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**Proceedings Paper:**

Petersen, L., Fallou, L., Reilly, P. [orcid.org/0000-0002-6890-778X](https://orcid.org/0000-0002-6890-778X) et al. (1 more author) (2017) Public expectations of disaster information provided by critical infrastructure operators: lessons learned from Barreiro, Portugal. In: Information Systems for Crisis Response and Management in Mediterranean Countries. ISCRAM-med: International Conference on Information Systems for Crisis Response and Management in Mediterranean Countries, 18-20 Oct 2017, Xanthi, Greece. Lecture Notes in Business Information Processing, 301 . Springer Verlag , pp. 193-203. ISBN 9783319676326

[https://doi.org/10.1007/978-3-319-67633-3\\_16](https://doi.org/10.1007/978-3-319-67633-3_16)

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The final publication is available at Springer via  
[http://dx.doi.org/10.1007/978-3-319-67633-3\\_16](http://dx.doi.org/10.1007/978-3-319-67633-3_16)

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# Public expectations of disaster information provided by critical infrastructure operators: Lessons learned from Barreiro, Portugal

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**Abstract.** Previous research into the role of social media in crisis communication has tended to focus on how sites such as Twitter are used by emergency managers and the public rather than other key stakeholders, such as critical infrastructure (CI) operators. This paper sets out to address this gap by examining Barreiro residents' expectations of disaster communication from CI operators through the use of an online questionnaire and comparing the results to the current practices of the Barreiro Municipal Water Network, which were examined via an in person interview. The findings suggest that the public expect CI operators to communicate via traditional and social media and that the Barreiro Municipal Water Network should expand their current practices to include digital media.

**Keywords:** Social media; traditional media; crisis communication; critical infrastructure operators; public expectations.

## 1 Introduction

Effective crisis communication can be defined as “the provision of effective and efficient messages to relevant audiences during the course of a crisis process” [1]. Social media has been identified as an increasingly important source of information during crisis situations [2]. Previous research in this area has tended to focus on how emergency response personnel or the public use social media during such incidents [3 - 7], overlooking other key stakeholders such as critical infrastructure (CI) operators. As such, there remains relatively little empirical research exploring public expectations of information provided by CI operators during crisis situations. The EU Horizon 2020 project IMPROVER (Improved risk evaluation and implementation of resilience concepts to critical infrastructure), makes use of Living Labs, or clustered regions of different types of infrastructure which provide specific services to a city or region. One such Living Lab is the Barreiro Municipal Water Network. This paper then addresses these under-researched issues by presenting a brief literature review on public expectations of disaster related information shared via social media. It then

describes the Barreiro case study. After, the methodology of the online questionnaire and interview-based study of the Barreiro Living Lab are described. This is followed by a presentation of the questionnaire and interview results, accompanied by a comprehensive discussion on the subject.

## **2 General expectations of social media use in crisis**

The public expect to be able to search for and find real-time information relating to disasters from both traditional and social media sources and research suggests that people use a combination of these sources to find information during disasters [6 - 9]. When it comes to social media platforms such as Facebook and Twitter, studies show that the public also expect responses from emergency services to their questions and comments [3, 6]. As previously stated, less is known about public expectations of social media use by CI operators. Self-evidently, citizens appear to expect updates from CI operators in regards to service restoration and some operators are already using social media to meet this need [2].

## **3 Background on Barreiro case study**

According to the 2011 Census, Barreiro's municipality has a population of 78,764 people with an area of 36.41 km<sup>2</sup> [10]. The municipality is integrated in the district of Setúbal, which belongs to the Lisbon Metropolitan Area, and is located on the south bank of the Tagus River estuary. It is located about 40 km from Lisbon and is connected to Lisbon by two bridges as well as ferries [11]. The Barreiro Municipal Water Network delivers potable water to the municipality of Barreiro and serves 42,400 customers. It has an annual water flow of 6,200,000 meters cubed [12]. The drinking water comes exclusively from underground aquifers [12]. Several hazards may influence the water network in Barreiro including earthquakes, droughts and heatwaves. A historical example can be found in 1969, when Barreiro's water network endured moderate damage due to a 6.8 Magnitude earthquake event which led to the unavailability of potable water for 24 hours [11]. More recently, in 2012, rice and cereal agriculture in Setúbal were affected by a water shortage [11].

## **4 Methodology**

### **4.1 Research Questions**

Specifically, two Research Questions emerged from the literature reviewed above:

1. What do Barreiro residents expect of CI operators in regards to information provision during crisis situations?
2. How do these declared expectations compare to the current communication efforts of the Barreiro Municipal Water Network?

An online questionnaire and interview-based study was designed to investigate these questions. Ethics approval was sought and obtained from the respective authorities prior to data being collected.

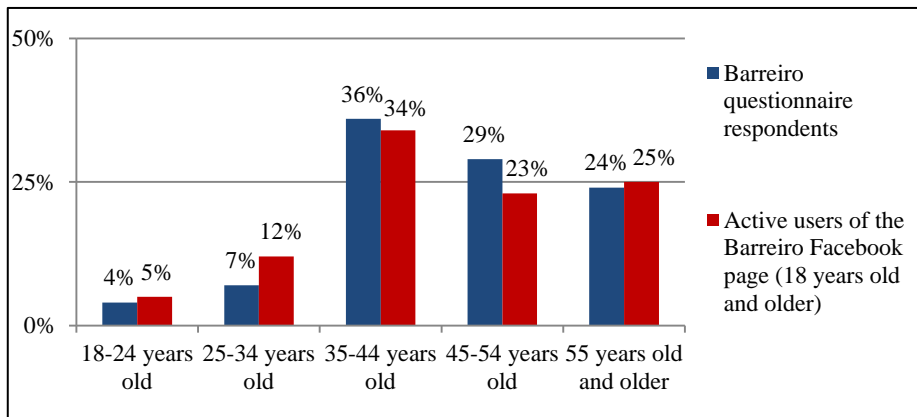
## **4.2 Questionnaire**

The target population for the questionnaire was residents of Barreiro, Portugal aged 18 years and over. In order to maximise the response rate, the questionnaire was translated into Portuguese and also made available in English. Convenience sampling was used for the questionnaire. It was structured as follows: First, a brief description of the project was provided and participants were informed of their right to withdraw from the project at any time, as well as how all data would be handled during the project. For the purposes of this questionnaire, respondents were presented with the following definition of a disaster: “an event which has catastrophic consequences and significantly affects the quality, quantity, or availability of the service provided by the infrastructure.” Second, a Likert scale was used to measure participants’ expectations (going from strongly agree, agree, unsure/neutral, disagree to strongly disagree). Participants were asked two questions regarding information provision. The first asked, “During and immediately after a disaster, I expect critical infrastructure operators to provide me with information...” and presented four scenarios: via calling their telephone number, on their website, on their social media site and through traditional media e.g. interviews with television networks or the radio, press releases. The second asked, “During and immediately after a disaster, I expect critical infrastructure operators to respond to my questions and comments on their social media sites e.g. Twitter.” The questionnaire also asked about the participants’ demographics and social media habits. Data from the questionnaire was collected between 28 March 2016 and 30 April 2016. The questionnaires were translated back into English at the data entry stage. The questionnaire was hosted on Google Forms and disseminated through the IMPROVER consortium partners’ contacts and through Living Lab contacts, especially via the Barreiro Municipality Facebook page.

### **Sample characteristics**

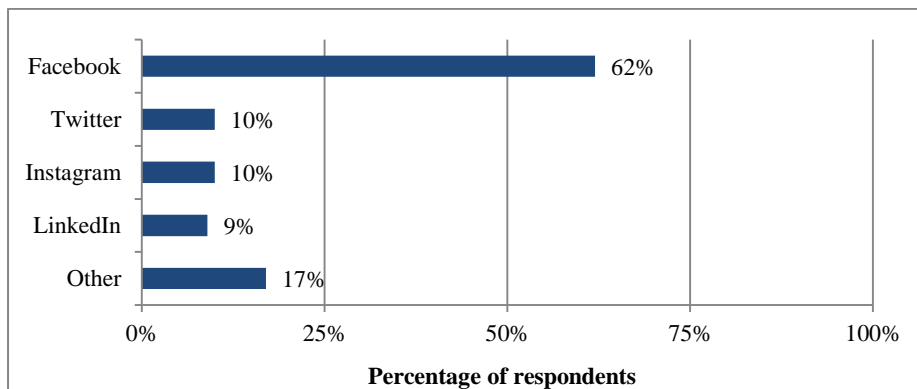
A total of 133 participants from Barreiro, Portugal completed the online questionnaire. Due to the dissemination method, this self-selected sample was not broadly representative of the Barreiro municipality. Sample characteristics showed that 57% of the respondents were men and 40% were women. The 2011 Census revealed a predominance of the number of women compared to men (53% against 47%) among the resident population in the Barreiro municipality [10]. Most respondents were highly educated with 69% of them having a university degree or higher, whereas only 15% of the Barreiro population has a university level education [10]. 93% of respondents are of Portuguese nationality. Both young and old people appeared to be underrepresented in the study. Respondents aged 18-24 accounted for only 4% of the total sample (for comparison, Barreiro 15-24 year olds make up 10%), with 12% identifying themselves as aged 55 years and older (for Barreiro, 22% of the population is 65 years or older) [10]. However, the questionnaire sample is more

representative of the Barreiro Facebook<sup>1</sup> page active users<sup>2</sup> when it comes to age (Figure 1). This shows the impact of the dissemination method on our sample, keeping in mind that some respondents found out about the questionnaire via other methods than Facebook (direct ask via email, for example).



**Fig. 1.** Age of Barreiro questionnaire respondents compared to the age of the active users of the Barreiro Municipality's Facebook page.

Lastly, 86% of respondents have an account with a social media site such as Facebook or Twitter. For comparison, in Portugal, 70% of households have Internet access, and 69% of individuals have used Internet in the last three months [13]. When asked an open-ended question to list up to three social media sites the respondent used most, 62% listed Facebook, with 10% or less choosing other popular platforms (Figure 2).



**Fig. 2.** Respondent's most frequently used social media sites (list up to three).

<sup>1</sup> The data about Barreiro Facebook was provided by Elisabete Carreira, Advisor to the Board of Directors at INOV, Portugal on 13/05/2016.

<sup>2</sup> Facebook defines an active user as a Facebook user who liked, commented or shared the page publication or interacted with the page in the last 28 days.

### 4.3 Interview

The findings were then compared to the current practices of the Barreiro Municipal Water Network. An in-person interview took place with actors from the Living Lab. These included an actor from the wastewater and water supply management, an environmental engineer for water quality, and the manager of the new technologies and Water Security Plan. Data from the interview was collected on 18-19 February 2016.

## 5 Questionnaire results

### 5.1 Expectations for information to be provided on social media

When asked if respondents expect CI operators to provide disaster related information on social media, 69% strongly agreed or agreed (Figure 3). Less than a fifth of respondents (19%) were unsure or neutral in regards to the use of social media by CI operators to push disaster related information to the public, with another 12% having disagreed or strongly disagreed. Social media users had higher expectations than non-users when it comes to CI operators using this medium for crisis communication, with 74% having agreed or strongly agreed. Social media non-users were mostly (50%) unsure or neutral about this.

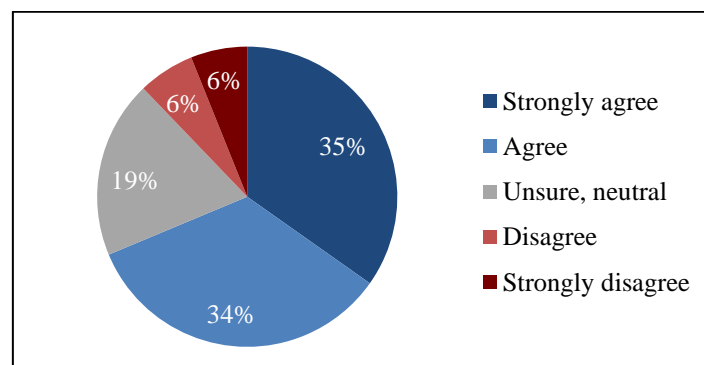
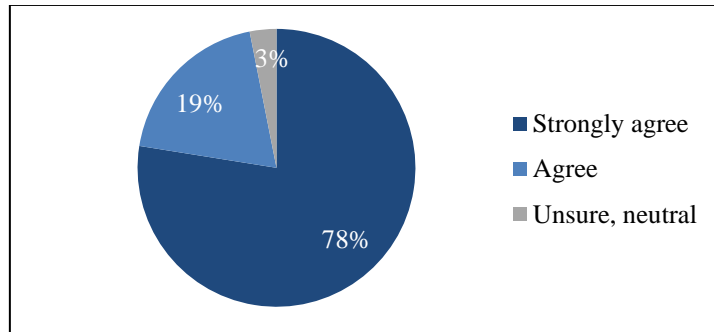


Fig. 3. Expectations that crisis information should be provided via social media

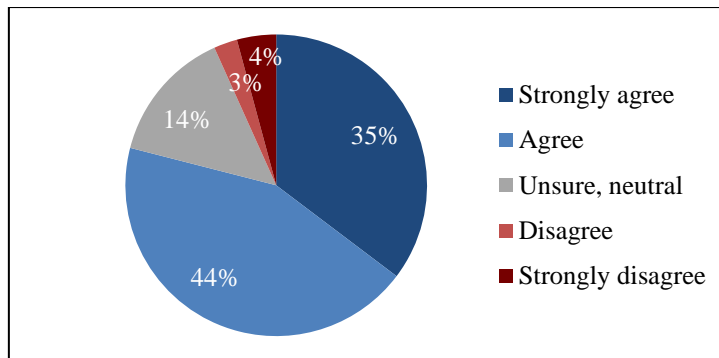
### 5.2 Expectations for information to be provided via other channels

CI operators were expected to use traditional broadcast media such as newspapers, radio or television to communicate with members of the public during such incidents, with 97% of respondents having strongly agreed or agreed with this statement (Figure 4). No respondents disagreed or strongly disagreed with this statement, and only 3% declared that they were unsure or neutral. The majority of respondents also had high expectations in relation to the availability of crisis information on the website of operators, with 79% having agreed or strongly agreed (Figure 5). Only 14% of respondents were unsure or neutral. Respondents also expected operators to provide

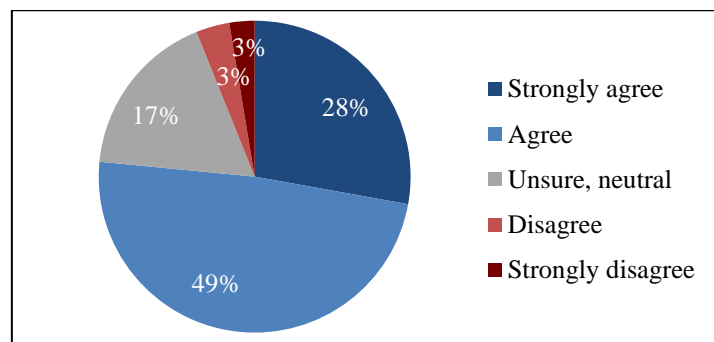
information via them calling a telephone number, with 77% having agreed or strongly agreed. 17% of respondents were unsure or neutral in regards to CI operators having a telephone hotline to make disaster related information available to the public.



**Fig. 4.** Expectations that crisis information should be provided via traditional media



**Fig. 5.** Expectations that crisis information should be provided via websites



**Fig. 6.** Expectations that crisis information should be provided via calling a telephone number

### 5.3 Expectations for two way communication on social media

When asked if they expect CI operators to respond to questions and comments sent by members of the public to their social media accounts, 63% of respondents agreed or strongly agreed (Figure 7). There was high uncertainty/neutrality (18%) in regards to responding to queries, and a large portion of respondents selected disagree and strongly disagree (14% and 5%, respectively). Social media users have a higher expectation than non-users in regards to responding on social media, 68% agreed or strongly agreed. For social media non-users, the majority (39%) were unsure or neutral, and these respondents appeared to be more divided on the issue with 34% having agreed or strongly agreed compared to 28% having disagreed or strongly disagreed. Lastly, 58% of respondents who expected CI operators to communicate via social media also expected them to respond to questions or comments.

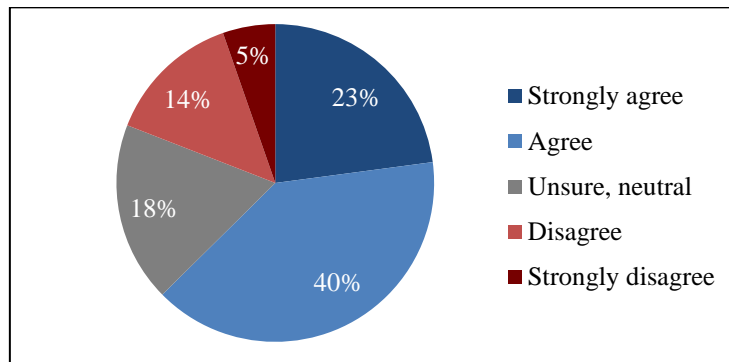


Fig. 7. Respondents' expectations for two way communication on social media during and after a disaster

## 6 Interview results

The Barreiro Municipal Water Network considers communication with their stakeholders as not very efficient, stating that they do not communicate with the general public enough. Currently the operators do not have their own communication strategy in place to communicate with the public during disasters. With the implementation of Water Safety Plan they are creating procedures to reverse this situation and develop a real communication strategy, but it is still at an early stage. A general communications plan does exist within the municipal emergency plan, which includes using traditional media. The Barreiro Municipal Water Network also participates in semi-annual meetings within the framework of the municipal observatory for water issues. The Water Safety Plan will mandate that they have stakeholder meetings with for example regulators, municipal services, civil protection, local charities, the industrial park companies, local hospitals and the general public. These face-to-face stakeholder meetings are seen by the operators to be the most effective means of communicating with the public. However, the most used means of communication is the telephone. Indeed, they provide a call center for



damages. The operators also believe that most people in the city would use the telephone to contact the emergency response authorities if there was a disaster. The operators do not have their own website or social media accounts.

However, it appears that most of the communication with the public comes from the municipality in general, and not from the infrastructure operators themselves. Indeed, the operators participate in neighbor meetings that are organized for the entire municipality where water is not the only issue being discussed. The municipality also has a media department that handles communication with the public and they work closely with the operators. The municipality provides a website, an FAQ page, and social media sites. Despite this, the operators said that they feel that “communication tends to fail during incidents.”

The operators only inform the population of the interruptions that are scheduled and that are more time consuming and involve a higher level of complexity in terms of implementation. These interventions are usually done at night to cause minimal impact. However, and although not always, but in many cases, when it comes to service disruptions, it has been the citizens who report by calling their telephone line. “People are searching for information,” said one interviewee, “and we recognize the need to become more proactive.” As such, they are working on a smartphone application to provide the public with information and also to gather information from the public. As the municipality of Barreiro has a high percentage of elderly residents that do not have access to the internet, they are also focusing on developing automatic communication via SMS to reach those residents. They would like for in the future to have a clear strategy in terms of communication, internal and external, that guaranteed the population that their basic needs will be met, in order to strengthen public confidence in the authorities with emergency situations and to guarantee a collaborative platform among all stakeholders, including the general public. The operators also mentioned that Portuguese people are known for their resilience and adaptability, which means that current communication expectations are probably not as high as they could be.

## **7 Discussion**

Results indicate that members of the public expect CI operators to provide disaster related information via both traditional and social media. Overall, expectations were high for all four channels studied. There was no disagreement among respondents when it came to expecting disaster related information relevant to CI to be provided by CI operators through traditional means such as radio or television. This further reinforces the idea that even to the public, social media is meant to compliment more traditional crisis communication methods and not replace them. Social media should then be used as another channel for information dissemination, as 69% of respondents expected it to be used by CI operators. High expectations for information to be available on the Internet via social media and websites demonstrate high expectations for operators to be proactive in pushing information to citizens. The majority of respondents expected operators to respond to queries, confirming the importance of two-way communication. However, the high amount of disagreement with this statement furthers the idea that pushing information to citizens should be more of a

priority for operators than responding to queries. People tend to use the media platforms that they are already familiar with during crisis [14, 15], and as such it seems natural that respondents who use social media have higher expectations for social media use by CI operators than social media non-users. However it is interesting to note that despite a telephone number being the only current, and thus familiar, way of contacting Barreiro Municipal Water Network, expectations for information to be available on a website were higher than for there to be a telephone hotline. This further substantiates the importance of understanding the technological culture of the local population when putting into place crisis communication plans [16].

The current efforts of the operators at Barreiro Municipal Water Network to communicate with the public appear to meet certain public expectations. They currently use traditional media and have a telephone hotline available for the public to use, both of which were highly expected from respondents. However, as they do not have social media accounts or a website, they are not yet meeting this expectation. As the IMPROVER questionnaire did not establish what the participants understood as crisis-related information, this expectation may be an uninformed one. The fact that expectations for information to be available on a website were higher than those for a telephone hotline clearly indicates that this is an area where the operators can improve the effectiveness of their crisis communication. As they already work alongside the municipality more generally when it comes to public communication, it may be interesting to see if the municipality's social media sites and websites would be considered by the public as an appropriate source to find CI related disaster information. More research should examine if the CI operators need to use social media, or if they just need to make their information available via social media via other official sources. Further research should look into this. While the operators find that face-to-face stakeholder meetings are the most effective means of communicating with the public, this option was not presented to respondents as it is impractical to have a stakeholder meeting in the immediate aftermath of a damaging disaster. Despite the fact that they do not currently use Internet to communicate with the public, their acknowledgement of the need to be more proactive in informing the public in times of crisis demonstrates an awareness of these issues. Their ideas to develop smart phone applications or SMS alerts are innovative, but as these two channels were not presented as options to respondents, further work should study public expectations for these two channels. In conclusion, it is suggested then that the operators expand their crisis communication strategy to include social media and websites.

## **7.1 Limitations**

The method we followed is not free from limitations. As discussed earlier, a self-selecting sample group was involved in the questionnaire study, which did not adequately represent the demographics of Barreiro. It should also be noted that the use of the website to distribute the questionnaire was likely to have skewed the sample in favor of those who used the Internet and social media on a regular basis.

## 8 Conclusions

Our findings suggest that CI operators should continue to use traditional media during crisis situations, and that this should be supplemented through the provision of disaster related information via websites, telephone hotlines and social media platforms maintained by CI operators. The Barreiro Municipal Water Network should expand their crisis communication efforts to include Internet communication via social media and websites in order to meet public expectations. However, it should be acknowledged that this was a self-selecting sample that was not representative of the demographics in the population studied, and as it was an online questionnaire it most likely attracted people who generally use the Internet and social media. Further work is needed to explore the perspectives of citizens who are unable or unwilling to use digital media. A future questionnaire is being developed within the IMPROVER project that will be disseminated by telephone in Barreiro in order to try to reach such citizens and it will also address expectations of smart phone applications and SMS as communication channels for CI operators. This work should also examine the differences between expectations of CI operators as information providers and the expectation of CI related information to be available. Other future work will consider the implications of these findings for the development of the Barreiro Municipal Water Network communication strategy and Water Safety Plan. Lastly, the IMPROVER project is also currently working on the development of a communication strategy for CI operators to deploy during each stage of a crisis that will encompass both digital and traditional media platforms.

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