Toward the operation guidelines for municipal social media account: From the analysis of user's behavior on Twitter in the Great East Japan Earthquake

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Abstract – More and more municipal organizations have been using Twitter for information distribution or interactive information exchange. Such official information sources are supposed to be relied upon by citizens when a disaster breaks out, but how such information on social media should be operated is not known.

This research investigated the user behavior around the Twitter accounts of municipal organizations in the Great East Japan Earthquake. Through the close investigation, the operation guidelines for a municipal Twitter account were obtained.

Keywords: Social media, Twitter, Information behavior, the Great East Japan Earthquake, Guideline

1 INTRODUCTION

Together with the rising popularity of social networking services, a micro blogging service Twitter had been used extensively when the Great East Japan Earthquake happened on March 11, 2011.

There were a few types of Twitter use; information broadcasting to public, information receiving from public, and information exchange among closed members. They were useful when other media disclosed their own weaknesses. The mass media worked well for nation-wide broadcasting but not so much for regional broadcasting. The phone line was overloaded to connect [1][2]. People were anxious about what was happening, what would be going on, and wanted the information. Twitter matched to fulfill these needs.

As for the Twitter use by municipal organizations, it was still in the beginning stage of big growth at that time. Some accounts were relatively new while some other already had a number of followers. Soon after the disaster, we gained increasing momentum to use such social media. More numbers of municipal organizations officially started to use social media, especially Twitter. Recently the government officially encouraged municipal organizations to use social media for their information broadcasting [3].

However, we do not know exactly how municipal Twitter account worked, and thus we do not know how municipal social media account could be operated effectively so that the account is useful to the public, especially in emergency. To answer this question, we investigate the user's behavior on Twitter in the Great East Japan Earthquake, and draw the operation guidelines for municipal social media account.

2 RELATED WORKS

2.1 Twitter

Twitter is an online microblogging service. It provides almost real-time online short text communication. It can be used from various internet devices including a personal computer, a smart phone, and other mobile phones. A short text message called a "tweet" can be viewed from the world if it is not sent from the specially closed account. This normal tweet can be searched by keywords, tags, and accounts. Subscribing an account called "following" is a feature of Twitter. By this, a subscriber called a "follower" can view the tweets of the "following" account without any operation. Thus an account that sends useful information regularly to the receiver, or that "tweets" useful information regularly, is likely to be followed. When a receiver of a tweet thinks to distribute the tweet, he/she can tweet that tweet. This action is called "retweet."

2.2 Twitter Use in Disaster

Mendoza et al. studied the behavior of Twitter users in the 2010 Chilean earthquake in the hours and days following this disaster [4]. They performed a preliminary study of the dissemination of false rumors and confirmed news. They analyzed how this information propagated through the Twitter network to assess its reliability as an information source under extreme circumstances, and showed that the propagation of rumors differed from that of news because rumors tended to be questioned more than news by the Twitter community.

Longueville et al. studied how Twitter could be used as a reliable source of spatio-temporal information by focusing on the 2009 French forest fire, aiming to demonstrate its possible role to support emergency planning, risk assessment and damage assessment activities [5]. They studied the temporal dynamics of the tweets, how location names were cited, who published the tweets, what type of domains were cited as URLs.

Vieweg et al. analyzed the tweets generated during two concurrent emergency events in North America 2009, the Oklahoma Grassfires of April and the Red River Floods in March and April [6]. They focused on communications broadcast by people on the ground, investigated the tweets in terms of location information and update with their dissemination. They then identified information that might contribute to enhancing situational awareness during emergencies. Qu et al. studied the messages in a microblogging site Sina-Weibo that is very similar with Twitter and is popular in China in the 2010 Yushu Earthquake [7]. They investigated the content of the messages, the trend of different topics, and the information spreading process.

Miyabe et al. studied the tweets in the Great East Japan Earthquake in terms of their locations [8]. They concluded how people used Twitter was different from the locations depending on the damages.

Umejima et al. studied the false rumors and their corrections in a disaster, and indicated that a false rumor is easier to disseminate [9].

These studies analyzed the Twitter uses by people at large in emergency cases, where this study focuses on the use of municipal accounts in emergency cases.

2.3 Twitter Use by Public Institutions

Alam et al. studied six governmental Twitter accounts in Australia [10]. They analyzed the content of the tweets as well as the responses from the citizens.

Kavanaugh et al. studied the local governmental use of social media including Twitter [11]. They conducted a survey to local governmental institutions, the analysis of the followers of governmental Twitter accounts, and the analysis of the messages in Facebook accounts.

These studies analyzed the use of Twitter by public institutions in normal circumstances, while our study focuses on the Twitter use in emergency.

3 DATA AND ANALYSIS

3.1 Data

The analyzed data were from the Twitter accounts that were registered in "Govtter," the link site of official municipal Twitter accounts [12]. Govtter only lists the Twitter accounts that were confirmed as those operated by governmental institutions. A total of 363 accounts were listed as of January 2012 including the municipal accounts, the governmental accounts, and other public institutions. Among those accounts, 149 accounts were older than March 11th of 2011, before the earthquake.

In Twitter, a tweet is stored with the links to the date and time of the tweet, the identifier number called Status ID, and the account information. These tweets could be acquired from the latest tweet to as far back as 3200 tweets by Twitter API in the official site (in 2011 when the data was collected) [13]. However the number of follows and the number of followers in the account information were those at the time of getting the tweet data, which meant chronological change of those values could not be obtained by this method.

Thus we used Twilog service to obtain the change of the number of followers [14]. In Twilog, the number of follows and the number of followers are recorded along with the tweet itself for the registered Twitter accounts. We used all the data of the municipal accounts that were listed in Govtter and registered to Twilog before March 11th of 2011, which counted to 34 accounts.

The data were obtained from February 1 to April 30 in 2011. The total number of the tweets was 42825.

3.2 Analysis

The data was analyzed in the following way.

First the outline of the data was obtained. It was about the tweet and follower in this study. The basic structure of information behavior is sending information and receiving information. Information is sent by a tweet. Thus the number of tweet was used for analysis. If a person wants to receive the information from an account, the person follows the account. This action is reflected as the number of followers across time, the increasing rate of followers was used for analysis.

After getting the outline of the number of tweets and the number of followers for all the accounts, the accounts were categorized into four groups in quantitative viewpoint according to the number of the tweets and the number of followers across time. The average values of these metrics were used as the borderlines of the groups, which is common in explorative data analysis. Each group was investigated accordingly.

Furthermore, the content of the tweets were investigated. They were categorized in five in qualitative viewpoint. The relation between the groups and the content categories were also discussed.

4 RESULT

4.1 Change of the Number of Tweets and Followers

The change of the number of tweets for all the 34 accounts is shown in Fig. 1. The account names in the legend are simply in alphabetical order. Because a tweet bot "Obsekuri" which was an extremely frequent tweeter than other accounts is included in Fig. 1, it is difficult to see the data of other accounts. To get the general outline of the change of the number of tweets, the account was removed from the graph and Fig. 2 is shown.

The Change of the number of followers for all the accounts is shown in Fig. 3. Figure 4 shows the change of the number of followers of the accounts that had increasing rate of the followers more than the average.

As for the change of the number of tweets, we naturally can see the peak right after the day 3/11, but the patterns seem to vary for the other parts. As for the change of the number of the followers, some accounts have increasing number of followers while other accounts do not have such rapid increasing number of followers. There seems to be that the accounts that already had many followers before the day 3/11 were likely to have more increasing rate of the followers after the day 3/11.

4.2 Quantitative Categorization of the Accounts

To better understand what was going on after the general view in 4.1, we categorized all the accounts into four groups in terms of



Figure 1: Change of the number of tweets for all the accounts



Figure 2: Change of the number of tweets for the 33 accounts



Figure 3: Change of the number of followers for all the accounts



Figure 4: Change of the number of followers for the accounts that were above the average in increasing rate of followers



Figure 5: Four groups according to quantitative categorization of the accounts

2) the increasing rate of the number of follower per day after the date of the earthquake.

The average number of tweet per day was 7.5 and the average increasing rate of the number of follower per day was 1.15%. Thus the account could be divided whether it was more than 7.5 tweets or not, and whether it had more than 1.15% increasing rate or not. As shown in Fig. 5, we

numbered each group from (1) to (4) that was same with the quadrant.

Figure 6 shows the graphs of the group (1) with many tweets and high increasing rate of followers. Five accounts belonged to this group. We see additional graphs besides the number of tweets and the number of the followers in the figure. Those are the number of tweets per content category. EQ-Communication, EQ-Citation, EQ-Announcement, EQ-Primary Info and Non-EQ in the legend are the content categories where EQ means earthquake. They are explained later in this paper. Figures 7 and 8 also have the same graphs and legends. This group (1) gained rapid increasing number of followers after the day 3/11.

Figure 7 shows the graphs of the group (2) with many tweets and low increasing rate of followers. Four accounts belonged to this group. Although this group had many tweets but the change of the number of tweets was not very noticeable.

The group (3) is one with few tweets and low increasing rate of followers. Twenty accounts belonged to this group. Although most number of the accounts belonged to this group, the group appears to be of inactive accounts. Thus this group is not focused in this paper hereafter. Figure 8 shows the graphs of the group (4) with few tweets and high increasing rate of followers. Five accounts belonged to this group.



Figure 6: Group (1) with many tweets and high increasing rate of followers



Figure 7: Group (2) with many tweets and low increasing rate of followers



Figure 8: Group (4) with few tweets and high increasing rate of followers



Figure 9: Tweet content of Group (1)



Figure 11: Tweet content of Group (2)

We might expect that many tweets draw many followers. This was not true however. Certainly it seemed to be true that few tweets usually did not draw much attention, as seen in the group (3). We also saw the cases where many tweets drew much attention as seen in the group (1). However at the same time we saw the cases where many tweets did not draw much attention as in the group (2), and the cases where few tweets drew much attention as in the group (4).

Through this quantitative categorization, we could see interesting outline patterns of tweets and followers in the graphs. But this is not enough to explain what causes high increasing rate of followers.

4.3 Content of the Tweets

The content of the tweets were then investigated. The tweets were categorized in the following five types.

a-1) Earthquake related: Communication with other account (EQ-Communication).

This includes the reply using @ to communicate with other accounts about the earthquake. The reply to other accounts is in this category even if "RT" (this means retweet) was used. The tweet that used RT to make the information or the information exchange itself open can be in this category. Even if the tweet included new information, it is in this category if its main purpose is for communication.



Figure 10: Tweet content of Group (4)

a-2) Earthquake related: Citing existing information (EQ-Citation)

This includes the tweet that cites existing information related to the earthquake. The retweet, and the tweet of a link to the related news are included in this category. The tweet that includes cited information and appended new information can be in this category or in a-4) category depending on the weight of both parts.

a-3) Earthquake related: Announcing to people (EQ-Announcement)

This includes the tweet that is related to the earthquake and that can be taken as the announcement to the unspecified followers. Difference from a-4) category is that this does not include new information, and often includes a call or request for action. A tweet of general caution for blackout is an example.

a-4) Earthquake related: Announcing primary information (EQ-Primary info)

This includes the tweet that provides the information where the tweeter is the primary source, new information in other words. The examples are the tweet of primary information when the official Web site is not running, and the tweet of notifying the official Web update related to the earthquake.

b) Earthquake non-related (Non-EQ)

This includes the tweet whose content is not related to the earthquake. For example, all the tweets before the earthquake belong to this category.

The process to determine these content categories was as follows:

- 1) Two persons, a collaborator and the author, were involved with the process.
- 2) The tentative categories and their criteria were decided through the discussion over the collected tweet data.
- 3) One account was selected from each of the four groups in Fig. 5 randomly as the sample accounts. The tweets of those accounts from 3/11 to 3/17, immediately after the earthquake when Twitter users took rapid following actions, were categorized according to the tentative categories and the criteria. The categorization was independently conducted by the two persons.

4) To check the two person's agreement on categorization, Cohen's Kappa coefficient was calculated.

Cohen's Kappa = 0.861 for 1016 tweet items

- 5) After being confirmed that the Kappa was high enough, the categories and their criteria were determined without change.
- 6) The rest of the tweets were categorized according to the criteria by the collaborator.

4.4 Account Groups and Their Content

The content categories of the tweets in each account group are also shown in Figs. 6-8. Clear contrast between the groups was found. Many tweets in the group (1) and (4), which had high increasing rate of followers, seemed to be in a-4). Whereas many tweets in the group (2), which had low increasing rate of followers, seemed to be in a-2).

To analyze the relation between the account groups and the content categories more, the tweet content from 3/11 to 3/17, a week since the earthquake, was investigated in each of the three groups. The contents of the group (1), (4), and (2) are shown in Figs. 9, 10, and 11 respectively.

What is common in the group (1) and the group (4) is that the most numbers, nearly 70%, of tweets were in a-4). In contrast the most numbers of tweets in the group (2) were in a-2).

From this analysis, we see that the accounts that tweeted primary information were followed by many people.

5 OPERATION GUIDELINES

From the result of the previous section, we can draw operation guidelines for a municipal Twitter account in emergency.

(1) First and foremost, provide primary information. People want it.

Accounts with high increasing rate of followers mainly provided a-4) category tweets regardless of the number of tweet.

(2) Immediate tweet is helpful.

This can be observed from Figures 6 and 8. The content changed, and the number of tweets also changed after the earthquake in the group (1) and (4). The group (1) accounts that had been relatively active before the earthquake responded more immediately than other accounts, and were followed by much more people.

(3) Communication can also be helpful.

The group (1) accounts were most followed. This can be considered they were most useful or they drew most attention. What is different from other groups and is even different from the group (4) is that they tweeted a-1) more often.

(4) Citation can be tweeted, but not so many.

All accounts tweeted citation to some degree, but the group (2) which tweeted citation mainly did not get high increasing rate of followers in spite of many tweets.

(5) Daily activity to have followers is significant.

The group that gained the most number of followers, and the group that gained the most increasing rate of followers was the group (1). Another difference of the group (1) from other groups is that it held the most number of followers before the earthquake. Having more followers means having stronger dissemination ability, and this could result to draw more people.

6 CONCLUDING REMARKS

In this paper, the use of Twitter accounts by municipal organizations was focused. The user's behavior on Twitter in the Great East Japan Earthquake was analyzed from both quantitative and qualitative viewpoints in terms of the number of tweets and the tweeted content. Motivated reason is because it is not clear how such social media accounts can be used effectively in the emergency, although such social media, Twitter especially, are encouraged to use by the Japanese government.

Through this research, it was revealed that there were types of behaviors of the municipal accounts and some were useful and were followed by many people. Then the results obtained by close investigation were organized as the operation guidelines for a municipal Twitter account in emergency.

Although the research achieved this clear contribution, there are issues to consider in the future. This analysis only focused on the tweet itself. Other factors could affect the user's behavior. Examples are geographical factor and organization factor. The account closer to the disaster areas could be more followed. The account of the organization whose activity is more related to the disaster could be more followed. Those factors could be related to the number of primary information. Thus analysis from different viewpoints can be conducted.

Another issue is credibility of tweet. Twitter among other social networking services suffers from identity verification and fact verification. False rumor has been regarded as a problem. It is possible that the user's behavior reflected selfprotection from false rumors. The credibility of municipal accounts is high, and this could push the number of followers. The same behavior might partially explain why primary information was evaluated higher than citation. With this consideration, information from municipal account is important, and primary information from municipal account is even more important. Designing more credible social medium can also be another direction from this research.

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