Spring 6-10-2017

SENSEMAKING IN SOCIAL MEDIA CRISIS COMMUNICATION – A CASE STUDY ON THE BRUSSELS BOMBINGS IN 2016

Milad Mirbabaie
University of Duisburg-Essen, Duisburg, Germany, milad.mirbabaie@uni-due.de

Elisa Zapatka
University of Duisburg-Essen, Duisburg, Germany, elisa.zapatka@uni-due.de

Follow this and additional works at: http://aisel.aisnet.org/ecis2017_rp

SENSEMAKING IN SOCIAL MEDIA CRISIS COMMUNICATION – A CASE STUDY ON THE BRUSSELS BOMBINGS IN 2016

Research paper

Mirbabaie, Milad, University of Duisburg-Essen, Duisburg, Germany,
  milad.mirbabaie@uni-due.de

Zapatka, Elisa, University of Duisburg-Essen, Duisburg, Germany,
  elisa.zapatka@uni-due.de

Abstract

Uncertainty in crises often leads to knowledge gaps, which can be bridged through people's communication, resulting in sensemaking. Because research dealing with the identification of roles to examine how they guide sensemaking is almost non-existent, this paper seeks to clarify this problem. In the context of crisis communication related to the Brussels bombings in 2016, first social network analyses are conducted to identify influential users and their role. Second, content and sensemaking analyses are performed to determine what kind of content diffuses through them to contribute to sensemaking. The results indicate that frequently retweeted users (information starters) as well as those with the most followers (amplifiers) guide the gap bridging through tweeting and retweeting new information. Furthermore, users who have the potential to bridge different communities (transmitters) shared many opinions, leading to sensemaking differently. These first research insights provide practitioners in role-based, target-oriented communication with coding schemes for further crisis communication research.

Keywords: Crisis Communication, Information System, Sensemaking, Social Media, Twitter

1 Introduction

Social media is a vast research area and can be defined in several ways, but the most common definition posed by Kaplan and Haenlein (2010) says that "Social media is a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, and that allow the creation and exchange of User Generated Content" (p. 61). Such services can be applied to keep in touch with friends (Ellison et al., 2007; Zhao et al., 2010), to stay informed (Stieglitz et al., 2013; Zhao and Rosson, 2009), to share photos with the audience (Bicen and Cavus, 2012) or to discuss and interact in real-time with other social media users (Hwang and Lim, 2015; Kalsnes et al., 2014; Larosiliere et al., 2015).

As another field of application, social media can be used for communication in crisis situations (Eriksson, 2016; Goolsby, 2010; Mirbabaie et al., 2014; Xia et al., 2012) by different participants or roles and with various purposes as well. Referring to that, Twitter as a microblogging service (Gupta and Kumaraguru, 2012) is appropriate because of its 140-character communication, which allows short and public statements (Zhao and Rosson, 2009) and therefore quick response times (Gupta and Kumaraguru, 2012) and a fast diffusion of content (Oh et al., 2012). Accordingly, Starbird and Palen (2010) pointed out that Twitter was deployed to coordinate help among victims in the case of the USA

Red River flood in 2009. As another example for crisis communication on Twitter, Cassa et al. (2013) investigated the communication occurring around the 2013 Boston Marathon bombings, with results suggesting that Twitter was especially utilised to share eyewitness reports of individuals from the general public. As a consequence of such information-sharing activities, often user-generated content originated by citizens diffuses through the network, which alone cannot result in a successful understanding in crises (Oh et al., 2013). This implies the necessity of circulating messages provided by trusted roles for successful sensemaking (Oh et al., 2013). Such trust perceptions regarding different roles might be dependent on the anticipated role attributes of a user. Furthermore, several researchers point out that the diffusion of content may be affected or guided by roles (Ehnis et al., 2014; Lou and Tang, 2013; Riemer et al., 2015). Despite this importance of trusted roles in networks, research dealing with the identification of roles in social media crisis communication is almost non-existent, whereby this study seeks to clarify this problem. As another aspect, researchers questioned whether some roles or influential users who may e.g. be operationalised by the number of retweets (Dang-Xuan and Stieglitz, 2012; Oh et al., 2012) conduct and guide the sensemaking of others during crisis situations in Twitter communication.

Sensemaking can be understood as a steady process of gaining knowledge through the transformation and integration of new information into cognitive schemata (Pentina and Tarafdar, 2014), which is particularly essential in crises to understand such unstable situations and to make adequate decisions. Therefore, it aims to reduce and bridge knowledge gaps (Dervin, 1998; Savolainen, 1993) and can be impacted by several social factors like opinions (Dervin 1998, Savolainen, 1993) as well as interactions, discussions or information from other individuals (Weick et al., 2005).As another aspect, sensemaking is a social process (Jalonen, 2014; Landgren, 2005) and most notably, sensemaking can be provided through communication activities with other individuals (Dervin, 1983; Weick et al., 2005). Related to that, in Twitter, users have the choice to communicate with each other via private messages or through tweets. A tweet can be understood as a public message, which is posted by a user to his or her friends and followers within this platform. Those tweets can be retweeted and respectively shared, by others with their followers as well, which leads to the dissemination and diffusion of the content (Huang and Sun, 2013; Kawamoto, 2013; Nagarajan et al., 2010; Shi et al., 2014). Therefore, the retweet function in Twitter can be described as an important mechanism for information diffusion (Dang-Xuan et al., 2013; Huang and Sun, 2013; Kawamoto, 2013; Shi et al., 2014) and furthermore as a key mechanism to provide further understanding and sensemaking in a crisis situation (Zeng et al., 2016). Indeed, research has investigated the diffusion of information in crisis communication but sparsely mentioned the information diffusion for sensemaking during a crisis. Therefore, the relevance of examining information diffusion for sensemaking is given to understand the needs and communication behaviour of the Twitter users to improve these essential activities. Furthermore, organisations such as emergency service agencies could use this knowledge to manage crisis situations more efficiently through social media.

In this paper, we conduct a case study by analysing the Twitter communication network of the terror attacks in Brussels on 22 March 2016. This case is examined because of both its topicality and the international impact. Additionally, the Crisis Centre in Belgium asked the citizens to communicate via social media because of the overload of the telephone network. As a result, a great deal of communication became visible in Twitter. For this research purpose, first the most influential users were examined in terms of certain characteristics, e.g. their retweet amount and what kinds of roles they play during a crisis. Then, their communication behaviour was investigated by content and sensemaking analyses to see how sensemaking is provided by different roles. For that purpose, the results of the content and the sensemaking analyses should be linked with each other as well because the literature reveals that communication and content might have an impact on sensemaking (Heverin and Zach, 2012; Vos and Buckner, 2015). Because of the topic and context, the paper can be classified into information systems sensemaking literature. However, new aspects are also included, whereby this paper will provide some knowledge on the crisis communication network development as well as initial

insights into understanding which roles guide sensemaking and whether differences are identifiable between them. This provides recommendations for crisis communication practitioners like governments or several institutions to conclude which user role is responsible for what kind of sensemaking, aiming at enhanced, purposeful and effective communication. Therefore, section two provides the background containing topics like the social media usage in crisis communication and the state of the art concerning sensemaking through social media. Section three includes the case description, the data collection and the analysis of data. The results are depicted in section four, followed by the discussion of the outcomes in section five. Finally, section six deals with the conclusion, implications and the limitations.

2 Background

2.1 Crisis communication in social media

Social media can be used in crisis communications for various purposes, which are mainly dependent on crisis types (e.g. natural or man-made crises) and lead-times (the time between awareness and the impact/outcome of a crisis). According to that, Ehnis and Bunker (2013) differentiate between these two factors and reveal that a natural crisis has a longer lead-time than a terrorist attack, wherefore social media can be used to warn and to prepare the public and the organisations in former cases. In the context of terrorism, such attacks are mostly spontaneously occurring incidents with an immediately local and/or social impact (Ehnis and Bunker, 2013). As a consequence, social media cannot be used to prepare the public physically or emotionally, but rather to propagate the latest news and to coordinate help in the aftermath. These aspects can be revealed by several crisis communication studies, such as that of Starbird and Palen (2010), who demonstrated that tweets sourced by accounts of mainstream local media and service organisations were retweeted the most in both cases. During the Red River Flood, frequently retweeted tweets contained information about road closures, help coordination and updates regarding the level of the river. In terms of the Oklahoma Fires, the participants retweeted messages, which comprised very specific, emergency-related news like fire lines and shelter information. Regarding the Twitter usage during the Australian Queensland flood in 2011, Bruns et al. (2012) indicated that the Twitter hashtag #qldfloods was the central coordinating communication mechanism to directly and quickly share information, pieces of advice or news and to stay informed. Almost half of the messages containing #qldfloods were retweets and more than 15,500 users utilised this hashtag in approximately 35,000 tweets. In this context, emergency management agencies like the police and media organisations were some of the most visible participants, whereby the information diffused and the reach of the #qldfloods hashtag increased through the Twitter users (Bruns et al., 2012).

In the context of a man-made crisis, the social media communication of the Boston Police Department in Twitter and Facebook in the context of the Boston Marathon bombing 2013 was analysed by Ehnis and Bunker (2013) to understand whether the characteristics of the crisis or the attributes of the social media channel influenced their usage. The results revealed that both aspects impacted the utilisation. For instance, Twitter was primarily and more frequently used in comparison to the Facebook channel of the emergency service agency. Additionally, they point out that the two channels were used independently and that the broadcasted content was distinct because in Twitter, mainly the latest information was disseminated to keep the public informed regarding official investigations. In contrast, the police utilised Facebook mainly for the emotional processing of the incident. The results concerning this man-made crisis were compared to the outcomes of the 2011 Queensland flood case with the conclusion that only the bombing attack led to emotional sensemaking via social media. This might be due to the fact that the flood was relatively predictable and the social media usage of the public was mainly characterised by the coordination of help or updates concerning the flood level and not necessarily in terms of understanding what had happened and for making sense.

2.2   Sensemaking in social media

Sensemaking can be defined in different ways and is researched in various contexts (Blum et al., 2014; Nagar, 2012), such as communication as well as library and information science (Dervin, 1998), organisational theory (Weick, 1995; Weick et al., 2005) and in the context of social changes and movements (Oh et al., 2012, 2015). Referring to the last, such situations are composed of high uncertainty and collective anxiety, wherefore both affected as well as non-affected people persistently face the problem of cognitive gaps and as a consequence constantly try to bridge such gaps to make sense of the situation (Dervin, 1983; Heverin and Zach, 2012). Concerning that, investigations have revealed that sensemaking can be supported by the usage of social media channels like Twitter. For instance, an investigation of the 2011 Egypt revolution (Oh et al., 2015) indicated that the usage of hashtags contributed to sensemaking because they were utilised as mechanisms to gather information, to become aware of the situation and to provide situational updates with the public. Additionally, Heverin and Zach (2012) examined how Twitter was used to induce sensemaking during three U.S. campus shootings, showing that particularly at the onset of a crisis, people tend to make sense of the uncertain situation through information-sharing activities and that the contribution to a specific topic-related hashtag provide both the individual and the collective sensemaking. Furthermore, the communication development and therefore the circulating content during a crisis might affect sensemaking differently as well. This might be seen by an increase of opinion-related tweets during the crisis, for instance, which might be an indicator for a fairly bridged information gap (Heverin and Zach, 2012; Vos and Buckner, 2015). Such progresses lead to distinct sensemaking activities and mechanisms. Taken these mentioned aspects together, sensemaking in crises can be described as an essential as well as steady knowledge gaining process (Pentina and Tarafdar, 2014) to understand the situations and to make adequate decisions. With the aim of reducing and bridging knowledge gaps (Dervin, 1998; Savolainen, 1993), sensemaking is especially provided through communication activities with other individuals (Dervin, 1983; Weick et al., 2005). In relation to that Dervin (1983) and Pentina and Tarafdar (2014) argued that information sharing constructs sensemaking, which is in line with the research outcomes of Heverin and Zach (2012) and Oh et al. (2015).

Besides information sharing, Twitter can be used for supporting and caring for affected persons as well (Bruns and Stieglitz, 2014; Shaw et al., 2013). The expression of social support through communication technologies can be done in form of information dissemination (Oh et al., 2012), and this diffusion of information from one user to the next can further be seen as a key mechanism through which sensemaking can arise (Zeng et al., 2016). As a result, sensemaking often needs to integrate information from different sources (Schafer et al., 2007). Given the fact that the disseminated information can be both originated by official, trusted sources as well as through user-generated content, Oh et al. (2013) emphasised that social reporting solely cannot result in successful understanding and sensemaking in social crises. Additionally, several researchers point out that the diffusion of content may be affected or guided by roles (Lou and Tang, 2013; Stieglitz et al., 2017; Wasserman and Faust, 1994). The term role can have different meanings and definitions. Basically, Nadel (1957) argued that people could be classified into role categories depending on typical actions they perform or demographic factors like age or sex. Contrary to this role definition, Barley (1990) concludes that Nadels' distinction is too easy and that a role is more like a compound of relational and non-relational elements. Specifically, a role is somehow bounded to several social relationships and often influenced by tasks, jobs or activities a person performs (Barley, 1990). In contrast, Pervin et al. (2014) differentiated between three distinct user roles based on their information diffusion activities, namely information starters, amplifiers and transmitters. In detail, they define information starters as Twitter users, who are posting original tweets and whose tweets are retweeted by their followers (Pervin et al., 2014). This leads to the dissemination and diffusion of the content tweeted by information starters. However, amplifiers are necessary and relevant, especially because of the number of people who are following them (Pervin et al., 2014). Additionally, these users are treated as retweeters, as they do not create interesting original tweets by themselves, but share others' content within their community in the net-

work. This characteristic, in combination with their number of followers, enables them to make many people aware of the content published by others (Pervin et al., 2014). Lastly, transmitters are described as bridging nodes, who have the ability to reach other communities by their retweeting of content published by others (Pervin et al., 2014). As a result, and in opposition to amplifiers, transmitters facilitate and support a broader dissemination of original tweets (Pervin et al., 2014).

Additionally, several researchers hypothesise that some roles, who were retweeted the most, for instance, might guide and drive sensemaking in Twitter (Oh et al., 2012, 2013, 2015; Stieglitz et al., 2017; Zeng et al., 2016). As a result of that and in regard of the importance of information diffusion and trustful sources for sensemaking, the following research question will be investigated:

> *How and what kinds of information diffuse through roles in Twitter crisis-related communication to make sense of the situation?*

To clarify the research question, the next section depicts the case as well as the collection and analysis of data in more detail.

3 Research Design

3.1 Case Description

On 22 March 2016 three suicide bombings happened in Brussels, Belgium. At approximately eight 8am local time, two bursting charges were detonated by two men inside the Brussels-Zaventem airport near some check-in desks, and at 9:11am another bomb detonated in the centre of Brussels inside a metro station. These suicide bombings claimed altogether 31 people immediately during the terror attack and four more afterwards in hospitals. More than 300 people were injured. The following manhunts with several police raids revealed further nail bombs, chemicals and flags of the "Islamic State", also known as "Daesh". On 8 April 2016, the Brussels police caught the third suspect, and he confessed to be the wanted person, whose bomb was unexploded. In the intervening time, many assumptions about the body count and the number of implicated persons circulated in the media. Twitter in particular was highly utilised for communication in terms of disseminating information and providing updates in regard to the crisis-related proceedings. After the confession of members of the group "Daesh" on 22 March, it became obvious that these bombings were a politically motivated terror attack.

3.2 Data Collection

In our case study, we focused on the microblogging platform Twitter because, in contrast to Facebook, the communication is predominantly public and allows fast and spontaneous information diffusion concerning reactions to happenings and news dissemination. Additionally, local media correspondents often use Twitter for the fast propagation of breaking news close to the incident's location (Oh et al., 2012). Furthermore, the public communication allows other Twitter users around the globe to share these news updates through retweets, wherefore information diffusion is supported dynamically (Oh et al., 2012). Moreover, Twitter provides a Search API, which makes data collection possible (Bruns and Liang, 2012). To gather the data, we used a self-developed Java tool, by connecting to the Twitter Search API. For this purpose, a defined set of keywords is necessary to gather data in the form of tweets circulating in Twitter. The collected data were saved afterwards in a MySQL database for further analyses. Because of the sudden occurrence of a crisis like a terror attack, the well-planned collection of data is difficult. Therefore, the tracking of the content started immediately after gaining knowledge of the incident. We collected data from 8am UTC until 8pm UTC on 22 of March 2016, using the keywords *brussels*, *bruxelles* and *brusselsattacks*. These keywords were recognised as the most commonly used keywords within the whole communication related to this extreme event. To ensure the internationality of this investigation, only the English tweets and retweets were collected

and stored. Altogether, within this 12-hour period the data set consists of 2,020,780 messages, which contain the above-mentioned keywords. These 2,020,780 messages contain 1,569,442 retweets.

3.3   Data Analysis

To answer the research question, the communication network in Twitter will be examined. First, it is necessary to identify the roles, who participated in the crisis communication. For that purpose, a social network analysis (SNA) is conducted. This is realised with the open source tool Gephi (Gephi, 2016), which is useful for the analysis and visualisation of graphs and which provides several metrics for calculation. The complete and unfiltered network consists of 895,900 nodes, which represent the users, and 1,447,711 edges, which can be understood as relations between the users caused by retweets. This network is utilised to identify the roles first using Pervin et al.'s (2014) framework, which differentiates between information starters, amplifiers and transmitters. Hence, the metric of in-degree, which implies how often a participant node has been retweeted, was used to identify information starters through the SNA in our data set. As a result, the in-degree measure is based on inbound relations (Khokhar, 2015 see Figure 1). For this reason, they are sorted downward dependent on their in-degree scores to identify the most influential, namely the most frequently retweeted users acting as information starters. Amplifiers were sorted regarding their amount of retweeting (out-degree) as well, but with dependence of their followers count to identify the most followed users. The out-degree score was defined as greater or equal one to ensure that only those amplifiers are listed who retweeted at least one tweet from other users (Figure 1). Transmitters are identified with the metric of the betweenness centrality, which is calculated in Gephi as a part of the network diameter. The betweenness centrality is utilised because it measures how often a node lies on the shortest paths within the whole network and therefore gives the impression of the node's importance and centrality (Brandes, 2001). Nodes with a high betweenness score can be described as bridging nodes, which is the consequence of the dependence of users to connect with others through the bridging actor (Golan and Himelboim, 2015 see Figure 1). Similar to amplifiers, transmitters need to have an out-degree greater or equal one to guarantee their involvement in crisis communication through retweeting as well.

Figure 1. Visualisation of an information starter (left), amplifier (middle) and transmitter (right).

After the Gephi analysis on the whole and unfiltered network, for each user role the top 50 will be identified because these results are necessary to answer the research question. This implies the preparation of three separated data sets according to the top 50 information starters, amplifiers and transmitters to gather all tweets and retweets, which were made by each of the top 50. In relation to that, the tweets and retweets contained the above-mentioned keywords wherefore the relevance of the extracted communication is ensured. To determine what kind of information diffused through them for sensemaking, a manual content analysis with both qualitative and quantitative aspects is conducted, which is based on the systematical procedure of Mayring (2012), wherefore the method is valid and the approach is highly structured. The content categories are deductively developed on the basis of literature. Therefore, as a theoretical foundation the content categorisation of Heverin and Zach (2010, 2012) is used. It contains information-, opinion-, technology-, emotion- and action-related content categories, which they utilised to examine Twitter-related crisis communication on different crisis type. As another difference they only examined original tweets. According to the procedure of Mayring (2012), a pre-test was conducted as well to ensure validity and the fitting of the categories. Therefore, the coding scheme of Heverin and Zach (2012) was assigned to 50 tweets and retweets with results indicating that the category *others* has to be introduced to code tweets and retweets, which cannot be clearly assigned to one of the other categories above. Additionally, the descriptions were elaborated upon by

ourselves to provide an understanding of content tweets and retweets. The coding scheme with short descriptions is displayed in Table 1.

Content Category	Description
Information	Tweets and retweets providing crisis-related information like advice on how to best behave, eyewitness reports, help requests and situational information regarding both affected as well as non-affected areas.
Opinion	Tweets and retweets providing expressions of political as well as non-political opinions in the context of the crisis
Technology	Tweets and retweets dealing with information concerning technology usage and/or comments referring to Twitter or other communication technology
Emotion	Tweets and retweets with the explicit expression of all kind of emotions as well as expressions of support towards crisis-affected persons and their relatives and/or prayers for crisis-affected persons and their relatives
Action	Tweets and retweets dealing with appeals to perform all kinds of actions like to share something
Others	Tweets and retweets containing content that does not fit into one of the above mentioned categories (e.g. "*RT @DanScavino: .@realDonaldTrump discusses #Brussel*s.")

Table 1.   Scheme for coding tweets and retweets into content categories

Furthermore, the research question deals with sensemaking, for which an additional analysis is necessary. This should be realised with the observation of sensemaking patterns, wherefore the preliminary model of Heverin and Zach (2012) is explained in more detail in Table 2. Similar to the procedure of the content analysis, another pre-test was carried out to ensure that those patterns identified by Heverin and Zach (2012) cover all required aspects and to obtain the purest coding scheme possible for sensemaking analyses. The pre-test revealed that tweets and retweets leading to opinion- and solidarity sensemaking are shared commonly, which is why we add such categories to the identified patterns of Heverin and Zach (2012). Note that these two self-developed categories are mostly theoretically based on sensemaking literature analysis and were identified as possible influencing factors in research previously, what supports the results of the pre-test additionally. Furthermore, the results of the content and the sensemaking analyses have to be linked with each other as well because the literature reveals that communication and content might impact sensemaking (Heverin and Zach, 2012; Vos and Buckner, 2015).

Sensemaking pattern	Description
Information Sharing	Tweets and retweets providing new information
Information Negotiation	Tweets and retweets comprising reactions to conflicting messages like corrections or questioning for information or clarification
Information Seeking	Tweets and retweets containing questions for further information regarding all happenings and circumstances in the context of the crisis
Talking Cure	Expression of feelings and emotions (e.g. fear, hope) in tweets and retweets like *My heart is broken. These events have eternal impact on the lives of countless people. #Brussels, you're in my prayers*
Sharing Individual Actions	Tweets/retweets dealing with the sharing of individual actions in reaction to the crisis
Understanding the Why	Tweets/retweets dealing with the trying to understand why the crisis happened
Contemplating Awareness Outside of the Local Setting	Tweets/retweets dealing with the trying to create awareness outside of the local crisis setting

Questioning the Outcomes of the Crisis	Tweets/retweets that involve questioning the outcomes of the happening
Solidarity	Tweets/retweets providing the explicit expressions of solidarity or information concerning solidary actions in response to the crisis like *"The United States stands with the people of Belgium"*
Opinion Sharing	Tweets/retweets providing opinions like *He is at it again. #LyingTed taking advantage of Brussels tragedy to attack @realDonaldTrump*
Other	Tweets/retweets that cannot be assigned to another pattern (e.g. *RT @muhammadmusa313: #MuslimsForPeace Love, Love, & Love Peace, Peace & Peace #Brussels*)

Table 2.   Scheme for coding tweets and retweets into sensemaking patterns

4   Findings

The preparation of new Gephi data sets for information starters, amplifiers and transmitters results in networks with fewer nodes and edges in comparison to the whole data set of the 12-hour period. First, the top 50 of information starters were identified and their Gephi network comprised 347,369 nodes or users and 191,858 edges, namely relations between them. Within this data set and on average, an information starter has approximately 8,499,475 followers and the time to the first retweet amounts to an average of 29 seconds. Furthermore, the results indicate a range from one to 75 posted tweets within the data set of the top 50 information starters. The average tweet count is about 20 tweets per user. Additionally, nearly 25% of the users were retweeted more than 10,000 times. The weighted in-degree ranges from 74,704 to 3,698, which leads to an average retweet amount of 9,596. In contrast to information starters, the Gephi network related to the top 50 amplifiers contains 170 nodes and 181 edges. Furthermore, a range from 75,294,383 to 3,268,045 followers is obvious, wherefore the average number of followers is 10,777,732. The average retweets made by a top amplifier is four. On average, it takes 33 minutes and 34 seconds from the time of original tweet and the retweet by a top 50 amplifier within the data set. Above, the construction of the transmitter data set leads to 427 related nodes and 1,048 edges in Gephi, and the average number of retweets made by a transmitter is approximately 14. On average, a transmitter shares messages originated by others after approximately 55 minutes with their own followers. Additionally, a user identified as a transmitter has 1,014,638 followers. Following that, some intersections between the identified top 50 users of information starters, amplifiers and transmitters became obvious. The results are displayed in Figure 2, indicating that the most overlaps between the role categories are found between information starters and amplifiers. The only exception is that no user functions simultaneously as an amplifier and transmitter within the network, solely in combination of being an information starter as well.
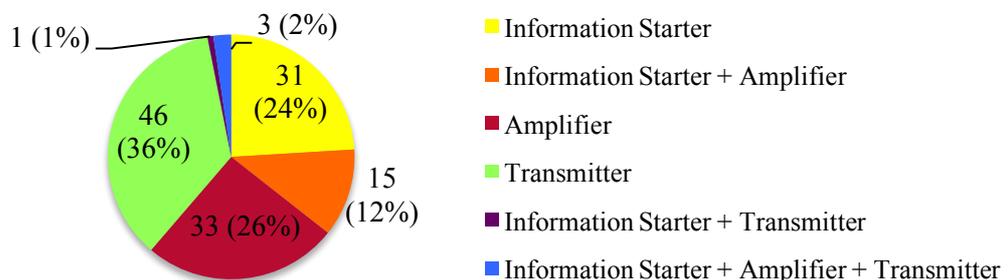
Figure 2.   Intersections between information starters, amplifiers, and transmitters.

Subsequently, the results of the content analysis of identified tweets and retweets made by the top 50 information starters, amplifiers and transmitters are displayed in Figure 3. To provide a general overview and a comparison between the three user roles, only the high-level content categories of *information*, *opinion*, *technology*, *emotion*, *action* and *others* are depicted within this visualisation.
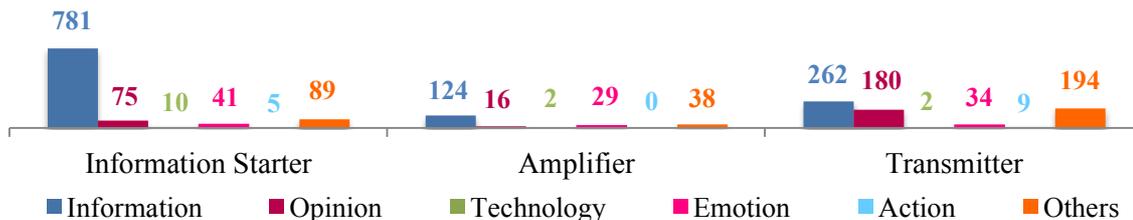
Figure 3.   Distribution of tweeted and retweeted content by the top 50 users of each user-role.

The second analysis aspect deals with the identification and categorisation of the sensemaking patterns. To provide an overview of the results, all values can be found in Figure 4. Note that patterns like *information negotiation, sharing individual actions*, *contemplating awareness outside of the local setting* and *questioning the outcomes of the crisis*, which were found by Heverin and Zach (2012), cannot be identified within any of the three data sets and are not mentioned further. Instead, the sensemaking patterns *solidarity* and *opinion sharing* are added.
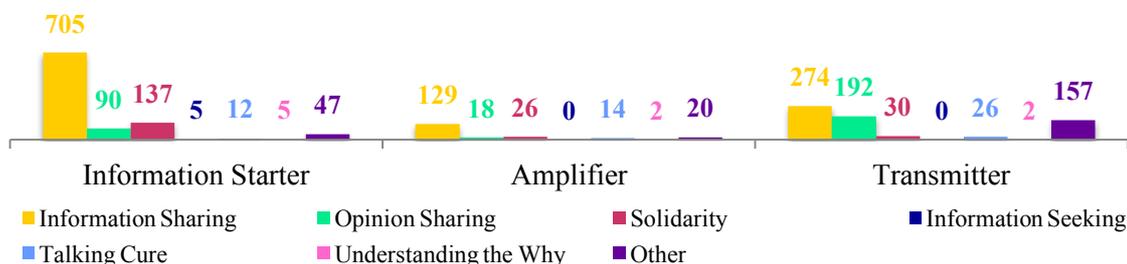

Figure 4.   Distribution of tweeted and retweeted sensemaking patterns.

After obtaining an overview of the overall distribution of tweets and retweets, the sensemaking amounts are displayed for each top 50 users in Figure 5 to provide a more dynamic perspective in regard to the distribution within the 12-hour period. The x-axes represent the time frame from 8am to 8pm UTC. The y-axes represent the number of tweets and retweets.
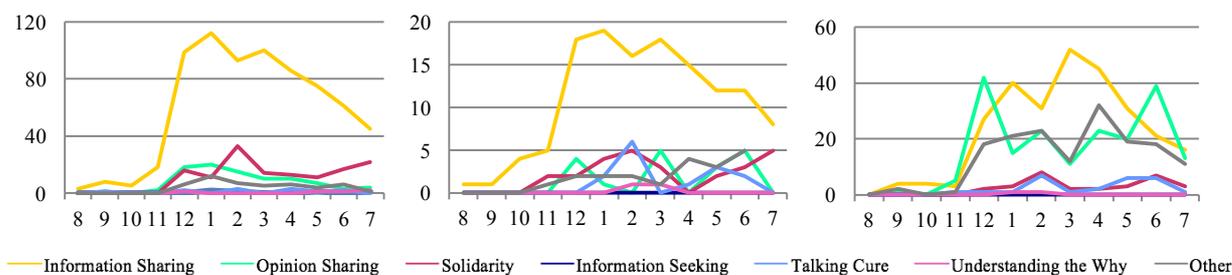

Figure 5.   Timelines of the sensemaking pattern distributions of information starters (left), amplifiers (middle) and transmitters (right) within the examined 12-hour period.

5   Discussion

Crisis situations are often composed of uncertainty and anxiety, which leads to the problem of facing cognitive gaps. To solve this, communication activities can aid in bridging such gaps, resulting in sensemaking (Dervin, 1983; Heverin and Zach, 2012). *Information sharing* is important in the context of crisis situations because it serves as an essential mechanism to fill knowledge gaps by providing e.g. new crisis-related information (Heverin and Zach, 2012), situational updates or advice concerning how to best react to stay safe or for supporting others. Our case study reveals that information starters supported their followers by posting informational content regarding the crisis and the happenings

related to it immediately after the crisis unfolds. Their tweets were retweeted most frequently within the whole data set, which leads to the assumption of having the broadest reach within the network and therefore impacting and guiding the communication. Hence, it can be assumed that people who are retweeted most frequently do not necessarily have the most followers as a consequence, which is indicated by the results of the social network analyses. Cha et al. (2010) come to similar conclusions using the followers count, number of retweets and mentions count as distinct influence measures within a Twitter network. Amplifiers also served as information sources for the general public. Particularly, they retweeted tweets dealing with informational content and were also responsible for the dissemination and aimed in bridging gaps within the communication network. In general, at the beginning of the crisis, amplifiers mostly retweeted information and later (similarly to information starters), opinions were shared for the first time as well, whereby content originated by others was disseminated within their communities. This might be due to the fact that several top users identified as information starters were among the top 50 of amplifiers and both their tweets as well as their retweets were analysed, coded and compared. In correspondence to their role characteristics, it can be stated that these overlapping users are therefore on the one hand among the most retweeted accounts within the whole network (information starters), and on the other hand, they have the highest followers count and belong to the top 50 amplifiers. In regard to the 15 intersectional information starters and amplifiers, the majority of tweeted as well as retweeted content belongs to *situational information (affected area)* and in regard to sensemaking *information sharing* dominated as well. Hence, a similar tweet and retweet behaviour becomes visible, which can be caused by some previous developed social media strategies. Furthermore, this informational sensemaking pattern is the only one that can be identified within the data set of these two user roles at the time immediately after the explosions at the airport Zaventem and at the metro, which is important inasmuch as of the increased uncertainty and the need to fill the knowledge gaps shortly after the incident. Therefore, the examination reveals initial insights into role-based sensemaking since information starters and amplifiers guide the informational sensemaking during the crisis as key actors.

Besides information sharing, we used further sensemaking patterns to investigate communication. Related to that, the counterpart to *information sharing* might be *information seeking*. With asking for new information or the questioning of the consequences of a crisis, it may help in sensemaking because it can serve as a mechanism to fill knowledge gaps when other people respond to a tweet dealing with such questions. According to Garnett and Kouzmin (2007), the sharing of and seeking for information is crucial in crisis situations, which became obvious through their investigation of communication during hurricane Katrina. They stated that the communication gaps during the crisis impeded and retarded the understanding of the situation. Concerning that and in relation to our investigation, with tweets like, "Was this revenge for the capture of Salah Abdeslam? https://t.co/ke1rL8xEar #Brussels https://t.co/isvnDt0djp" communication participants tried to understand why the bombings happened. Through this form of reasoning, affected as well as non-affected persons speculate about the motives for the violence with the aim of finding an explanation for the situation. Nevertheless, within the three data sets, few tweets dealt with *understanding the why* and *information seeking,* which might be an indicator of a sufficient amount of shared information, whereby the gap in understanding may be bridged already.

Against Pervin et al. (2014), whose role definition served as a basis for our investigation, it can be stated that the identified amplifiers post interesting content by themselves as well and do not merely retweet others. Therefore, the role definition has to be either broadened or further restricted to ensure that those users function only as retweeters (amplifiers) and not as tweeters as well. Additionally, this is stressed by the fact that amplifiers mostly retweet to a lesser amount than they post original tweets by themselves. Nevertheless, they fulfil an important function within this crisis communication because of their dissemination ability. As Boyd et al. (2010) state, the sharing of original tweets through retweeting seems to be an especially successful diffusion mechanism because of the potential reach an amplifier has. Considering these aspects, it became obvious that amplifiers are important in terms of their potential reach, but that the amplifier role definition of Pervin et al. (2014) is insufficient and

should be changed for further investigations to provide a better distinction between amplifiers and information starters.

Transmitters retweeted opinions to a higher level shortly after the crisis took place than they retweeted information. This outcome is contrary to the results of Heverin and Zach (2012), indicating that indeed the amount of shared opinions rises over time, but that the early phase of the crisis is dominated by information. In accordance with our research results, this may be due to the fact that the uncertainty is reduced sufficiently by information starters and amplifiers, for instance, wherefore more opinions are retweeted by transmitters immediately after the crisis unfolds. Another possibility might be that the users identified as transmitters received more opinion-related than informational original tweets at the onset of the crisis through their networks, wherefore they wanted to provide their audience with those as well.

Although new information is essential to handle an uncertain crisis situation, opinions are relevant as well. They can aid in developing a common understanding of the crisis through the negotiation and reinterpretation of one's own perspective (Eriksson, 2016). The expressions of opinions may generate further discussions and can be seen as social and collaborative sensemaking activities (Qu et al., 2009; Weick, 1995). As a result, *opinion sharing* as a new sensemaking pattern became obvious at the onset of the crisis within the data set of the top 50 of transmitters as well. It does not contribute to fill knowledge gaps, but it might influence the interpretations of the individuals (Savolainen, 1993). Furthermore, the sharing of opinions, regardless of whether political or non-political, can serve as a sensemaking mechanism (Dervin and Frenette, 2001) because it helps to gain the social support of like-minded people and reduces the situational complexity as a result of developing a common understanding (Pentina and Tarafdar, 2014; Qu et al., 2009). Furthermore, the opinions of others can aid in generating as well as reconsidering one's own opinion in terms of certain circumstances or happenings (Qu et al., 2009). Similar to the case of *information sharing* as a sensemaking pattern, information starters and amplifiers show nearly the same behaviour, as both post and share this pattern to a lesser amount than transmitters. This leads to the assumption that transmitters are responsible for opinion-related sensemaking by disseminating such messages originated by other users after the crisis unfolds. In relation to their role characteristics, this means that particularly in the early stages of the crisis, opinions and later on informational tweets are shared by transmitters and potentially disseminated to several communities because of their bridging function. Conspicuously and unlike information starters and amplifiers, both the content and sensemaking distribution of retweets made by transmitters shows no unambiguous predominant category or pattern within the timeline. This leads to the presumption that they retweet various content more frequently throughout the crisis. One explanation for that could be the structure of social networks, which are usually composed of several communities and which are connected through ties (Grabowicz et al., 2013; Rogers, 2003). Referring to that, Granovetter (1973) distinguished between strong and weak ties, whereby the first represents close relationships and weak ties depict loose connections between individuals (Garg et al., 2011; Shi et al., 2014) through which different communities are linked (Grabowicz et al., 2013; Rogers, 2003). As a result, this form of ties often acts as bridges between such communities (Rogers, 2003; Zhao et al., 2010), whereby new information is diffused from groups of actors with strong ties to other individuals who are connected by weak ties (Grabowicz et al., 2013). These aspects can be associated with the transmitter role characteristic of having the ability to bridge communities (Pervin et al., 2014) indicated by the betweenness centrality as well (Li et al., 2012). Furthermore, the variety of retweeted content may be due to the fact that weak ties are said to have only a couple of mutual contacts and more access to diverse users (Bakshy et al., 2012). As a result, they have the potential to enhance the variety of circulating content (Bakshy et al., 2012). Because crisis situations are mostly spontaneous and unexpected, this makes it difficult to identify such users immediately for using their potential of reaching different people and communities. Nevertheless, this investigation showed the huge potential this user role might encompass in relation to their amount of retweets and as a result their function as information intermediaries. This is further clarified by the fact that they retweet much more than amplifiers do, what may be due

to the fact that transmitters are connected to more diverse communities, which could result in a broad variety of information sources (Boyd et al., 2010).

We added *solidarity* as a sensemaking pattern to the investigation because research further indicates that it helps in coping with the crisis (Starbird and Palen, 2011; Terpstra et al., 2012) and that the expression of solidarity arises through the progress and in the aftermath of a crisis naturally as well (David et al., 2016). Furthermore, another investigation reveals that the solidarity expressions are one of the main observed themes through Twitter communication in the context of a crisis (Eriksson, 2016), which can be confirmed by the sensemaking analysis results as well. The expression of solidarity may fulfil a twofold functionality: from the perspective of the authors of such expressions, it might help to reduce their own awkwardness, as they are not able to change crisis situations. As a second aspect, it seems to be an instrument of trying to diminish the desperation of affected persons by creating a sense of community (Schaefer, 1999), which becomes apparent by tweets and retweets like, "The United States stands with people of Belgium" or "Standing with #Brussels: Europe's iconic landmarks turn red, yellow & black". Especially the creation of a sense of community can aid in sensemaking because it may reduce both the impression of being alone as well as the feeling of despair. In comparison to transmitters, information starters' and amplifiers' tweets and retweets contain approximately 3 times as many solidarity expressions. This indicates that the communication participants not only articulate their own solidarity with their followers and affected persons, but also that the amplifiers further disseminate tweets originated by others to make followers within their community aware of that as well, corresponding to Boutet et al. (2013), who state that people tend to mostly retweet messages that they want to share with their own network to aid affected as well as non-affected persons. Similar to *solidarity* and *opinion sharing*, the sensemaking pattern *talking cure* does not aid in filling knowledge gaps by providing new information, but it serves more as a mechanism to voice emotions, feelings and hopes (Heverin and Zach, 2012), for instance, wherefore the sensemaking function can be twofold as well. Within this examination, people who were not local to the crisis but rather worldwide mostly used the *talking cure* mechanism. Referring to the user roles and in comparison, to information starters and transmitters, amplifiers in particular retweeted messages providing *talking cure* sensemaking. What becomes obvious through the timelines of amplifiers and transmitters is that this pattern proceeds nearly parallel to the emotional content line, which might be explained by the fact that the talking cure includes the voicing of emotions as well. These talking cure and emotional aspects are important for sensemaking since the bridges, which are built to overcome knowledge gaps, consist of several components like emotions, ideas and experiences and can affect the sensemaking (Dervin, 1983, 1998; Savolainen, 2006). Furthermore, it might influence the sensemaking in terms of the beginning, the length, the form it takes and the end resulting in sensemaking, namely understanding (Cornelissen et al., 2014; Maitlis and Christianson, 2014).

6 Conclusion and Further Research

Through our study, we seek to understand how and what kinds of information are diffused through roles in social media crisis-related communication and how information contribute to sensemaking. We therefore focused on examining Twitter communication regarding the Brussels bombings on 22 March 2016. Information starters were retweeted most frequently by the audience. Amplifiers, identified as those users with the highest number of retweets and followers, retweeted similar content and provided the audience with information. Therefore, they guide the informational sensemaking and as a result aimed to bridge the knowledge gap of the audience. In contrast, transmitters are actively engaged in the dissemination of opinions, especially immediately after the crisis takes place, which serves for reconsidering or establishing one's own opinion, therefore leading to other sensemaking mechanisms. Unexpectedly, several identified users were visible in more than one data set, which results in intersections between information starters, amplifiers and transmitters. This leads to the conclusion of an increased potential for information diffusion in crisis communication because of being retweeted frequently and functioning as a bridge between several communities within a network,

which leads to a broader reach, for instance. By identifying this, practitioners are now able to address these users and utilise their whole potential to guide the information flow and sensemaking of the audience, which could further prevent misunderstandings and the circulation of rumours or misinformation. The examination contributes to obtaining more in-depth knowledge about role differences and their function in a network. It provides an initial understanding of which roles guide what kind of sensemaking in crisis situations, which is especially useful for practice to improve response strategies in future happenings. Furthermore, it enhanced already existing research frameworks with a more detailed content and sensemaking coding scheme for further investigations. Our work provides initial insights into analysing not only the tweets of top users but also the retweets made by influential users for sensemaking, as it demonstrates what is worth disseminating from the perspective of the key actors to support their audience in sensemaking. This is useful for further investigations as well as for practitioners work in crises. Lastly, it should be noted that the veracity and completeness of the data set could not be guaranteed, as the Search API was our point of access to the Twitter stream (Bruns and Liang, 2012) and we cannot ensure that the API tracked all existing tweets. Admittedly, Twitter was used to investigate the communication and sensemaking, but the utilised framework and coding scheme is not restricted to that microblogging platform and is rather applicable for other social media channels as well. For instance, it became visible that many pictures and videos were shared in the aftermath of the crisis, wherefore other platforms may be beneficial to be used for research as well. Because of the universally valid coding scheme and framework, this will help other researchers to conduct further empirical studies in different contexts as well. Here, a terrorist attack was examined, but investigations with other crisis types like floods, earthquakes or certain man-made crises are necessary to determine whether similar results become obvious. Furthermore, future research is needed to clarify what role attributes are responsible for appearing as key actors and being central within the network, and likewise whether these depend on trust, certain profile characteristics or the perceived and anticipated social role of a user. Since trust or swift trust might be the decisive factor for sharing tweets originated by other communication participants, this should be further analysed in detail to provide practitioners with insights concerning the necessary aspects leading to the construction of these from the perspective of the audience and the general public. Swift trust or mutual trust describes a form of trust that develops rapidly and in which no detailed knowledge about the trusted object or person is necessary (Coppola et al., 2004; Iacono and Weisband, 1997). This construct is especially relevant in short-term contexts like spontaneous developed communication networks in crises. As a new research area, emotions can be further analysed as well. Because emotions were the third most commonly posted topic in tweets and disseminated through retweets, which may be due to the fact that emotional tension increases through uncertain and unexpected situations like crises (Oh et al., 2013), a sentiment analyses may help in understanding the mood within the contents. Related to that, it can be assumed that sentiments may impact the diffusion of information within a network as well (Dang-Xuan et al., 2013). Although the study examined the main communication occurring within the first 12 hours after the bombings, the period is still a sequence of the communication.

References

Bakshy, E., Rosenn, I., Marlow, C. and Adamic, L. (2012), "The role of social networks in information diffusion", *WWW 2012 - Session: Information Diffusion in Social Networks April 16-20, 2012, Lyon, France*, pp. 519–528.

Barley, S.R. (1990), "The Alignment of Technology and Structure through Roles and Networks", *Administrative Science Quarterly*, Vol. 35 (1) No. April, pp. 61–103.

Bicen, H. and Cavus, N. (2012), "Twitter Usage Habits of Undergraduate Students", *Procedia - Social and Behavioral Sciences*, Vol. 46, pp. 335–339.

Blum, J., Kefalidou, G., Houghton, R., Flintham, M., Arunachalam, U. and Goulden, M. (2014),

"Majority report: Citizen empowerment through collaborative sensemaking", *ISCRAM 2014 Conference Proceedings - 11th International Conference on Information Systems for Crisis Response and Management*, No. May, pp. 767–771.

Boutet, A., Kim, H. and Yoneki, E. (2013), "What's in Twitter, I know what parties are popular and who you are supporting now!", *Social Network Analysis and Mining*, Vol. 3 No. 4, pp. 1379–1391.

Boyd, D., Golder, S. and Lotan, G. (2010), "Tweet, tweet, retweet: Conversational aspects of retweeting on twitter", *Proceedings of the Annual Hawaii International Conference on System Sciences*, available at:https://doi.org/10.1109/HICSS.2010.412.

Brandes, U. (2001), "A faster algorithm for betweenness centrality*", *The Journal of Mathematical Sociology*, Vol. 25 No. 2, pp. 163–177.

Bruns, A., Burgess, J.E., Crawford, K. and Shaw, F. (2012), "#qldfloods and@QPSMedia: Crisis Communication on Twitter in the 2011 South East Queensland Floods", *ARC Centre of Excellence for Creative Industries and Innovation*, available at: http://eprints.qut.edu.au/48241/.

Bruns, A. and Liang, Y.E. (2012), "Tools and methods for capturing Twitter data during natural disasters", *First Monday*, Vol. 17 No. 4.

Bruns, A. and Stieglitz, S. (2014), "Twitter Data: What Do They Represent?", *It - Information Technology*, Vol. 56 No. 5, pp. 240–245.

Cassa, C.A., Chunara, R., Mandl, K. and Brownstein, J.S. (2013), "Twitter as a Sentinel in Emergency Situations: Lessons from the Boston Marathon Explosions", *PLoS Currents*, Vol. 5 No. 1, available at:https://doi.org/10.1371/currents.dis.ad70cd1c8bc585e9470046cde334ee4b.

Cha, M., Haddai, H., Benevenuto, F. and Gummadi, K.P. (2010), "Measuring User Influence in Twitter : The Million Follower Fallacy", *International AAAI Conference on Weblogs and Social Media*, pp. 10–17.

Coppola, N.W., Hiltz, S.R. and Rotter, N.G. (2004), "Building trust in virtual teams", *Ieee Transactions On Professional Communication*, Vol. 47 No. 2, pp. 95–104.

Cornelissen, J.P., Mantere, S. and Vaara, E. (2014), "The contraction of meaning: The combined effect of communication, emotions, and materiality on sensemaking in the stockwell shooting", *Journal of Management Studies*, Vol. 51 No. 5, pp. 699–736.

Dang-Xuan, L. and Stieglitz, S. (2012), "Impact and Diffusion of Sentiment in Political Communication–An Empirical Analysis of Political Weblogs", *AAAI Conference on Weblogs and Social Media*, pp. 3500–3509.

Dang-Xuan, L., Stieglitz, S., Wladarsch, J. and Neuberger, C. (2013), "an Investigation of Influentials and the Role of Sentiment in Political Communication on Twitter During Election Periods", *Information, Communication & Society*, Vol. 16 No. 5, pp. 795–825.

David, C.C., Ong, J.C. and Legara, E.F.T. (2016), "Tweeting supertyphoon Haiyan: Evolving functions of twitter during and after a disaster event", *PLoS ONE*, Vol. 11 No. 3, available at:https://doi.org/10.1371/journal.pone.0150190.

Dervin, B. (1983), "An overview of sense-making research: Concepts, methods, and results to date", *International Communication Association Annual Meeting*, pp. 1–14.

Dervin, B. (1998), "Sense-making theory and practice: an overview of user interests in knowledge seeking and use", *Journal of Knowledge Management*, Vol. 2 No. 2, pp. 36–46.

Dervin, B. and Frenette, M. (2001), "Sense-making methodology: Communicating communicatively with campaign audiences", *Public Communication Campaigns*, pp. 69–87.

Ehnis, C. and Bunker, D. (2013), "The Impact of Disaster Typology on Social Media Use by Emergency Services Agencies: The Case of the Boston Marathon Bombing", *24th Australasian Conference on Information Systems 2013, Melbourne*, No. December, pp. 4–6.

Ehnis, C., Mirbabaie, M., Bunker, D. and Stieglitz, S. (2014), "The role of social media network participants in extreme events", *25th Australian Conference of Information Systems (ACIS)*, available at:https://doi.org/10.1109/HICSS.2016.33.

Ellison, N.B., Steinfield, C. and Lampe, C. (2007), "The benefits of facebook 'friends:' Social capital and college students' use of online social network sites", *Journal of Computer-Mediated Communication*, Vol. 12 No. 4, pp. 1143–1168.

Eriksson, M. (2016), "Managing collective trauma on social media: the role of Twitter after the 2011 Norway attacks", *Culture & Society*, Vol. 38 No. 3, pp. 365–380.

Garg, R., Smith, M.D. and Telang, R. (2011), "Measuring Information Diffusion in an Online Community", *Journal of Management Information Systems*, Vol. 28 No. 2, pp. 11–38.

Garnett, J.L. and Kouzmin, A. (2007), "Communicating throughout Katrina: Competing and complementary conceptual lenses on crisis communication", *Public Administration Review*, Vol. 67 No. SUPPL. 1, pp. 171–188.

Gephi. (2016), "Gephi", available at: https://gephi.org (accessed 18 November 2016).

Golan, G.J. and Himelboim, I. (2015), "Can World System Theory predict news flow on twitter? The case of government-sponsored broadcasting", *Information, Communication & Society*, Vol. 19 No. 8, pp. 1150–1170.

Goolsby, R. (2010), "Social media as crisis platform: The future of community maps/crisis maps", *ACM Transactions on Intelligent Systems and Technology (TIST)*, Vol. 1 No. 1, p. 11.

Grabowicz, P.A., Ramasco, J.J. and Eguiluz, V.M. (2013), "Dynamics in online social networks", *Dynamics On and Of Complex Networks*, Vol. 2, pp. 3–17.

Granovetter, M.S. (1973), "The Strength of Weak Ties", *American Journal of Sociology*, Vol. 78, pp. 1360–1380.

Gupta, A. and Kumaraguru, P. (2012), "Credibility ranking of tweets during high impact events", *Proceedings of the 1st Workshop on Privacy and Security in Online Social Media*, pp. 2–8.

Heverin, T. and Zach, L. (2010), "Microblogging for Crisis Communication : Examination of Twitter Use in Response to a 2009 Violent Crisis in the Seattle-Tacoma, Washington Area", *Proceedings of the 7th International ISCRAM Conference*, Vol. 2009 No. November, p. 5.

Heverin, T. and Zach, L. (2012), "Use of microblogging for collective sense-making during violent crises: A study of three campus shootings", *Journal of the American Society for Information Science and Technology*, Vol. 63 No. 1, pp. 34–47.

Huang, R. and Sun, X. (2013), "Weibo network, information diffusion and implications for collective action in China", *Information, Communication & Society*, Vol. 17 No. 1, pp. 86–104.

Hwang, Y. and Lim, J.S. (2015), "The impact of engagement motives for social TV on social presence and sports channel commitment", *Telematics and Informatics*, Vol. 32 No. 4, pp. 755–765.

Iacono, C.S. and Weisband, S. (1997), "Developing trust in virtual teams", *Proceedings of the Thirtieth Hawaii International Conference on System Sciences*, Vol. 2, pp. 412–420.

Jalonen, H. (2014), "A framework for dealing with fundamental knowledge problems through social media", *VINE: The Journal of Information and Knowledge Management Systems*, Vol. 44 No. 4, pp. 558–578.

Kalsnes, B., Krumsvik, A.H. and Storsul, T. (2014), "Social media as a political backchannel Twitter use during televised election debates in Norway.", *Aslib Journal of Information Management*, Vol. 66 No. 3, pp. 313–328.

Kaplan, A.M. and Haenlein, M. (2010), "Users of the world, unite! The challenges and opportunities of Social Media", *Business Horizons*, Vol. 53 No. 1, pp. 59–68.

Kawamoto, T. (2013), "A stochastic model of tweet diffusion on the Twitter network", *Physica A: Statistical Mechanics and Its Applications*, Vol. 392 No. 16, pp. 3470–3475.

Khokhar, D. (2015), *Gephi Cookbook*, Packt Publishing Ltd.

Landgren, J. (2005), "Shared Use of Information Technology in Emergency Response Work: Results from a Field Experiment.", *Proceedings of the Second International ISCRAM Conference*, No. April, pp. 1–7.

Larosiliere, G.D., Meske, C. and Carter, L.D. (2015), "Determinants of social network adoption: A country-level analysis", *Proceedings of the Annual Hawaii International Conference on System Sciences*, Vol. 2015–March, pp. 3424–3433.

Li, K., Gong, X., Guan, S. and Lai, C.H. (2012), "Efficient algorithm based on neighborhood overlap for community identification in complex networks", *Physica A: Statistical Mechanics and Its Applications*, Vol. 391 No. 4, pp. 1788–1796.

Lou, T. and Tang, J. (2013), "Mining Structural Hole Spanners through Information Diffusion in Social Networks", *Proceedings of the 22nd International Conference on World Wide Web, Rio de Janeiro, Brazil, May, 13-17*, pp. 837–847.

Maitlis, S. and Christianson, M. (2014), "Sensemaking in Organizations: Taking Stock and Moving Forward", *The Academy of Management Annals*, Vol. 8 No. 1, pp. 57–125.

Mayring, P. (2012), "Qualitative Inhaltsanalyse - ein Beispiel für Mixed Methods", *Mixed Methods in Der Empirischen Bildungsforschung*, pp. 27–36.

Mirbabaie, M., Ehnis, C., Stieglitz, S. and Bunker, D. (2014), "Communication roles in public events – A case study on Twitter communication", *Information Systems and Global Assemblages. (Re)Configuring Actors, Artefacts, Organizations*, pp. 207–218.

Nadel, S.F. (1957), *The Theory of Social Structure*, *American Sociological Review*, Vol. 23, available at: http://www.amazon.com/dp/0029224209.

Nagar, Y. (2012), "What do you think?: the structuring of an online community as a collective-sensemaking process", *Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work*, pp. 393–402.

Nagarajan, M., Purohit, H. and Sheth, A. (2010), "A Qualitative Examination of Topical Tweet and Retweet Practices", *ICWSM*, pp. 295–298.

Oh, O., Agrawal, M. and Rao, H.R. (2013), "Community Intelligence and Social Media Services: A Rumor Theoretic Analysis of Tweets During Social Crises", *MIS Quarterly*, Vol. 37 No. 2, pp. 407–426.

Oh, O., Eom, C. and Rao, H.R. (2015), "Research Note—Role of Social Media in Social Change: An Analysis of Collective Sense Making During the 2011 Egypt Revolution", *Information Systems Research*, Vol. 26 No. 1, pp. 210–223.

Oh, O., Tahmasbi, N., Rao, H.R. and de Vreede, G.-J. (2012), "A Sociotechnical View of Information Diffusion and Social Changes: From Reprint to Retweet", *ICIS 2012 Proceedings*, available at: http://aisel.aisnet.org/icis2012/proceedings/ResearchInProgress/66.

Pentina, I. and Tarafdar, M. (2014), "From 'information' to 'knowing': Exploring the role of social media in contemporary news consumption", *Computers in Human Behavior*, Vol. 35, pp. 211–223.

Pervin, N., Takeda, H. and Toriumi, F. (2014), "Factors Affecting Retweetability: An Event-Centric Analysis on Twitter", *ICIS 2014 Proceedings*, pp. 1–10.

Qu, Y., Wu, P. and Wang, X. (2009), "Online Community Response to Major Disaster: A Case Study of Tianya Forum in the 2008 China Earthquake", *42nd Hawaii International Conference on System Sciences*, No. January, pp. 1–11.

Riemer, K., Stieglitz, S. and Meske, C. (2015), "From Top to Bottom: Investigating the Changing Role of Hierarchy in Enterprise Social Networks", *Business and Information Systems Engineering*, Vol. 57 No. 3, pp. 197–212.

Rogers, E.M. (2003), *Diffusion of Innovations.*, *5th Edition*, The Free Press.

Saravanou, A., Valkanas, G., Gunopulos, D. and Andrienko, G. (2015), "Twitter Floods when it Rains: A Case Study of the UK Floods in early 2014", *Proceedings of the 24th International Conference on World Wide Web - WWW '15 Companion*, pp. 1233–1238.

Savolainen, R. (1993), "The sense-making theory: Reviewing the interests of a user-centered approach to information seeking and use", *Information Processing and Management*, Vol. 29 No. 1, pp. 13–28.

Savolainen, R. (2006), "Information use as gap-bridging: The viewpoint of sense-making methodology", *Journal of the American Society for Information Science and Technology*, Vol. 57 No. 8, pp. 1116–1125.

Schaefer, D.J. (1999), "From community to community-ings: Making sense of electronic discussion groups", *Electronic Journal of Communication*, Vol. 9 No. 2–4, p. na.

Schafer, W.A., Ganoe, C.H. and Carroll, J.M. (2007), "Supporting community emergency management planning through a geocollaboration software architecture", *Computer Supported Cooperative Work*, Vol. 16, pp. 501–537.

Shaw, F., Burgess, J., Crawford, K. and Bruns, A. (2013), "Sharing news, making sense, saying thanks: patterns of talk on Twitter during the Queensland floods", *Australian Journal of Communication*, Vol. 40 No. 1, pp. 23–40.

Shi, Z., Rui, H. and Whinston, A.B. (2014), "Content Sharing in a Social Broadcasting Environment: Evidence From Twitter", *MIS Quarterly Quarterly*, Vol. 38 No. 1, pp. 123–142.

Starbird, K. and Palen, L. (2010), "Pass it on?: Retweeting in mass emergency", *Proceedings of the 7th International ISCRAM Conference*, No. December 2004, pp. 1–10.

Starbird, K. and Palen, L. (2011), "Voluntweeters: Self-Organizing by Digital Volunteers in Times of Crisis", *Proceedings of the Conference on Human Factors in Computing Systems (CHI)*, pp. 1071–1080.

Stieglitz, S., Mirbabaie, M., Schwenner, L., Marx, J., Lehr, J. and Brünker, F. (2017), "Sensemaking and Communication Roles in Social Media Crisis Communication", *Proceedings Der 13. Internationalen Tagung Wirtschaftsinformatik (WI 2017), St. Gallen*, pp. 1333–1347.

Stieglitz, S., Schallenmuller, S. and Meske, C. (2013), "Adoption of social media for internal usage in a global enterprise", *Proceedings - 27th International Conference on Advanced Information Networking and Applications Workshops, WAINA 2013*, pp. 1483–1488.

Terpstra, T., Stronkman, R., Vries, a De and Paradies, G.L. (2012), "Towards a realtime Twitter analysis during crises for operational crisis management", *Proceedings of the 9th International ISCRAM Conference*, No. April, pp. 1–9.

Vos, S.C. and Buckner, M.M. (2015), "Social Media Messages in an Emerging Health Crisis: Tweeting Bird Flu", *Journal Of Health Communication*, Vol. 21 No. 3, pp. 301–308.

Wasserman, S. and Faust, K. (1994), *Social Network Analysis: Methods and Applications*, Cambridge University Press, available at:https://doi.org/10.1525/ae.1997.24.1.219.

Weick, K.E. (1995), *Sensemaking on Organizations*, Vol. 9, SAGE, Thousand Oaks, CA.

Weick, K.E., Sutcliffe, K.M. and Obstfeld, D. (2005), "Organization Science and the Process of Sensemaking", *Organization Science*, Vol. 16 No. 4, pp. 409–421.

Xia, X., Yang, X., Wu, C., Li, S. and Bao, L. (2012), "Information credibility on twitter in emergency situation", *Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)*, Vol. 7299 LNCS, Springer Berlin Heidelberg, pp. 45–59.

Zeng, L., Starbird, K. and Spiro, E.S. (2016), "Rumors at the speed of light? modeling the rate of rumor transmission during crisis", *Proceedings of the 49th Hawaii International Conference on*

System Sciences, Vol. March, pp. 1969–1978.

Zhao, D. and Rosson, M.B. (2009), "How and Why People Twitter: The Role that Micro-blogging Plays in Informal Communication at Work", *The ACM 2009 International Conference on Supporting Group Work*, pp. 243–252.

Zhao, J., Wu, J. and Xu, K. (2010), "Weak ties: Subtle role of information diffusion in online social networks", *Physical Review E - Statistical, Nonlinear, and Soft Matter Physics*, Vol. 82 No. 1, available at:https://doi.org/10.1103/PhysRevE.82.016105.