**The role of Facebook and Twitter as organisational communication platforms in relation to flood events in Northern Ireland**

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**Abstract**

Social media networks enable flood-affected individuals to obtain and share credible information, however, their full potential is not recognised by official institutions. This study evaluates flood-related usage of Facebook and Twitter by organisations in Northern Ireland. Data collection involved extraction of publicly visible flood-related Facebook and Twitter posts, over a 9-month period, from official accounts of selected organisations. NVivo was used to conduct a content analysis of the data. The results concluded that flood-related information is predominantly distributed at the flood response stage, illustrating the present reactive social media presence of organisations. Twitter accounted for a higher proportion of broadcasting information, while Facebook was more likely to encourage specific behaviour. Public preference was associated with information provided by emergency services and information transmitted at the response stage. Policy implications include the need for an established proactive social media presence among organisations with a flood-related function and community consultation to identify public information needs.

**Keywords** Social media; Flood; Facebook; Twitter

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**Introduction**

Traditional communication channels such as television and radio have conventionally been employed by organisations to disseminate essential information before, during and after natural disasters, such as flood events. However, in recent years social media has emerged as an important contemporary communication tool, playing a pivotal role in permitting governmental agencies and organisations to instantly interact with individuals affected by natural disasters (Herfort et al. 2014). Social networks have been defined as “online venues for information sharing and social communication, where users create public profiles, interact with friends, and connect with other users” (Masedu et al. 2014, pp 1). Although social media is currently used in combination with traditional measures, during many recent extreme events it has actually been preeminent, broadcasting vital information before mainstream media (Abedin et al. 2014; Cho et al. 2013; Huang and Xiao 2015; Murthy and Longwell 2012; Takahashi et al. 2015). Furthermore, social media has become significantly instrumental in diminishing the communication gap between emergency services and individuals located in inaccessible areas during the aftermath of a disaster (Cho et al. 2013; Ehnis and Bunker 2012; Neubaum et al. 2014; Takahashi et al. 2015).

Initially, social media communication during natural disasters was instigated by members of the public (Simon et al. 2015) and has been successfully utilised by disaster victims to obtain support, confirm the safety of family members and provide updates on ongoing extreme events (St. Denis et al. 2014; Fritze and Kray 2015). Furthermore, it has been suggested that social media engagement during natural disasters can have positive psychological implications as participation can increase perceived control among users, as well as being therapeutic (Alexander 2014; Masedu et al. 2014; Neubaum et al. 2014). The routine usage of social media in everyday life has led to public expectation that emergency services and local authorities will communicate via social media during natural disasters (Meaton and Stringer 2014). Members of the public increasingly rely on official agency social media accounts as a platform for accessing key information, seeking assistance and subsequently sharing relevant disaster information with family and friends (Cho et al. 2013; St. Denis et al. 2014). Consequently, the rapid expansion of social media channels is fundamentally changing how organisations assemble and convey disaster information (Zhang et al. 2015). Emergency services can primarily use their official social media accounts to broadcast warnings at crucial stages during natural disasters (Ehnis and Bunker 2012). However, numerous social media channels also have the potential to act as two-way communication platforms, permitting the public to engage directly with government agencies to secure aid and also collaborate to enhance relief efforts (St. Denis et al. 2014; Ehnis and Bunker 2012).

A considerable problem with regards to social media communication in relation to natural disasters is that current public sanction of it as a communication tool vastly outweighs governmental and local authority endorsement (St. Denis et al. 2014). Although the majority of government agencies and organisations recognise the extensive influence of social media and its evident potential, this important communication tool is not currently effectively utilised or explored in relation to emergency planning. It has previously been suggested that this limited endorsement is related to lack of official support, inadequate knowledge with regards to its usability in relation to natural disasters and the lack of a standard framework for its effective integration with traditional communication channels (Cho et al. 2013; St. Denis et al. 2014; Ehnis and Bunker 2012; Fritze and Kray 2015; Sutton et al. 2015; Zhang et al. 2015). Therefore institutional changes and the development of a suitable communication framework is necessary in order to explore the full potential of social media disaster communication by agencies and organisations (Cho et al. 2013; St. Denis et al. 2014; Ehnis and Bunker 2012; Fritze and Kray 2015).

Two of the most extensively utilised social media networks by government agencies and members of the public are Facebook and Twitter. Official statistics in December 2015 revealed that Facebook remains the predominant social network, with an average of 1.59 billion active monthly users (Facebook Newsroom 2016). Twitter, which is also a widely accessed social network, was identified as having 320 million active monthly users (Twitter 2016). Both social media sites have the potential to act as effective communication platforms for the transmission of natural disaster information (Rizza and Pereira, 2014). Facebook facilitates visible and direct interaction between agencies and members of the public, allowing the public to request localised natural disaster information (Hughes et al. 2014). Twitter has also emerged as a significant reporting tool during natural disasters, particularly as its accessibility is not limited to smart phones (Chavez et al. 2010).

Although social media is frequently effectively used during natural disasters, it must be recognised that it has various limitations, for example issues relating to data quality. When critical information is submitted by civilians, agencies are required to verify its content in order to limit the dissemination of inaccurate information (Alexander 2014; Rizza and Pereira 2014; Takahashi et al. 2015; Xiao et al. 2015). Due to the volume and speed of information generated, particularly on Twitter (Herfort et al. 2014), verification procedures can be lengthy, consequently the transmission of critical information is often delayed (Alexander 2014; Chavez et al. 2010; Ehnis and Bunker 2012; Fritze and Kray 2015; Kavanaugh et al. 2011). In addition, thorough consideration of message style is essential to ensure its effectiveness. Mileti and Sorensen (1990) emphasised the importance of message clarity as it increases the likelihood that individuals will take protective action. Furthermore, it is essential for agencies to contemplate accessibility of social media, which is often limited by demographic factors such as age and socio-economic status (Alexander 2014; Chavez et al. 2010; Feldman et al. 2016; Rizza and Pereira 2014; Xiao et al. 2015). Consequently at present, in order to maximise communication flow in relation to natural disasters, social media must be used in combination with traditional communication measures (Chavez et al. 2010).

**Social media and floods**

Extensive research exists which examines how social media has previously been used with regards to flood events. However, this review of the literature focuses specifically on the role of social media as a communication tool between organisations and members of the public. The review examines studies published from 2010 until present identified via a literature search using Scopus. Scopus was used as it is the largest abstract and citation database of peer-reviewed research literature. The research search was limited to studies published from 2010 to consider how social media is used within this decade rather than examining the development of its use in relation to natural disasters and more specifically flood events. The following keywords and search strategies were used: “Social media” OR Facebook OR Twitter AND “natural disaster” OR flood\* Examination of previous studies highlighted five key research themes within past research.

Firstly, a number of previous studies have explored governmental and community response and collaboration via social media in relation to flooding (Bruns et al. 2012; Cheong and Cheong 2011; St. Denis et al. 2014; Ehnis and Bunker 2012; Fritze and Kray 2015; Palen et al. 2010; Rizza and Pereira 2014). The level of public engagement with governmental social media has demonstrated receptivity to this method of communication (St. Denis et al. 2014) and social media communication has been suggested to potentially enhance community resilience (Rizza and Pereira 2014). However, other studies concluded that social media was not used to its full potential (Ehnis and Bunker 2012) and that governmental social media strategies should be proactively developed to avoid communication disruption during the response stage of flood events (Fritze and Kray 2015).

Secondly, several studies scrutinised the content of the social media posts exchanged between organisations and those affected by flood events, identifying the key themes and topics contained within the messages (Ehnis and Bunker 2012; Fritze and Kray 2015; St. Denis et al. 2014; Sutton et al. 2015). Most of these studies evaluated all flood-related information, however, Sutton et al. (2015) focused on emergency public health information broadcasted during a flood event. The study identified that the principal public health message focused on by organisations related to the safety of drinking water (Sutton et al. 2015). It would be beneficial to establish the most frequently distributed public health messages via social media at different stages of flood events.

Thirdly, various previous studies reflected on how communities affected by flood events used social media (Al-Saggaf and Simmons 2014; Bird et al. 2012, Bunce et al. 2012; Kongthon et al. 2012; Murthy and Longwell 2012; Yates and Partridge 2015). Members of the public utilised social media in numerous ways which included: to gain assurance, improve awareness of the flood event, express sadness, criticise the government, monitor information, communicate the extent of the damage and offer or request assistance (Al-Saggaf and Simmons 2014; Bunce et al. 2012; Kongthon et al. 2012; Murthy and Longwell 2012; Yates and Partridge 2015).

Fourthly, Sutton et al. (2015) evaluated the importance of message style in relation to social media posts disseminated during flood events. An implication of the study for future social media communication was that both imperative*/*instructional and declarative*/*explanatory styles of content are crucial for promoting public health during emergency events.

Finally, the fifth theme identified in previous research involved the consideration of social media usage before, during and after flood events (Kaewkitipong et al. 2016). With regards to the Thai 2011 floods, social media was most effectively utilised post-event, providing relevant information relating to recovery needs of flood victims and available assistance. However, the study highlighted key social media communication gaps relating to the inadequate provision of warnings prior to the flood and the restricted provision of information during the flood due to limited human resources. Precise and expedient communication is important not only to respond to and recover from natural disasters, but also to mitigate and prepare for them (Abedin et al. 2014). It would be beneficial to explore social media usage at the distinct stages of a flood event within the developed world, as this previous study was conducted in a developing country (Kaewkitipong et al. 2016).

**Research aim**

It is evident that Facebook and Twitter are emerging as important communication tools in relation to natural disasters, including flood events. Although the limitations of social media networks cannot be disregarded, they have the potential to play a pivotal role during flood events, such as broadcasting flood warnings and public health advice. Previous studies have evaluated the use of social media during the preparedness, response and recovery stages of flood events, however, limited consideration has been given to its role in relation to flood risk identification and mitigation. Consequently, in order to explore the role of social media throughout the flood management cycle, it would be beneficial to analyse social media over an extended timeframe, rather than only during a single flood event. Furthermore, it would be useful to compare the social media networks utilised by organisations to disseminate flood related information with those most popular among communities, in order to assess whether social media is being used to its full potential.

The overall aim of this research is to collect flood related data disseminated via social media by organisations and agencies in Northern Ireland in order to appraise the extent to which social media is used for flood risk communication. Therefore the study involves analysis of social media communication by particular institutions over a prolonged timeframe to evaluate communication in relation to flood risk identification, mitigation, preparedness, response and recovery. Furthermore the study considers public interaction on the institutional social media accounts, identifying the type of flood information shared, in order to establish preferred categories of advice and guidance. Regarding the key five themes in past research, this research aims to develop these themes through:

* Determining if governmental social media accounts are proactively used for flood risk communication, that is whether particular agencies in Northern Ireland establish their social media presence in relation to flooding prior to a flood event
* Considering the content of social media posts transmitted by organisations to communities affected by flood events, with a particular focus on public health
* Investigating how communities used social media at certain stages of flood events, that is seeking to assess when communities are most likely to seek/value information through examining message retransmission at individual flood stages
* Considering whether instructional or explanatory styles of information are more frequently retransmitted by the public
* Exploring flood information provision via social media at the distinct stages of flood events in a case study within a region of the developed world, specifically Northern Ireland

**Method**

The primary data collected in this study is the publicly visible messages transmitted by the official Facebook and Twitter accounts of emergency services, local authorities and government departments, predominantly those with a flood-related function. These include:

* The Police Service of Northern Ireland (PSNI) which is responsible for overall flood management emergency response, assisting in evacuation procedures
* The Northern Ireland Ambulance Service which provides initial care for individuals injured during flooding incidents
* The Rivers Agency which seeks to diminish flood risk to properties, through maintaining drainage infrastructure and flood defences
* Northern Ireland Water which deals with out-of-sewer flooding, drinking water quality issues and loss of water supply
* Transport NI which protects properties from flooding through clearing blockages in drainage systems
* Local authorities which ensure communities have resources to protect their properties, also providing long-term support
* The Public Health Agency, which has a key function in health protection (British Red Cross, 2012; DARD, 2016; OFMDFM, 2011; PHA, 2016).

Due to the differences in organisational roles it was recognised that organisational vision for social media presence would vary. A utility provider, an industrial company and a health service organisation were also included for comparison purposes. Both regional and local emergency services accounts were analysed in order to clarify the preference of the public in relation to local or regional flood information. Fifty-six organisations were chosen for inclusion in the research, however, as detailed in the results, not all had Facebook and Twitter accounts.

*Data collection procedure*

The first step of the data collection process was the selection of an appropriate timeframe in which social media data was collected. The review of public administration in Northern Ireland led to the establishment of 11 new councils in April 2015. Consequently, all existing local authority social media accounts were created subsequent to this date. Therefore for comparison purposes, all of the social media accounts analysed in the study were analysed commencing in April 2015.

Data collection involved the extraction of Facebook and Twitter posts over a 9-month period: 1st April 2015 to 8th January 2016. Initially, each of the organisational official websites were examined to determine the existence of social media accounts. Subsequently, Facebook and Twitter were searched using the organisational name. If no social media accounts were identified using these methods, it was presumed that either that specific organisation did not have any accounts or alternatively the accounts were not easily located by any public user, therefore the organisation was eliminated from the research. Following the identification of the existence of social media accounts among the organisations, the overall number of “Likes/Followers” for the page was recorded in order to establish the influence of the organisation.

*Data analysis*

Data analysis and coding was undertaken by the first author. Initial data analysis involved examining each individual organisational social media account to identify flood-related posts. All identified relevant posts were extracted then imported into NVivo. For all flood-related posts, a record was made of the organisation which created the post, the date of the post and the number of “shares”.

Subsequently, NVivo was used to conduct a content analysis of the data through the development of a coding system. Firstly, the data contained within the social media posts were coded into the following flood stages: hazard identification, mitigation, preparedness, response and recovery. Within the context of this study, the five stages are defined as follows:

1. Hazard identification – Establishing the likelihood of a flood occurrence and identifying specific at risk locations
2. Mitigation – Flood relief schemes to reduce flooding/property level protection
3. Preparedness – Measures taken in anticipation of and to reduce the consequences of flooding
4. Response – Assistance to ensure community safety, protection and shelter
5. Recovery – Supporting to communities to enhance restoration

Secondly, topic categories were used to further code the data within each flood stage. The three chosen topic categories (broadcast information, broadcast warnings and encourage behaviour) were in agreement with a previous study by Ehnis and Bunker (2012) and defined in *Table I*.

**Table I** Explanation of topic categories

|  |  |  |
| --- | --- | --- |
| **Category 2** | **Description** | **Example post/tweet** |
| **Broadcast Information** | Informing the public about particular situations, as well as assistance and resources available | “£650,000 Flood alleviation scheme for Rostrevor complete” |
| **Broadcast Warnings** | Advance notice regarding specific risks before, during and after flooding | “There is flooding all over the district this morning” |
| **Encourage Behaviour** | Cautionary advice | “Motorists should heed road closure or flood signs and find an alternative route” |

Further previous studies were utilised to assist in creating appropriate sub-categories Bruns et al. 2012; St. Denis et al. 2014). For example within broadcast information, sub-categories included contact information, transport information etc. These sub-categories are detailed in *Table VI*. Numerous posts/tweets contained more than one type of information, consequently each information type was coded individually, thus the results section refers to the total number of flood-related references rather than the total number of posts/tweets. After the completion of the coding it was possible to conduct a frequency analysis, identifying the key topic categories within the dataset.

**Results**

Within the timeframe of the data collection, a total of 242 flood related Facebook posts and 343 flood related tweets were generated by the organisations. Twitter accounted for 58.6% of all the flood related posts.

*Facebook and Twitter account features*

Most of the organisations had both Facebook and Twitter accounts (*Table II*), except for the Rivers Agency and Transport Northern Ireland (Transport NI), who had no social media accounts.

With regards to regional emergency services, the Police Service of Northern Ireland (PSNI) had the greatest number of followers on both Facebook and Twitter, although the organisation had twice as many followers on Twitter compared to its Facebook account. In contrast all the local PSNI departments had a much greater following on Facebook. The majority of local authorities had a higher following on Facebook. A number of organisations, including the Northern Ireland Fire & Rescue Service employed Twitter to distribute most of their flood information, despite having a wider influence on Facebook.

Translink and Northern Ireland Water (NI Water) most frequently broadcasted flood-related information during the data collection period, followed by the southern branch of Northern Ireland Fire & Rescue Service and its regional branch.

Hughes et al. (2014) found that Facebook usage among fire and police departments during Hurricane Sandy was much more prevalent than Twitter use (66% compared to 13%). No clear conclusion could be drawn regarding the emergency services within this study, however, Translink and NI Water appeared to more predominantly use Twitter compared to Facebook (Table II).

**Table II** Organisational Facebook and Twitter account features

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Sector** | **Organisation** | **Facebook** | | **Twitter** | |
| **No. of page likes** | **No. of flood related posts** | **No. of followers** | **No. of flood related tweets** |
| **Regional emergency services** | PSNI | 36977 | 3 | 93500 | 8 |
| PSNI Road Policing | 7021 | 4 | 26700 | 14 |
| Northern Ireland Fire & Rescue Service | 6438 | 9 | 3570 | 18 |
| Northern Ireland Ambulance Service | 5894 | 1 | 4417 | 1 |
| **Local emergency services** | PSNI Bangor | 23138 | 5 | 3813 | 2 |
| PSNI Ards | 22532 | 4 | 3942 | 3 |
| PSNI Newtownabbey and Carrickfergus | 19132 | 3 | 4247 | 2 |
| PSNI West Belfast | 12663 | 2 | 2026 | 2 |
| PSNI Newry and Mourne | 11460 | 12 | 4375 | 10 |
| PSNI North Belfast | 11222 | 3 | 3551 | 2 |
| PSNI Lisburn | 10618 | 8 | 3408 | 10 |
| PSNI Belfast City Centre | 9550 | 3 | 7224 | 2 |
| PSNI Craigavon | 9275 | 9 | 3212 | 6 |
| PSNI Ballymena | 8451 | 5 | 3901 | 3 |
| PSNI Down | 8280 | 3 | 2321 | 3 |
| PSNI North Coast | 7992 | 5 | 2258 | 3 |
| PSNI Fermanagh | 7587 | 4 | 1949 | 4 |
| PSNI Omagh | 6828 | 4 | 1626 | 3 |
| PSNI Banbridge | 6744 | 8 | 1100 | 6 |
| PSNI East Belfast | 6742 | 2 | 2346 | 2 |
| PSNI Holywood | 6326 | 5 | 2339 | 2 |
| PSNI Armagh | 5763 | 12 | 1713 | 9 |
| PSNI Castlereagh | 4709 | 10 | 1781 | 3 |
| PSNI Foyle | 4643 | 3 | 2162 | 4 |
| PSNI Antrim | 4493 | 3 | 2365 | 2 |
| PSNI Dungannon & South Tyrone | 4442 | 6 | 1578 | 6 |
| PSNI South Belfast | 4351 | 3 | 2094 | 2 |
| PSNI Larne | 3870 | 4 | 1543 | 4 |
| PSNI Cookstown | 3796 | 8 | 1178 | 3 |
| PSNI Limavady | 3620 | 4 | 1664 | 2 |
| PSNI Ballymoney | 3355 | 3 | 1258 | 2 |
| PSNI Strabane | 3286 | 4 | 1304 | 3 |
| PSNI Magherafelt | 3068 | 3 | 1356 | 2 |
| PSNI Moyle | 809 | 4 | 722 | 3 |
| Northern Ireland Fire & Rescue Service – West | 1153 | 10 | 345 | 14 |
| Northern Ireland Fire & Rescue Service – South | 586 | 7 | 312 | 25 |
| Northern Ireland Fire & Rescue Service – North | 340 | 0 | 293 | 5 |
| Northern Ireland Fire & Rescue Service – East | 241 | 0 | 248 | 1 |
| **Regional government departments and agencies** | Transport NI | 🗶 | 🗶 | 🗶 | 🗶 |
| Rivers Agency | 🗶 | 🗶 | 🗶 | 🗶 |
| Northern Ireland Environment Agency | 5618 | 0 | 1888 | 0 |
| Health and Safety Executive NI | 1157 | 0 | 1317 | 0 |
| **Local government departments** | Antrim and Newtownabbey Borough Council | 🗶 | 🗶 | 3888 | 6 |
| Ards and North Down Borough Council | 4966 | 4 | 🗶 | 🗶 |
| Armagh City, Banbridge and Craigavon Borough Council | 10199 | 3 | 540 | 3 |
| Belfast City Council | 35000 | 2 | 55200 | 9 |
| Causeway Coast and Glens Borough Council | 2415 | 1 | 307 | 1 |
| Derry City and Strabane District Council | 5195 | 3 | 1547 | 4 |
| Fermanagh and Omagh District Council | 2506 | 12 | 887 | 7 |
| Lisburn and Castlereagh City Council | 3536 | 0 | 629 | 2 |
| Mid and East Antrim Borough Council | 1117 | 3 | 649 | 5 |
| Mid Ulster District Council | 2740 | 1 | 2174 | 1 |
| Newry, Mourne and Down District Council | 3762 | 8 | 1471 | 3 |
| **Health Services** | Public Health Agency NI | 6955 | 1 | 5127 | 2 |
| **Industry** | Translink | 18092 | 0 | 42200 | 75 |
| **Utilities** | NI Water | 1979 | 18 | 4572 | 30 |

🗶 means no social media accounts identified

*Information provision at each flood stage*

In total, 1259 flood-related references were coded within the posts collated from Facebook and Twitter. As illustrated in *Table III*, most flood related information was generated at the response stage (71.09%), followed by the preparedness stage (24.54%). Very limited information was broadcast at the other stages.

The key difference in information distributed via Facebook and Twitter occurred during the preparedness and response stages. Almost twice as many flood-related references were generated on Facebook during the preparedness stage, while almost 20% more references were distributed during the response stage on Twitter in comparison to Facebook.

**Table III** Number of references to flood related information at each flood stage

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Disaster Stage** | **Total number of references within flood related posts/tweets** | | | **Percentage of references per disaster stage** | | |
| **Overall** | **Facebook** | **Twitter** | **Overall** | **Facebook** | **Twitter** |
| **Hazard Identification** | 1 | 1 | 0 | 0.08% | 0.17% | 0% |
| **Mitigation** | 11 | 4 | 7 | 0.87% | 0.69% | 1.03% |
| **Preparedness** | 309 | 197 | 112 | 24.54% | 33.91% | 16.52% |
| **Response** | 895 | 359 | 536 | 71.09% | 61.79% | 79.06% |
| **Recovery** | 43 | 20 | 23 | 3.42% | 3.44% | 3.39% |

*Categorisation of flood related information*

More than half of the flood-related information distributed by organisational Facebook and Twitter accounts (*Table IV)* involved the broadcasting of information, such as agency contact details. The second most popular category was encouraging behaviour (20.81%), while the broadcasting of warnings accounted for the smallest proportion of the data (14.85%).

With regards to differences between the social media networks, Twitter accounted for a higher proportion of broadcasting information, while Facebook posts were more likely to encourage specific behaviour.

**Table IV** Flood related references per topic category

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Topic category** | **Total number of references within flood related posts/tweets** | | | **Percentage of references per topic category** | | |
| **Overall** | **Facebook** | **Twitter** | **Overall** | **Facebook** | **Twitter** |
| **Broadcast Information** | 810 | 333 | 477 | 64.34% | 57.31% | 70.35% |
| **Broadcast Warning** | 187 | 94 | 93 | 14.85% | 16.18% | 13.72% |
| **Encourage Behaviour** | 262 | 154 | 108 | 20.81% | 26.51% | 15.93% |

*Breakdown of topic categories per flood stage*

Categorisation of the flood-related information per flood stage demonstrates that broadcasting of information increased as flood events progressed. Furthermore, *Table V* illustrates that warnings were only distributed during the preparedness and response stages, with the highest proportion transmitted during the response stage. Facebook and Twitter posts which encouraged behaviour were in existence only during the preparedness, response and recovery stages. Further analysis classified the flood-related references into sub-categories as illustrated in *Table VI*. For clarification, flood advice information involved further explanation regarding flooding e.g. on resource provision, whereas encouraging behaviour involved instructing or urging individuals to take specific action.

**Table V** Information type by flood stage

|  |  |  |  |
| --- | --- | --- | --- |
| **Flood Stages** | **Topic category (Frequency and percentage)** | | |
| **Broadcast Information** | **Broadcast Warning** | **Encourage Behaviour** |
| **Hazard Identification** | 1 (100%) | 0 | 0 |
| **Mitigation** | 11 (100%) | 0 | 0 |
| **Preparedness** | 142 (46.4%) | 88 (28.8%) | 76 (24.8%) |
| **Response** | 614 (68.6%) | 98 (10.9%) | 183 (20.4%) |
| **Recovery** | 41 (95.3%) | 0 | 2 (4.7%) |

**Table VI** Sub-categorisation of information by flood stage.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Hazard Identification** | **Mitigation** | **Preparedness** | **Response** | **Recovery** |
|
| **Broadcast Information** | | | | | |
| Contact information (Flooding Incident Line, Emergency phone number, British Red Cross, Specific area contact number, Road closure information, Sandbag suppliers, NIE, NI Water, Firmus Gas) |  | 1 | 48 | 109 | 5 |
| Minimising effects of flooding |  | 1 |  |  |  |
| URL  (Belfast Live, BBC News, NI Weather & Flood Advisory Service, NI Water, Connswater Community Greenway, Local Council website, NI Water, Consumer Council, NI Direct, Public Health Agency, Traffic Watch NI, Met Office, Translink, DARD, NIFRS Twitter or Facebook account, NIE, Gov.uk) |  | 3 | 61 | 150 | 12 |
| Flood alleviation works |  | 6 |  |  |  |
| Flood advice information | 1 |  | 22 | 5 | 2 |
| Agency response information |  |  | 2 | 37 | 4 |
| Transport information |  |  | 2 | 249 | 4 |
| Information on sandbag provision |  |  | 2 | 4 |  |
| Public health advice |  |  | 1 |  |  |
| Disruption to/ closure/re-opening of community amenities |  |  |  | 8 | 4 |
| Flood information (Flood incidents, Flood photographs, Update on current water levels) |  |  |  | 48 |  |
| Weather information |  |  | 5 | 4 |  |
| Emergency Payment Scheme |  |  |  |  | 10 |
| **Broadcast Warnings** | | | | | |
| Flood warnings |  |  | 11 | 85 |  |
| Weather warnings |  |  | 78 | 13 |  |
| **Encourage Behaviour** | | | | | |
| Drive carefully |  |  | 50 | 87 | 1 |
| Take alternative route |  |  | 2 | 26 |  |
| Monitor weather information |  |  | 1 | 8 |  |
| Watch vulnerable neighbours |  |  | 1 |  |  |
| Avoid unnecessary journeys |  |  | 4 | 11 |  |
| Share information |  |  | 1 |  |  |
| Do not drive or walk through floodwater |  |  | 18 | 51 | 1 |

*Public interaction on Facebook and Twitter*

A final element of this study involved establishing the individual flood-related Facebook posts and tweets that received the most “shares” by the public and determining at which flood stage they were shared. Public interaction on Facebook exceeded that of Twitter, with a total of 4149 shares of Facebook posts, in comparison to 1521 retweets.

Social media users were most likely to re-distribute flood-related information generated by the emergency services (*Table VII*; *Table VIII*). Public interaction with flood-related information was most likely to occur at the response stage, as evidenced among the most frequently shared Facebook posts and tweets in *Table VII* and *Table VIII.*

The key topics within the most frequently shared or retweeted posts were: transport information, advice for motorists to drive carefully, flood warnings, weather warnings and advice to avoid driving/walking through floodwater.

**Table VII** Top 15 most frequently shared flood related Facebook posts

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Agency** | **Flood Stage** | **Number of shares** |
| **30/12/15** | PSNI Newry & Mourne | Response | 466 |
| **29/12/15** | PSNI | Preparedness | 463 |
| **30/12/15** | PSNI Newry & Mourne | Response | 376 |
| **30/12/15** | PSNI Craigavon | Response | 220 |
| **29/12/15** | Northern Ireland Fire & Rescue Service | Response | 211 |
| **04/01/16** | PSNI Newry & Mourne | Response | 199 |
| **29/12/15** | PSNI Ards | Preparedness | 182 |
| **28/12/15** | Derry City & Strabane District Council | Preparedness | 152 |
| **04/01/16** | PSNI Newry & Mourne | Response | 83 |
| **04/01/16** | PSNI Ards | Response | 75 |
| **29/12/15** | PSNI Bangor | Preparedness | 72 |
| **30/12/15** | PSNI Craigavon | Response | 68 |
| **05/12/15** | PSNI Bangor | Response | 57 |
| **09/12/15** | Northern Ireland Fire & Rescue Service | Response | 53 |
| **29/12/15** | Newry, Mourne and Down District Council | Response | 51 |

**Table VIII** Top 15 most frequently retweeted flood related Twitter posts

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Agency** | **Disaster Stage** | **Number of retweets** |
| **29/12/15** | PSNI | Response | 55 |
| **29/12/15** | PSNI Road Policing | Response | 39 |
| **29/12/15** | Northern Ireland Fire & Rescue Service | Response | 38 |
| **28/12/15** | PSNI | Response | 33 |
| **30/12/15** | Northern Ireland Fire & Rescue Service | Response | 31 |
| **29/12/15** | PSNI Newry & Mourne | Response | 30 |
| **28/12/15** | PSNI Road Policing | Response | 29 |
| **29/12/15** | Northern Ireland Fire & Rescue Service (South) | Response | 27 |
| **07/12/15** | Northern Ireland Fire & Rescue Service (North) | Response | 26 |
| **30/12/15** | Northern Ireland Fire & Rescue Service | Response | 25 |
| **29/12/15** | Northern Ireland Fire & Rescue Service (South) | Response | 24 |
| **30/12/15** | Northern Ireland Ambulance Service | Response | 21 |
| **29/12/15** | Northern Ireland Fire & Rescue Service (South) | Preparedness | 20 |
| **28/12/15** | Derry City & Strabane District Council | Preparedness | 19 |
| **30/12/15** | PSNI | Response | 17 |

**Discussion**

A prominent finding of the study is that two of the main regional bodies with central roles in relation to flood management in Northern Ireland, Transport NI and the Rivers Agency, do not have either Facebook or Twitter accounts. The Rivers Agency is partially responsible for maintaining flood defence measures, while Transport NI is involved in drainage infrastructure maintenance (British Red Cross 2012; DARD, 2016). Consequently, the current deficiency of social media usage by these organisations illustrates a significant omission within Northern Ireland governmental communication strategies in relation to flooding. Exploiting all potential communication measures is particularly crucial during flood events when agencies are inundated with phone calls and have limited personnel available to respond. This limited endorsement of social media is in agreement with previous studies (Cho et al. 2013; Ehnis and Bunker 2012; Fritze and Kray 2015; St. Denis et al. 2014), with the findings of this research recommending that policy changes are required to successfully incorporate social media communication into future flood strategies.

Some issues were identified with regards to the agencies who employed social media, for example the NI Fire and Rescue Service used Twitter to broadcast the majority of flood- related information, even though the organisation has a considerably greater following on Facebook. This emphasises the importance of proactive consideration of social media communication within flood strategies to ensure its effective employment.

In relation to the agencies who most frequently broadcast flood-related information, it was evident that NI Water was the only regional government organisation with a flood-related function that sought to utilise social media to communicate regarding flooding outside of the preparedness, response and recovery stages. The data collection period encompassed both floods and normal weather conditions, thus NI Water is proactively seeking to use social media to maintain awareness in relation to flooding. A key finding of the study was that an organisation with a non-flood related role, Translink, most frequently posted flood-related information on social media. Although most of the information transmitted by Translink was associated with disruption to its transport services, its leading role within this study emphasises the potential for more productive usage of social media by organisations with prominent roles in flood management in Northern Ireland.

A central aim of this study was to enable the examination of social media communication by organisations at distinct flood event stages. The results indicate that there is currently a critical lack of information provided in relation to flood risk identification, mitigation and recovery. A possible explanation identified by this study is the lack of social media communication by the Rivers Agency and Transport NI, who play significant roles at these flood stages. For example, the Rivers Agency is involved in hazard identification via flood mapping and mitigation via reducing damage to properties from flooding. The crucial gap in information at the recovery stage results in a lack of external support for those affected, which has the potential to hinder both their financial and psychological recovery (Stephenson et al. 2015). Furthermore, the limited advice and guidance relating to flood risk identification and mitigation measures restricts the extent to which individuals can proactively prepare for flooding. However, it must be acknowledged, although outside the scope of this paper, that this information is potentially being communicated by another means, for example via television, albeit in a less time-sensitive manner.

The results highlight different trends in the usage of Facebook and Twitter at different flood stages. Agencies evidently currently use Facebook more frequently at the preparedness stage, while Twitter is used more frequently during the response stage. Sharing of the same message on both an organisation’s Facebook and Twitter account was very limited in this study. In contrast to this finding, Chavez et al. (2010)found that Facebook and Twitter were used to broadcast information on the same emergency management topics, however Twitter had an additional function in that residents could also sign up to receive emergency Twitter alerts via text message. It is important for agencies to recognise the strengths of specific social media platforms and use these to maximise the effectiveness of social media communication during flood events. Ehnis and Bunker (2012) concluded that Queensland Police Service used Facebook as a more detailed information platform with a significant number of Twitter posts containing links to Facebook posts providing further information on the topic concerned.  
It is essential for future governmental flood strategies to take into consideration that individuals may only have one active social media account, thus both Facebook and Twitter accounts should be used to convey important information.

It is evident from the results that the majority of flood-related communication distributed via social media involved the broadcasting of information, rather than providing warnings or encouraging behaviour. This finding highlights both the limited provision of flood warning information in Northern Ireland and the lack of guidance as to how to effectively protect health before, during and after flood events. This was particularly the case in relation to Twitter, thus a review of governmental social media strategies in Northern Ireland may be necessary to ensure that public information needs are fully identified and met.

Analysis of the results further highlighted the inadequacy of the type of information provided at each flood stage. Although it is essential for institutions to provide warnings at the preparedness stage, it is also crucial to effectively maintain the provision of warnings during the response stage, to ensure those at risk have the necessary information to avoid danger. A further concern was the limited information aimed at encouraging behaviour during the recovery stage, when it is extremely important to provide advice regarding safely restoring properties and to encourage those that are experiencing stress and psychological implications to seek support. Mileti and Sorensen (1990) recognised the importance of message clarity as it increases the likelihood that individuals will take protective action.

With regards to public interaction on Facebook and Twitter, the results illustrate that flood-related Facebook posts were shared almost three times as much compared to Twitter posts. Although it was not investigated within this study a possible explanation may relate to the photographs provided within posts. Future work could consider the type of photographs provided within flood-related social media posts and examination of those with are most frequently shared or generate the most public interaction. One of the limitations of this study is that it cannot identify the number of individuals who actually saw Facebook or Twitter posts, only those who liked/shared/commented on posts.Sutton et al. (2015) highlighted the importance of message style, thus perhaps organisations need to review the content of Facebook posts and tweets, focusing on features that have been found to increase retransmission to ensure important flood-related messages reach the target population.

A notable finding in relation to public interaction was that social media users most frequently share flood-related information provided by the emergency services in Northern Ireland. This is primarily related to the high number of followers of emergency services social media accounts as detailed in *Table II*. However, it should be emphasised that Belfast city council has 55200 Facebook followers and 35000 Twitter followers yet only posted 9 and 2 flood-related posts respectively. Thus this finding also suggests there is a gap in information provision by regional government departments and local authorities, highlighting the need for an improved social media presence and potential collaboration with the emergency services in order to improve future communication strategies.

The identification of the most frequent public interaction occurring at the response stage indicates the desire of the public to obtain flood related information during flood events. It is important for future flood communication strategies to use social media to proactively attract public attention to flood risk and flood mitigation measures as this will assist in reduction flood impact on community health and wellbeing.

**Conclusion**

Social media is playing an increasingly important role as a communication measure in relation to flood management. Its escalated use within modern society has led to the expectation that governmental organisations will effectively use it to provide information in relation to flooding. This study has highlighted that current social media uptake among regional governmental departments in Northern Ireland is insufficient. Consequently, a key recommendation of this research is that all government organisations with a flood-related function should establish a social media presence and effectively use this emerging communication tool to provide relevant flood information. This should involve the development of a social media strategy, which should be partially based on analysis of public requests on social media platforms for information and resources in relation to previous flood events and the subsequent use of this data in future flood events to ensure community information and resource needs are fulfilled. The study did demonstrate examples of good practice in relation to social media communication among a number of organisations including Translink, which could be adapted by regional government departments. However, the limitations of social media, such as the digital divide, should be recognised by organisations and social media communication should be effectively integrated with traditional communication measures, such as TV, radio and face-to-face interation. A further recommendation is community consultation, identifying public information requirements in relation to flooding and consequently maximising the relevance of flood information distributed.

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