Regular Paper

User's Action and Decision Making of Retweet Messages towards Reducing Misinformation Spread during Disaster

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Abstract: The online social media such as Facebook, Twitter and YouTube has been used extensively during disaster and emergency situation. Despite the advantages offered by these services on supplying information in vague situation by citizen, we raised the issue of spreading misinformation on Twitter by using retweets. Accordingly, in this study, we conduct a user survey (n = 133) to investigate what is the user's action towards spread message in Twitter, and why user decide to perform retweet on the spread message. As the result of the factor analyses, we extracted 3 factors on user's action towards spread message 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, and 3) Search for further information about the content of the retweet messages. Then, we further analyze why user decides to perform retweet. The results reveal that user has desire to spread the message which they think is important and the reason why they retweet it is because of the need to retweet, interesting tweet content and the tweet user. The results presented in this paper provide an understanding on user behavior of information diffusion, with the aim to reduce the spread of misinformation using Twitter during emergency situation.

Keywords: emergency, misinformation, decision making, retweet, Twitter

1. Introduction

The utilization of social media by public and organization during disaster and emergency situation is not new. One of the first example of events covered by public or "citizen reporter" using Flickr and Wikipedia occurred during the 2005 7/7 London Bombings [1]. The social media is a platform for citizen to generate and disseminate information because they are the real first respondents in the event and able to reach those around them for help [2]. The use of social media is beneficial during emergencies as it allows instant transmission of messages to a broad audience range and therefore can contribute to the public's awareness and help responders to gain accurate picture of the situation happened [3]. The key characteristics of social media as reported in Ref. [4] are participation, connectedness, conversation, openness and community. There are several studies in the literature reporting and discuss the effectiveness of social media on supplying information during disaster such as during Victorian bushfire [3], Haiti Earthquake [5], The Great East Japan Earthquake [1], [6], [7], and Hurricane Sandy [8]. In Japan, it is reported that the amount of tweets on the day of the March 2011 Tohoku earthquake was 1.8 times larger than usual [7]. Although information provide by citizen in social media proved useful in coordinating humanitarian relief, information overload raise an issue to be concern. Therefore, several studies in the literature point to information credibility as one of the greatest problems with social media use during emergencies [4], [6], [9], [10], [11]. Another issues arise with the use of social media during disaster is the spread of misinformation. There were several studies indicate the potential of social media on misinformation and rumor transmission in emergencies [8], [11], [12], [13].

Although there were many research studies focusing on the social media use in emergency domain have been reported, only little work focused on how to reduce misinformation from spreading through social media. Few research studies were made based on a psychological viewpoint which examines the relationship between ambiguity, anxiety, importance, distance and feelings with rumor transmission and crisis information sharing behavior in disaster situation [12], [14], [15], [16], [17]. Recent study also highlight the need to investigate user behavior towards crisis information and reveals the relationship between user's feeling and information sharing behavior during emergencies [14]. Moreover, research by Ref. [5] also indicates that the emotional state of the citizens affects texting behavior as one of the issues raised in social media use for crisis management during 2010 Haiti Earthquake. The community involvement, citizen participation and social computing can leads to successful emergency preparedness and management [2].

Thus, our research is motivated by the need to understand the user behavior of information diffusion focusing on Twitter retweet function as a spreading medium in Twitter. Accordingly, our aim of the study is towards reducing misinformation transmission using social media, focusing on the citizen who has no official role and wants to know what happen and wants to help, and who may or may not directly affected in disaster on

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spreading disaster-related information behavior. Therefore, to understand individual behavior relating to rumor transmission, we study the nature of human rumor spreading behavior from psychology background.

Despite the benefits of social media in event reporting, we raised our concern on inaccurate information diffusion issue, or in this paper, we refer it as misinformation spreading in Twitter during emergencies. To accomplish this aim, we conduct a survey to investigate one action after they read retweet message, and if they have the desire to perform retweet, what factors contribute to user decision-making on whether to spread information using retweet in Twitter. Although this is our preliminary study analysis, the findings of this paper will help to understand user's behavior and decision making towards spread message. In this paper, the terms misinformation or inaccurate information and rumor are used interchangeably.

The rest of the paper is organized as follows. Section 2 explains the social media and Twitter usage within the emergency management domain and rumor transmission issue in disaster situations. Next, in Section 3, we explain the research method and analyses. We elaborate our result and findings in Section 4. Section 5 presents the discussion of the research. Finally, we describe our limitation and future work plan in Section 6 and we conclude our work in Section 7.

2. Background of the Study

2.1 The Social Media in Emergency Management Information System

The United Nations Office for Disaster Risk Reduction (UNISDR) defined crisis or an emergency as "*A threatening condition that requires urgent action*" [18]. Emergency management is a continuous process that group individual and communities to manage hazards in comprehensive and coordinated ways to reduce the impact of the hazards [19]. Meanwhile, disaster communication, as part of the emergency management highlight three important element needed when dealing with immediate response with real incident which are speed, rhythm, and trust [20]. There are four phases of Emergency Management Information System (EMIS) which are: mitigation, preparedness, response and recovery [21].

In recent years, several studies focused on the utilization of social media for mass collaboration in response and rescue for emergency management professional during emergencies [4], [8], [9]. White et al. [4] state that social media is beneficial during emergency for preparation for and response to it. Information from citizen via social media proved to be useful especially in area level in coordinating humanitarian relief after 2010 Haiti earthquake [5]. Compared to Facebook, Twitter was listed as the top form of social media to gather disaster-related information after 2011 The Great East Japan Earthquake [7], [22]. The amount of tweets on the day of the earthquake was 1.8 times larger than usual [1]. In disaster, social media has been used extensively because of the availability to connect people outside and inside the affected areas. During 2012 Hurricane Sandy, the US government used Twitter for information exchange with citizen in disaster-related preparation, response and recovery stage [10].

Twitter act as a news media for people to get information rather than for social purpose [23]. According to Ref. [21], citizen supplying information by photos for example is crucially helpful in response phase. Information dissemination activities are crucial for disaster preparation, warning response and recovery, as citizen around is the real "first responders" to reach out those affected people around them for aid purpose [2]. Disaster situation can develop a shared sense of danger and fate, which leading to solidarity and selfless acts to help others even amongst strangers [24]. One of the user's motivations for using social media during disaster is because of the desire to help [1]. With the ability as a platform for everyone to speak their mind and shared information with freedom, social media is an important information system tool during emergency. Thus, in our research, we set our focus on the response phase in emergency management cycle, where it is crucial to reduce the transmission of misinformation at this stage so that proper action can be taken to reduce disaster impact.

2.2 Misinformation Transmission in Twitter

Twitter, a microblogging service emerged since 2006 and recently, there are more than 241 million active users monthly with 500 million tweets are sent per day [25]. Several reasons on why people depend on social media during emergency are because of convenience, prior experience, mass sending ability and time and cost effective [1], [4]. An analysis done proved that the tweet frequencies from mobile phone in Japan were dominant just after the great Japan earthquake compared to the normal situation before the disaster happened [26]. Furthermore, a survey done by Ref. [7] shows most of the respondents, 39.1% agreed Twitter is their most important medium for obtaining information on the day of the Great East Japan Earthquake and to understand Fukushima nuclear accident in Japan.

However, information overload may cause misinformation from creep in and transmitting in vague situation because as noted by Ref. [7], the centrality of mass media increases as the ambiguity in social environment increases. Previous studies by Refs. [8], [13] state that Twitter is also a medium to spread rumors and fake news during disaster. In Twitter, retweet function encourage instant information sharing to broad number of audience whether to direct or indirect list of followers. According to Ref. [27], by retweet, one is also validating and engaging with others because retweet is also a way by which user can be in a conversation. The one with highest number of retweets is the most influential person within the specific domain [28].

Misinformation can create a panic situation during disasters since people are strongly reliant on social media as one of the most reliable information channel in disaster [6], [11], [13]. According to Ref. [24], research suggests that panic behavior may occur when lack of resources were presented. In Japan, misinformation transmission in Internet captured the government attention as it may lead to other serious problems in the society [12], [13]. Misleading information may not only cause delay in response and rescue effort for emergency professional management side, but also to the public who wants to know how they should prepare and react to the ambiguous and vague situation happened around them.

However, there is no doubt that social media is also an effective emergency tool to establish connection with the public, counter misinformation and verify or counter rumors. Authorities create official Twitter account to engage with citizen during 2012 Hurricane Sandy [10] and 2009 Victorian bushfires [3]. Moreover, there is also Twitter account (@IsTwitWrong) created by the public to criticize and combat fake images spreading around in Twitter. It shows that Twitter is also a beneficial tool to combat misinformation from spreading not only for authorities or official organizations to make announcement or provide information, but also as a platform for public to voluntarily cooperate and contribute their efforts in reducing fake news from spread widely in social media.

2.3   Rumor Psychology

According to DiFonzo and Bordia [29], rumor can be defined as:

"*Unverified and instrumentally relevant information statements in circulation that arise in contexts of ambiguity, danger or potential threat and that function to help people make sense and manage risk.*"

The transmission of rumor might happen in any situation, either in an organization or a nation, and will always be a part of human history. From sociology view, Shibutani [30] define rumor as a recurrent form of:

"*Communication through which men caught together in an ambiguous situation attempt to construct a meaningful interpretation of it by pooling their intellectual resources.*"

Rumor is a collective transaction of cognitive and communicative activity. It is "news" that does not stem from reliable and formal institutional channels [30]. Following the psychology background, research on rumor transmission started since World War II where people tend to transmit rumor when they distrust the news they heard, although official statement from government has been made on the issue [17]. The increasing use of social media nowadays allows rumor and inaccurate information to disseminate widely in a short period of time. According to Shibutani [30], rumor is generated if the demand of news is high, but the information supply is low. If the supply and demand of news is balance, then the rumors disappeared. From the psychological literature, there are five variables involve in rumor transmission: uncertainty, importance or outcome-relevant involvement, lack of control, anxiety and belief [29].

There are three phases in rumor life cycle, which are: generation, evaluation/belief and transmission [29]. Rumor is generated in times of uncertainty and anxiety regarding topics of high importance. Next, if the rumor is reasonable, it will get widely spread in transmission phase. Rumor spreading is temporary, it usually happen aftermath the disaster, and last for certain time before the spread start to decrease. Among other social network services, Twitter act more as a news media because it is less "social" than other online social media [23]. We agreed with Kwak et al. [23] to view Twitter as citizen news media because Twitter usually have the trending topics and users usually talk about timely topics. With the characteristics of Twitter as fast and wide spread "word-of-mouth" (WOM) news media [23], and a place where everybody has power to share their thought [25], Twitter can become a speedy informal channel for rumor spreading. In a different study, based on the numerical analysis done by Ref. [31], several misinformation tweet spread after 2011 Tohoku Earthquake got high number of retweet by users. Consequently, if the inaccurate information is widely circulated, it may influence people to change their belief and opinion [12].

Accordingly, due to the rise issue of misinformation diffusion in social media, we tend to focus on the transmission phase in the rumor life cycle, and for the first step, we conduct a survey to understand how user reacts with spread message they read in Twitter and the reason why they want to continue spreading it to others. The following section describes the questionnaire design and the research method used for the survey and analyses.

3.   Research Method

3.1   The Questionnaire Design

The questionnaire developed in Japanese language with 48 question items is designed in three parts with 7-likert scale answer. The questionnaire developed basis from analysis of related research on misinformation spreading issue and retweet messages in Twitter during disaster [31], [32] followed by discussion with several active Twitter users to understand individual retweeting behavior in Twitter. However, since the main purpose of this questionnaire is to understand one retweeting behavior, we design the questionnaire considering all possibilities of actions user will take towards retweet messages, together with Twitter functions and tweets such as "Favorite" function and the availability of URL link. Since we did not mention the case of disaster situation to respondents during the survey, the survey asked questions regarding retweeting behavior in ordinary situation to get an idea of user behavior towards spread messages which could lead to the spread of misinformation during disaster. 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.

Likert scale is commonly used in questionnaire to obtain respondents degree of agreement with a statement [33]. 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). In Twitter, we can view tweet that has been retweeted by our following list although we do not follow the original tweet creator.

As described in the previous section, our focus in this research is on the rumor transmission phase, instead of rumor generating or evaluation phase in the rumor life cycle. Therefore, 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 B saw retweet message that was retweeted by user A, although user B do not "follow" user X (the original tweet author) directly. In this
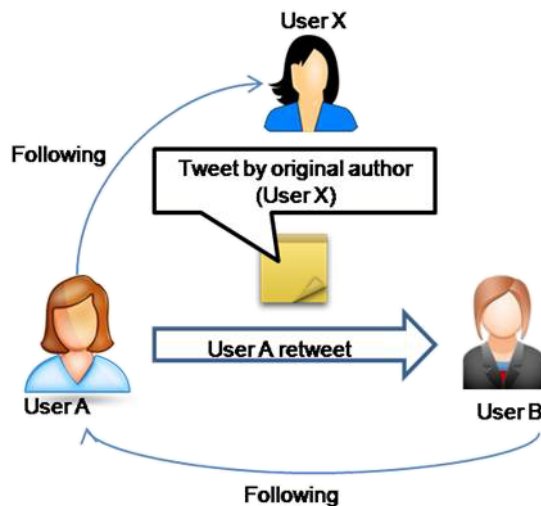
Fig. 1 The questionnaire design.

questionnaire, we investigate user B 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 study. Our subject should have a Twitter account and is a Twitter user. We exclude incomplete questionnaire answered from the analyses.

3.2 The Demographic Information

We conducted a survey on 10 and 11 December, 2012 with total number of respondents, 133 students from Iwate Prefectural University, Japan. The respondents consisted of 94 male, and 39 female with mean age = 20.5. They are given approximately 20 minutes to answer all questions and explanation on the survey purpose and Twitter terms use in the questionnaire are described. 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.

3.3 The Analysis Method

We conducted factor analysis for this survey to confirm the factors on user's actions and decision making towards spread messages statistically. We want to analyze the factors contributing to what makes people decide to retweet, and what action user will take after they read spread messages. Therefore, for the analysis part, 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. 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. Thus,

out of 48 question items, only 28 question items remain for the analyses. 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 a model with three highest variable loadings for each factor. The following section describes our previous and present work analyses findings.

4. Result and Findings

In this section, we described our factor analyses findings. The first analysis phase findings, which is stated as previous work findings are reported in our previous papers [34], [35]. The factors found in previous work lead us to conduct the second analysis phase which is the new findings in this paper. First, in Section 4.1, we discuss the overview of the previous work. The factors found in previous work are the user's action towards the retweet messages. Next, in Sections 4.2 and 4.3, we discuss the results of the factor analyses which are the user's reason on spreading the retweet messages. In Section 4.2, we discuss the result of EFA for the second analysis phase. In Section 4.3, we discuss the CFA result for the factors found in EFA for the second analysis. Finally, we described the overall model of user's action and decision making of retweet in Section 5.

4.1 User's Action Factors

We conduct the analyses on two phases. For the first phase, 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. The research question for the first analysis phase is:
"*What is the user's action after they read the retweet messages?*." From the 48 question items in the questionnaire, we exclude questions that have problems 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 as reported in Refs. [34], [35] as 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.

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. The factor findings from the analysis highlighted the first factor, which is: **Desire to spread the retweet messages as it is considered important**, as the most important factor of user's decision making towards retweet messages [35]. Because the first factor indicate user's action to spread, it is important to further investigate what is the reason of this behavior which may lead to misinformation spread.

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 does a user want to spread a retweet message?*," if they choose to further retweet the message. In this paper, we emphasize our result for the second analysis phase. The next section presents our EFA and CFA result for the analyses.

4.2 The Exploratory Factor Analysis (EFA) Result

We perform EFA with 21 question items grouped from the first factor: **Desire to spread the retweet messages as it is considered important** on previous work findings. **Table 1** shows the descriptive statistics with mean and standard deviation values for all question items analyzed. The original question items in the survey were developed in Japanese language. In this paper, we provide the question items in English translation as presented in Table 1. The Cronbach's alpha value for all items is .930.

However, out of 21 question items analyzed, 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 for the second phase analysis. We conduct EFA for these 17 items and as a result, we found 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

Table 1 Descriptive statistics of the question items.

		Mean	Std. Deviation
17	I do not know the retweet content in details. But if I think the information is important, I will retweet it.	3.263	1.6601
32	I will retweet all the retweet contents displayed continuously (related with each other).	2.805	1.7032
30	I will retweet if the retweet content contains [Pls spread] written in it.	2.759	1.7283
31	I will retweet if the retweet content is related to my situation.	3.376	1.8199
34	I will retweet if the retweet content was from the official Twitter account of an organization or company.	3.421	1.7804
35	I will retweet if the retweet content was from reliable original author.	3.331	1.7655
27	I will retweet if the retweet content is a negative thing.	3.098	1.6554
16	I check the retweet content if it is from a trusted source of information. For example, from televisions or newspaper, if the content is same, then I will retweet it.	3.17	1.657
29	I will retweet if the retweet content is for fun or joke.	4.263	2.0446
38	I will retweet if the one who retweeted the message has a good "follower" relation.	4.015	1.8090
26	I will retweet if the retweet content is a positive thing.	3.759	1.8674
42	I will decide to retweet or not after I check the retweet content	3.789	1.9308
20	I read the retweet content now, and it capture my interest, so I retweet it.	4.263	1.9458
28	I will retweet if the retweet content is a call to action for people to read it	3.451	1.7297
41	I will decide to retweet or not after I see who (followers) have retweet it.	2.955	1.7315
36	I will retweet after I determine the retweet content's author.	3.346	1.9190
40	I read some of the retweet content that has been retweeted from my followers.	3.105	1.7244
8	I access all URL link in retweet message if it is available.	2.86	1.543
5	I feel an urge to take action after I read the retweet content.	3.42	1.810
9	I will open the URL in retweet if it is available and I know the URL destination.	3.18	1.664
24	I will decide the trustworthy of the retweet content, whether it is true or false when I retweet it.	3.955	1.9183

Table 2 The Factor Pattern Matrix.

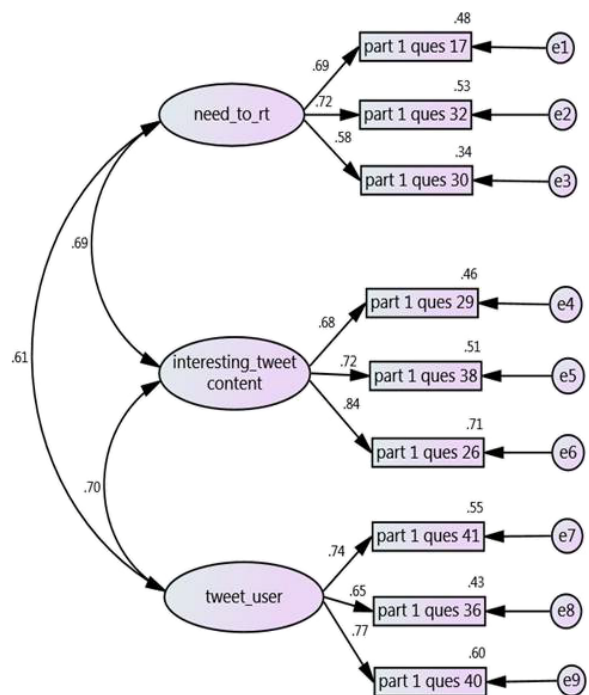| Question item	Factor 1	Factor 2	Factor 3
17	.808	.032	-.170
32	.691	-.212	.311
30	.673	.000	-.075
31	.607	.169	.053
34	.503	.014	.150
35	.499	.182	.172
27	.400	.139	.239
16	.392	.097	.254
29	.095	.782	-.195
38	-.184	.741	.186
26	.171	.620	.030
42	.107	.593	.100
20	.419	.547	-.231
28	.373	.440	.069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

Fig. 2 The initial SEM diagram.

each factor.

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.

4.3   The Confirmatory Factor Analysis (CFA) Result

From the EFA result, we conduct CFA with 17 question items to confirm the initial factor from EFA provide good fit to the data. SEM is a statistical modeling technique used to establish relationship among variables. It describes the relationship between a set of observed dependent variables (factor indicators) with a set of continuous latent variables (factors) [36]. We made SEM diagram with 3 highest factor loadings for each factor. Thus, for the SEM model, we got the values as follows: Goodness of Fit Index (GFI) = .924, Comparative Fit Index (CFI) = .940, RMSEA = .087. For GFI and CFI, the value of .90 and above indicates good model fit of the data [37]. Meanwhile, for the Badness of Fit, the RMSEA value between .05–.08 indicate acceptable fit model. **Figure 2** shows the initial SEM diagram.

However, since our initial model has RMSEA value of more than .08, which is not an acceptable model, we revise the model
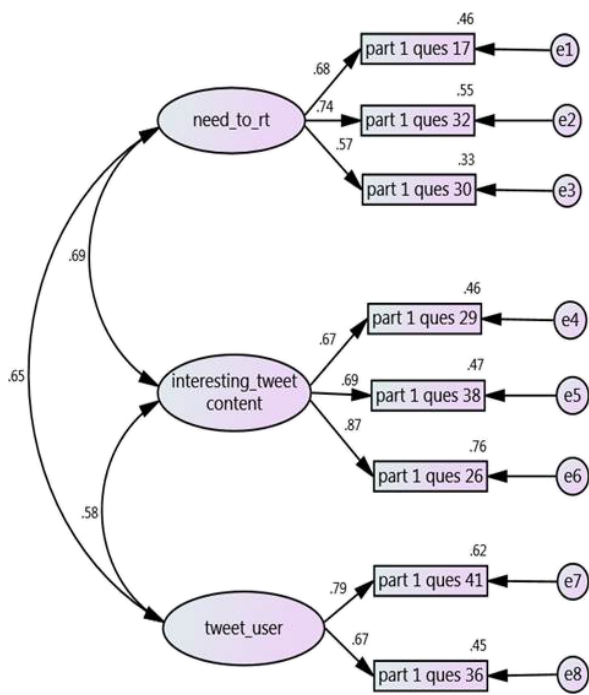

Fig. 3 The improved SEM diagram.

details and we used modification index to determine whether we need to add or remove any problem path in SEM diagram. Then, we discovered that the question item number 40 from factor 3 has a problem where it is highly correlated with both factor 2 and 3. Thus, we eliminate question item 40 from the SEM diagram because of the problem with the question that may affect our model acceptance.

Hence, the overall fit of this model turns out to be acceptable 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. **Figure 3** illustrates the SEM

diagram for these 3 factors: need to retweet, interesting tweet content and tweet user.

5.   Discussion

Based on our 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 help us to understand factors on user's action after they read the retweet messages, which are whether they have the desire to perform retweet, or mark the messages as "favorite" or decide to search for further information regarding the messages content, to verify the retweet content. The first and second factors will lead people to believe and to transmit the information. The problem is if it is inaccurate information, these actions will lead to the circulating of misinformation to public. While the third factor, search for further information after read the retweet messages, this kind of action will help to reduce the spread of inaccurate information because we will try to validate the information with other sources, or even checked with other tweets from the author. Thus, from the factor analysis of the first phase, we have confirmed the factors of the user's action into 3 kind of action: desire to retweet, using favorite function and retweet or not, and search for further information without retweeting it.

Then, we further conduct the second analysis phase to extend our findings on why user makes decision to perform retweet if they have the desire to forward the spread message to their followers. As a result of the factor analyses, we extracted another 3 factors related to why user makes decision to perform retweet, and therefore continue to spread the retweet message, which are:
1) Need to retweet.
2) Interesting tweet content.
3) Tweet user.
The findings from second analyses provided an insight to understand factors influencing one decision to perform retweet. The first factor, "need to retweet" explained why 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. Based on these findings, we can see that the first two factors impacted people reasons to perform retweet is because of the content of the spread messages. However, the one who create and who retweeted the messages also play roles
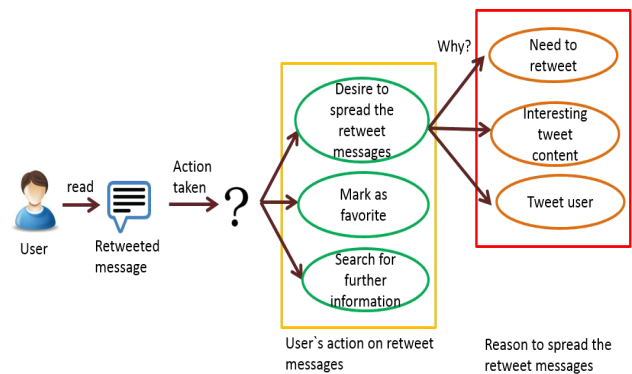

Fig. 4   Summary of the findings.

influencing people decision to perform retweet.

In this paper, we extend our result on user's action towards retweet messages, and conduct factor analyses to showed what factors contribute to reason on why people have desire to perform retweet. We summarized our summary of findings in **Fig. 4**.

As a result of the factor analyses on the first phase, in order to answer what action user will take towards the retweet messages they read, we extracted 3 factors which indicate the action of retweeting, mark as favorite and retweet/not, and search behavior without retweeting it. From these result, we can see the third factor, which is the act of search before retweet will reduce the chance of misinformation transmission. Therefore, people should search for further information after they read any tweets including the tweets that have been circulating around, because not all available information is accurate in social media.

Meanwhile, since the first factor indicate the action of performing retweet, we analyze all question items grouped in the first factor to extract factors influencing reasons on why people has desire to retweet for the second analyses. We get another 3 factors related to user's reason to perform retweet. The first two factors related to the content of the retweeted messages while the third factor surrounding the people related to the tweet. Thus, we suggest that although the twitter users influenced people retweet behavior, the most important aspect to be concern is the information content. How people perceived the information influenced whether they want to continue spreading it or not. According to Ref. [13], there is a need to understand user's behavior in social media usage to help minimizing the spread of misinformation. Based on our survey result, we discovered that the act of searching for further information on the spread messages may reduce the chance of misinformation from spreading, and the content of retweet messages influenced people decision to retweet. As the information itself plays greater role impacting one decision to retweet, there is a need to investigate what kind of information people believe and want to transmit, especially during disaster situation. The findings in this paper also support Ref. [38] analysis 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.

Our preliminary findings contribute to understand user behavior on information diffusion in ordinary situation, and towards understanding user behavior of information diffusion in disaster situation next. Although our questionnaire asked general ques-

tions on retweeting behavior, we believe our initial model helps to understand how people react with information sharing. By understanding how people react with retweeted messages, and what factors influenced them to retweet, it helps us to understand why some inaccurate information continue to spread, especially during disaster situation.

However, few question items such as question 17, 32, and 30 in "Need to retweet" factor have mean value below 4.0. Previous study by Tanaka et al. [13] state that in disaster situation, if user evaluates the tweet as important, they tend to transmit it although it is a rumor. Since our questionnaire design for ordinary situation, user evaluation might be different between ordinary and disaster situation. We will investigate further about this difference in the future.

In other work, Macskassy et al. [39] proposed 4 models to describe individual retweet behavior such as "General," "Recent," "Topic" and "Profile." In our study, we extract three factors on why people choose to retweet; "Need to retweet," "Interesting tweet content" and "Tweet user." Our question items for these factors covered the general ideas of the four models proposed. However, for the two models, "Topic" and "Profile" model, compared to our factor definition of the "Interesting tweet content" and "Tweet user" factor, we ask questions on types of retweet messages content and Twitter user regardless of the similarity on topic-of-interest on tweets or profile of a user with the other. For example, in Macskassy [39] study, for "Topic" model, they investigate whether a person is likely to retweet tweet of their own interest or not, while our questions falls under "Interesting tweet content" factor refers to any kind of retweeted message content that attract user's attention and interest that makes them feel trigger to retweet.

6. Limitations and Future Topics

As this paper present our preliminary study findings, we discovered several problems in the questionnaire survey. The original questionnaire developed with 48 question items, however, many question items need to be eliminated from the analysis because of the statistical problem. Moreover, this survey may have limited generalizability because of the single region sample of student used for the survey. However, we control our respondents for those who are Twitter user only and most of our respondents are active Twitter users. Another limitation of our questionnaire is it designed to investigate one action and retweeting behavior in ordinary situation.

Thus, we plan to improve the questionnaire by removing the problem question items and add more questions related to retweeting behavior in disaster situation using scientific method such as brainstorming and KJ method. Next, we will conduct the survey with greater number of subjects for various groups. Since the questionnaire used in current survey covers retweeting behavior in general, we plan to conduct survey setting using real tweets spreading during the disaster in our future work. Align with our motivation on misinformation transmission issue during disaster; we will focus on retweeting behavior in emergency situation in the next survey.

7. Conclusion

This paper presented results of the factors related to user's action and decision making towards spread messages in Twitter. With the aim towards reducing misinformation from spreading in social media, first, 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 spread messages by verifying the information from other sources before they retweet may leads to reducing misinformation spread, and 2) The content of the retweet messages and how people perceived information influenced people to continue retweeting the information or not. Misinformation will never completely disappear, however, by understanding on how people act towards the spread messages contribute to understand people information sharing behavior, with the aim towards reducing misinformation spread, especially in emergency situation.

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