indicate positive actions user shall take towards retweet messages. Next, to enhance the reliability of EFA result obtained, we performed Confirmatory Factor Analysis (CFA) to confirm the initial model of EFA provides a good fit to the data. Structural Equation Modeling (SEM) is a confirmatory technique used to validate the model with three highest variable loadings for each factor. Then, we model our factors with SEM and check the model fit to confirm the findings of factors obtained to answer our research questions. We used the modification indices to determine whether we need to add or remove any problem path in the SEM diagram. The following section elaborates the results and findings of the factor analyses.

4. Results and Findings

We analyze all question items from part two and three regarding user action and decision making after they read retweet message from their Twitter timeline. For the first analysis, we want to investigate "*What is the user's action after they read the retweet messages?*".

We eliminate question items with ceiling and floor effect, low communalities, Cronbach alpha value during reliability test in factor analysis, and questions that do not indicate positive action user will take towards retweet message. As a result of the EFA, 3 factors derived from 28 question items. The 3 factors were explained by 52.415% (Cumulative) as a total. The cumulative value describes how much the factors explain all the question items. For the reliability measure, the Cronbach's coefficient alpha of each factor subscale factor 1, factor 2 and factor 3 are .930, .862, and .787 respectively.

We identified the factors related to user's action towards retweet messages as follows:

Factor 1: Desire to spread the retweet messages as it is considered important.

This factor consists of 21 items regarding user willingness to take action towards the retweet messages by retweet it to their followers, if they think the message is important to be spread. The message could be positive, negative thing, call for action, "Please RT" messages or with the presence of URL link.

Factor 2: Mark the retweet messages as favorite using Twitter "Favorite" function.

This factor consists of 3 items related to user's decision to use the Twitter favorite function (star symbol) to mark the retweet messages as favorite.

Factor 3: Search for further information about the content of the retweet messages.

This factor consists of 4 items related to user's action to make further reading if their interest sprung on the message content or about the tweet author.

Table 1 shows the factor loadings for each factor for the first analysis on 48 question items. Next, in order to verify the 3 factors found in EFA, we conduct CFA using SEM diagram. As a result, we found that the overall fit of the model was acceptable with values as follows: Goodness of Fit Index (GFI) = .950, Comparative Fit Index (CFI) = .981, RMSEA = .057. The model is a close fit model by the criteria of GFI and CFI above .90 and RMSEA value below .08. Thus, it verified the validity of the 3 factors on user's action towards retweet messages.

Based on the findings from this analysis, we conduct the second analysis phase to investigate why user have the desire to spread the retweet messages and thus continue the information flowing in Twitter. We further analyze 21 question items on the first factor from the first analysis: **Desire to spread the retweet messages as it is considered important**. Thus, the research question for the second analysis is:

"*Why user wants to spread the retweet messages?*", if they choose to further retweet the message.

From 21 question items from the first factor, we perform EFA for the second analysis phase. There are 2 questions (question 5 and 8) with low communalities and 2 questions (question 24 and 9) problem with Cronbach alpha value during the reliability test in EFA. Thus, we exclude these 4 questions and therefore, only 17 question items remained and as a result, 3 factors derived. The 3 factors were explained by 61.854% (Cumulative) as a total. The cumulative value describes how much the factors explain all the question items. It usually requires value of more than 60%. For the reliability measure, the Cronbach's coefficient alpha of each factor subscale factor 1, factor 2 and factor 3 are .875, .875, and .765 respectively. For the reliability test, the value of .70 and above is acceptable in most of the social science research. Table 2 shows the factor loadings for each

factor for the second analysis on 17 question items.

Table 1. The First Analysis Factor Pattern Matrix

Question item	Factor 1	Factor 2	Factor 3
40	.853	-.287	.005
35	.797	-.042	-.012
28	.770	.048	-.021
38	.695	-.206	.139
31	.687	.085	-.003
26	.661	.124	.002
27	.658	.081	-.074
42	.645	-.034	.127
41	.633	-.077	-.032
9	.613	-.137	-.016
32	.581	.245	-.131
30	.576	.117	-.185
36	.565	-.157	.094
16	.563	.153	.014
34	.547	.082	-.022
5	.460	.146	-.009
17	.442	.299	-.007
20	.426	.215	.223
29	.423	.106	.273
24	.414	-.024	.128
8	.382	.049	.023
13	-.067	.940	.020
14	-.195	.861	.039
15	.032	.739	.056
18	-.081	-.067	1.054
19	-.050	.104	.825
12	.123	.129	.368
7	.152	.134	.276
Cumulative %	37.882	45.792	52.415
Cronbach's coefficient alpha	.930	.862	.787

We identified the factors as the factors related to user's decision making to perform retweet on the spread message as follows:

Factor 1: Need to retweet.

This factor consists of 8 items regarding although user do not know the details of the message, if they think it is important to be spread, related to their situation, tweet from official account or reliable author, negative tweet or from trusted source, they will retweet.

Factor 2: Interesting tweet content.

This factor consists of 6 items related to user's desire to perform retweet because of the retweet message content. The message could contain joke/fun and positive tweet, call to action and messages that capture user interest.

Factor 3: Tweet user.

This factor consists of 3 items related to user's decision to retweet after checking who has retweeted it, check the original tweet author and followers.

Next, in order to verify the 3 factors found in EFA, we conduct CFA using SEM diagram. The overall fit of this model with values as follows: GFI = .949, CFI = .964, RMSEA = .072. Therefore, it verified the validity of the 3 factors and our model is an acceptable fit model of the data.

Then, we model these 5 factors found from these analyses using SEM diagram. Figure 2 shows the SEM diagram for the overall factors derived. The overall fit of this model with values as follows: GFI = .909, CFI = .957, RMSEA = .066. Since the value of GFI and CFI are above .90 with RMSEA value less than .08, our model is an acceptable model and it verified the validity of the 5 factors derived in this study.

Table 2. The Second Analysis Factor Pattern Matrix

Question item	Factor 1	Factor 2	Factor 3
17	.808	.032	-.170
30	.673	.000	-.075
31	.607	.169	.053
32	.691	-.212	.311
34	.503	.014	.150
35	.499	.182	.172
27	.400	.139	.239
16	.392	.097	.254
29	.095	.782	-.195
38	-.184	.741	.186
26	.171	.620	.030
20	.419	.547	-.231
42	.107	.593	.100
28	.373	.440	.069
36	.033	-.068	.703
40	-.251	.514	.583
41	.082	-.092	.767
Cumulative %	46.901	54.971	61.854
Cronbach's coefficient alpha	0.875	0.875	0.765

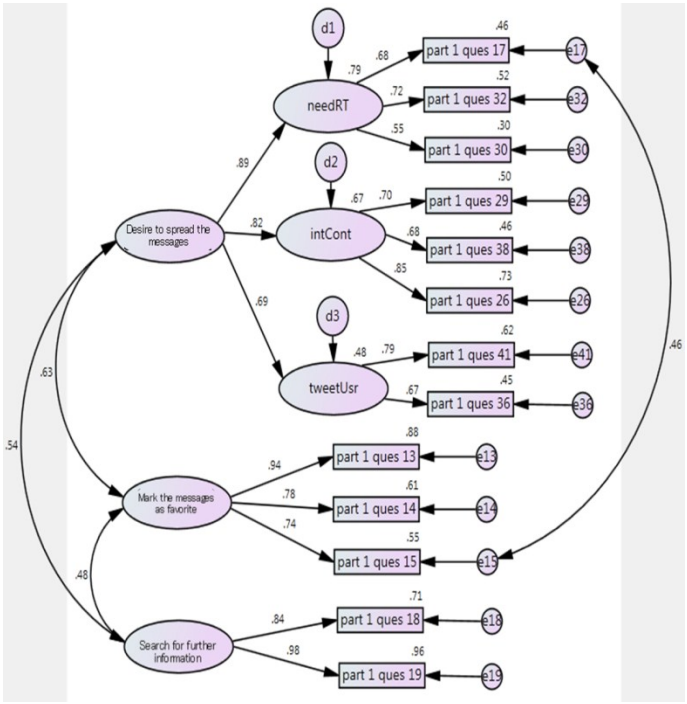

Figure 2. The SEM Diagram

5. Discussion and Future Work

From the first analysis, we extracted 3 factors on user's action after they read the retweet messages, which are:

1) Desire to spread the retweet messages as it is considered important.

2) Mark the retweet messages as favorite using Twitter "Favorite" function.

3) Search for further information about the content of the retweet messages.

These results helps us to understand actions taken towards retweet messages, whether user will retweet it or not and the use

of Twitter function. We can see that the first and second factor leads to people believe and transmitting the information. Although by using the "Favorite" (star symbol) function is not the same as forwarding the messages, but this act may influence people believe that the people who mark it as acknowledging the content. The problem is if it is inaccurate information, when it seems like much people acknowledging and retweeting it, then more people will tend to believe it and continue circulating the information to the public. While the third factor, the act of search for further information after one read the retweet messages, this action will help to reduce the spread of misinformation because when we do further validation from other sources, or even check other tweets from the same author, we may find if there are any corrections or updated information about the matter.

Meanwhile, the findings from second analyses help us to understand factors influencing why people desired to retweet. The first factor, "need to retweet" explained users are more likely to retweet messages that they evaluate as important and they want to spread it, including credible tweets from official account or trusted source, but not only limited to that, also retweeted messages that related to their situation or negative tweets. The second factor, "interesting tweet content" explained one desire to perform retweet because of the message content that captured their interest, whether it is a joke, fun, positive kind of tweets or call to action tweets. The third factor, which is the "tweet user" explained the other side instead of the messages content, which is the factor of Twitter user, including the original author, the following and followers, which refers to people related to the retweeted messages, that influenced one decision to continue retweeting it or not. As we can see the first two factors is about the content of the retweet messages. Similar to study by Boyd [20] which indicates that why people retweet is related to what they retweet. Meanwhile, the third factors highlighted that the actor or people who create and retweeted the messages also influence people decision to retweet. For example, we tend to believe information we get from people whom we trust or credible people whom we believe their statement. The findings in this paper also support [21] findings which indicated two main reasons on why user retweet is because of the tweet's visibility and position in the Twitter feed, and the original tweet author who create the tweet.

For future work, we plan to further examine is different kind of messages content affect people likelihood to spread the information, with focus in disaster situation. In addition, several factors that may influence user's decision making to evaluate the online information will be investigated in our next study. Align with our motivation on misinformation transmission issue during disaster; we will focus on retweet behavior in emergency situation in the next survey with greater number of subjects. Figure 3 summarize the findings of factors explained in this paper.

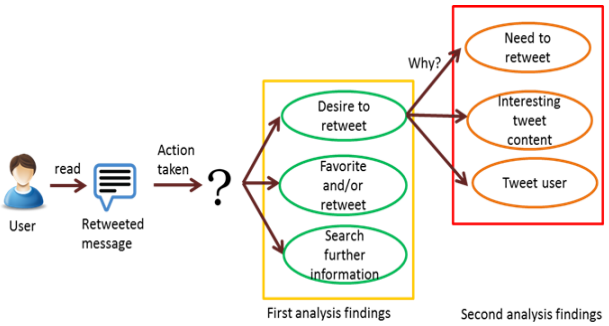

Figure 3. Summary of the findings

6. Conclusion

This paper presented results of the factors related to user's decision making towards the spread messages in Twitter. We conduct a user survey as a preliminary study to understand user's behavior of information diffusion using retweet function in ordinary situation. The following conclusions can be made: 1) User's act of searching for more information after they read the spread messages before they retweet may leads to reducing the chance of misinformation spread, and 2) How people perceived the information influenced people to continue retweeting it or not. The findings in this paper contribute to understand user behavior towards spread messages in Twitter which also helps us to understand why misinformation transmission through online environment happened. Although misinformation would never go away, by understand how people behave in social media facilitate us to plan on how to control the distribution of misinformation through online stream.

Reference

[1] Dugdale, J., Van de Walle, B., and Koeppinghoff, C.: Social media and SMS in the haiti earthquake, *Proceedings of the 21st international conference companion on WWW '12*, ACM, NY, USA, pp.713-714 (2012).

[2] Chatfield, A.T., Scholl, H.J., and Brajawidagda, U.: #Sandy Tweets: Citizens' Co-Production of Time-Critical Information during an Unfolding Catastrophe, *Proc. of HICCS-47*, pp.1947-1957 (2014).

[3] Emma, S.S., Sutton, J., Greczek, M., Fitzhugh, S., Pierski, N., and Butts, C.T.: Rumoring During Extreme Events: A Case Study of Deepwater Horizon 2010. *WebSci 2012 ACM*, pp.275-283 (2012).

[4] Acar, A., and Muraki, Y.: Twitter for crisis communication: Lessons learned from Japan's tsunami disaster, *Int. J. Web Based Communities*, pp.392-402 (2011).

[5] Peary, B.D.M., Shaw, R., and Takeuchi, Y.: Utilization of Social Media in the East Japan Earthquake and Tsunami and its Effectiveness, *Journal of Natural Disaster Science 34(1)*, pp.3-18 (2012).

[6] Palen, L., and Liu, S.B.: Citizen Communications in Crisis: Anticipating a Future of ICT-Supported Public Participation. *Proc. of CHI*, pp.727-736 (2007).

[7] Doan, S., Ho Vo, B., and Collier, N.: An analysis of Twitter messages in the 2011 Tohoku Earthquake, Lec. Notes of the Inst. for Comp. Sciences, Social Info. & Telecom. Eng., pp. 58-66. Springer (2012).

[8] Fukushima, Y., et.al: Macroanalysis of Microblogs: An Empirical Study of Communication Strategies on Twitter During Disasters and

Elections. *In: AAAI Spring Symposium Series* (2014).
[9] Chen, R., and Sakamoto, Y.: Perspective matters: Sharing of Crisis Information in Social Media, *Proc. of HICCS-46*, pp.2033-2041 (2013).
[10]Tanaka, Y., Sakamoto, Y., and Matsuka, T.: Transmission of Rumor and Criticism in Twitter after the Great Japan Earthquake, *Proc. of the 34th Annual Conference of the Cognitive Science Society*, pp.2387-2392 (2012).
[11] Mukai, M.: Research on a Model for Decision Making in Retweet which caused Spreading of False Rumor in Emergencies, Master Dissertation, Iwate Prefectural University (in Japanese) (2012).
[12] Murayama, Y., Saito, Y., and Nishioka, D.: Trust Issues in Disaster Communication, *Proc. of HICCS-46*, pp.335-342 (2013).
[13] Jung, J.: Social media use and goals after the Great East Japan Earthquake, *First Monday,* 17(8), doi: 10.5210/fm.v17i8.4071 (2012).
[14] White, C., Plotnick, L., Kushma, J., Hiltz, S. R., and Turoff, M.: An online social network for emergency management, *Int. J. Emergency Management*, Vol.6, pp.69-382 (2009).
[15] Raue, S., Azzopardi, L., and Johnson, C.W.: #trapped!: Social media search system requirements for emergency management professionals. *Proc. of the 36th Int. ACM SIGIR Conference on Research and Development in Information Retrieval*, pp.1073-1076 (2013).
[16]Akimoto, A.: Japan, the Twitter nation. http://www.japantimes.co.jp/life/2011/05/18/digital/japan-the-twitter-nation/#.U_i4Y_m1ZmM (2011).
[17] Shannon,C.E., and Weaver, W.: The Mathematical Theory of Communication. Univ of Illinois Press. (1949).
[18] Capurro, R., and Hjorland, B.: The concept of information. *Annual Review of Information Science and Technology Ed. B. Cronin*, Vol. 37,Chap.8, pp. 343-411 (2003).
[19] DiFonzo, N., and Bordia, P.: Rumor Psychology: Social and Organizational Approaches. American Psychological Association, Washington (2007).
[20] Boyd, D., Golder, S., and Lotan, G.: Tweet, Tweet, Retweet: Conversational aspects of Retweeting on Twitter, *Proc. of HICCS-43*, pp.1-10 (2010).
[21] Pezzoni, F., An, J., Passarella, A., Crowcroft, J., and Conti, M.: Why Do I Retweet It? An Information Propagation Model for Microblogs. In: A. Jatowt et al. (Eds.), *Social Informatics 2013*, LCNS 8238, pp. 360-269 (2013).