Social Software as an Infrastructure for Crisis Management - a Case Study About Current Practice and Potential Usage

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ABSTRACT

In this paper we will be discussing how the (semi-)professional actors involved in crisis management (police, fire-fighters, etc.) and the affected citizens can communicate and collaborate by the use of social software. After the definition of the term 'social software' we will provide the state-of-the-art on current social software use in crisis management. Drawing from this, we will present two case studies where we examined the social software use in 2010: First during the disruption of air travel due to the eruptions of Eyjafjallajökull volcano in Iceland, second during the crisis at a stampede at the Love Parade music festival in Germany. We identified weak points and further potentials and tested the validity of the American case study findings from literature for Europe. We will conclude with a concept for using citizens in inter-organizational crisis management with a social software infrastructure and a communication matrix for crisis management.

Keywords

Crisis communication, social software, infrastructuring, citizen participation, love parade, Eyjafjallajökull

INTRODUCTION

In the last decade the number of crises grew and not only because of changes in climate. There are not just tsunamis, floodwaters, earthquakes or wildfires: Technical accidents like oil leakages, energy breakdowns or crises caused by humans like rampages and terror attacks affect both, organizations and citizen. The pictures of those accidents are always in the media: Cities in exceptional circumstances, a large number of injured people and often no functioning infrastructure. For people responsible for crisis management it is often hard to obtain essential information to make reasonable decisions and to help the people affected by the crisis. This is often caused by a lack of real infrastructures for the collaboration between people and organizations. As for the high effectiveness in a crisis, people are an authentic source of crisis-information and should be included in the information infrastructure. Palen and Liu (2007) point out that organizations of formal response may be shaped to "support the new information pathways that will arise". People often use a mobile phone and the Internet to inform their families and friends. Through the use of social software applications like social networks, blogs, micro-blogs, photo and video communities a lot of information could be published by everyone.

SOCIAL SOFTWARE

Social Software is a part of Web 2.0. The term 'Web 2.0' is not well defined but describes the innovations of the Internet after the crash of the new economy in 2000 (Alby, 2007). At a conference held by O'Reilly, the competences of the surviving companies of the new economy were summarized under the term web 2.0. Tim O'Reilly (2005) defined them in seven characteristics which include the usage of the Internet as a platform to provide different services, the participation of users and a collective intelligence, the consideration of the user generated data as capital of an application, the inclusion of the user in the development using new software

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development models, the usage of services on different terminals and rich user experience. The term 'Social Software' describes web based applications which support the user's interaction and communication process. In addition to this definition there are different other considerations. Hippner (2006) defined social software as the possibility to exchange information, manage relationships and communicate in a social context. Besides information exchange, Ebersbach et al. (2008) defined that user-generated content is an essential element of social software. Therefore, the community is an important pre-condition. Schmidt (2006) pointed out the possibility of self-expression as an important component of the social web.

In sum, the following characteristics arise from the different definitions and will be used as follows in this paper: Social software comprises a range of applications from the Internet which enable different people to contact and interact with each other. A community, providing the data, is the basis for these applications. Those applications support different activities: Allocation of information, generation of information, relationship management, communication and self-expression. Often different activities are combined. Based on the definition of activities various classes of social software applications are possible (Ebersbach et al., 2008):

- *Wikis*: Collaborative accumulation and creation of information and knowledge.
- *Blogs / Micro-blogs*: Publication of information and / or self-expression with an own journal.
- *Social networks*: Originally used for relationship management, self-expression and communication, those applications are more and more expanded by functionalities to blog and information allocation.
- *Social sharing / collaborative key wording systems*: Information exchange / generation, provision of content and key wording.

POTENTIAL SOCIAL SOFTWARE IN CRISIS COMMUNICATION

When a crisis impends, fast activities are necessary. Therefore, information about the event is needed. For social software this means that the user has to provide his/her information in real time on the Internet. Not every type of social software is adequate for this: *Wikis* are useful to collect knowledge about a topic based on one's own research. In a crisis this activity may be done by people who are not very affected by the crisis. *Blogs* are not useful for receiving a fast response as they often contain longer personal entries. *Micro-blogging* is an alternative. Those applications use SMS like texts of about 140 characters. The most prominent application is *Twitter*. Users can publish messages (tweets) on their site and tag words (#hashtag) within a message. With the help of tags certain messages can be found. It is possible to address other users with the '@user' notion. It is also possible to publish tweets by sending SMS using a mobile phone. Due to the tweet's SMS-like structure, tagging and easily finding tweets about specific topics, its huge dissemination with over a 100 billion users worldwide and its possibility of mobile use, Twitter is a significant social software for crises.

An example for a social networking service that offers good opportunities for crisis communication is *Facebook*. In addition to networking with people, links to websites, organizations, companies or celebrities are possible. Each profile includes a wall where people can leave a message or where the bearer of the profile can post his/her own status messages. The entries can include texts, links, photos, videos and comments from other users. On the wall a dialogue between individuals and businesses is possible. *Facebook* provides a client for various mobile devices to upload profile information from almost everywhere. People with older devices can receive updates by text message and in turn write their own messages via SMS. At last, the wide acceptance of *Facebook*, with about 600 million active users worldwide (January 2011), makes it the largest online community – a reason why we would recommend its use in crisis management.

The final categories of social software are *social sharing and collaborative key wording systems*. The purpose is the generation and categorization of digital content by the user. Most interesting for crisis communication are photo and video communities. The most popular are *Flickr* for photos and *YouTube* to share video clips. Both services allow indexing of the material using self-selected tags. These are used to describe the content and enable a targeted search. *Flickr* offers several ways to interact with the website by mobile phone: A website optimized for mobile devices makes it easier to use. The upload is also possible via special e-mail address. *YouTube* offers a mobile version of the page which supports the recording and uploading of clips by using a mobile phone. *Flickr* also offers the possibility to geotag pictures and place them on a map or display additional image information using EXIF data.

As for the potentials of different social software types, in this paper we will focus on micro-blogs, social networks, social sharing and the provision of content with an eye on further research on social software infrastructures for crisis management (Figure 1).

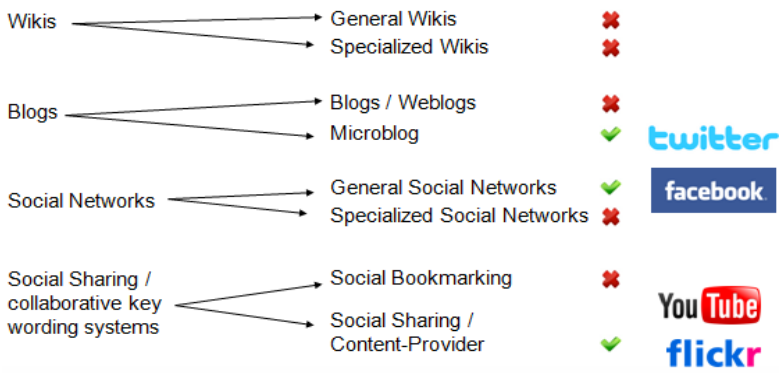

Figure 1. Potential Social Software in Crisis Management

STATE-OF-THE-ART: SOCIAL SOFTWARE USE IN CRISIS MANAGEMENT

The potential uses of social software in crises are manifold (Turoff et al., 2009). Already after the terrorist attacks of 11 September wikis, created by citizens, were used to collect information about missing persons (Palen and Liu, 2007). A study about the Southern California Wildfires showed that people communicated via mobile phones and used the Internet to search for information and to trigger off any kind of communication, to read blogs, news sites and forums. Furthermore the affected took up photo-sharing services like *Flickr* in order to obtain information (Sutton et al., 2008).

The use of *Twitter* was analyzed scientifically in the context of various crises such as in the case of technological failures (Sutton 2010), the flood of the Red River (Starbird et al., 2010), an attack on four police officers in Lakewood, Washington (Heverin and Zach, 2010) and hurricanes (Hughes and Palen, 2009). The focus of those investigations was on a general examination of all messages that had been twittered during the particular crisis. Objects of analysis included the geographical distribution of Twitter users around the trouble spot, their group membership (individual person, organization, journalist, activist, etc.), the daily Twitter activity, the number of tweets per user and the number of responding tweets, retweets and broadcasts. The observers tried to clarify what distinguishes the Twitter experience in a crisis from everyday Twitter use (Hughes and Palen, 2009). As for Twitter messages it had been found that twitterers assume the role of the classical media, if the news coverage of the media and organizations is not satisfactory (Sutton, 2010). Twitter is a medium to raise awareness of a crisis, as it is able to reach large numbers at once. Therefore, the service is often used as a broadcast medium (Hughes and Palen, 2009). False information is prevented by the collective intelligence of users, which ensures that faulty tweets are being corrected. In this context, retweets serve as an evaluation mechanism for important information (Starbird et al., 2010).

A study of decentralization and geographical distribution of twitter users has shown that people who are not or not as much affected, use Twitter more often than affected citizens and organizations, however, the generated information from those not involved are of great help to those affected (Sutton, 2010). In the investigation of individual Twitter users it was found that there are so-called information brokers (Hughes and Palen, 2009), who collect valid information from various sources and pass it on to help victims of the crisis (Sutton et al., 2008, Vieweg et al., 2008). In these exceptional situations the broadcast and brokerage of information plays an important role. These phenomena occur less often in everyday Twitter activities (Hughes and Palen, 2009). During a rampage, a decentralized problem-solving behaviour of students was observed; in short time after the attack they attempted to jointly identify the victims and used the group functionality of *Facebook* for that purpose (Vieweg et al., 2008). An important conclusion that can be drawn from this study is the falsification of the prejudice that rumours are disseminated via social software. The authors show that the collective intelligence of the citizens could help to correctly identify the victims because users were concerned about reliable sources in this particular situation.

In addition to those studies on user behaviour and the use of social software in crisis situations, there are other articles proposing solutions for including citizen-generated information in crisis management. The program Twitter Earthquake Detector (TED) is based on tweets, and scans for (previously defined) crisis-relevant hashtags (Guy et al., 2010). Relevant tweets are filtered and archived. The application is used during earthquakes to close the gap between the eruption and the publication of scientific data about 20 minutes after the earthquake. By focusing specifically on Twitter, the range of opportunities for citizens to help by using social software is not covered entirely. Also, the use of visual information, for example during floods, is excluded by TED. Starbird and Stamberger (2010) proposed the use of a particular hashtag-syntax for tweets during crises. A standardized hashtag-syntax would be machine-readable und could help to collect more relevant information. In their study, Latonero and Shklovski (2010) considered the Twitter-monitoring of a Fire Department to obtain citizen-generated information. Another proposal for the treatment of user-generated data is being provided by Bellucci

(2010): Their project eStoryS is a social software mash up to identify crisis-related photos from the *Flickr* API, and arrange them on a map. A similar function provides the TED system which can display tweets on a map.

To summarize, the following lessons can be drawn from the point of view of the present literature: The Twitter experience provides the most results. During crisis Twitter can take over the *role of the mass media* if these do not fully cover the needs of the recipients. Twitter is then used as a broadcast to pass on information to the public. Information is not only meant for the victims, but addressed to any reader and thus can draw attention to the crisis. Another finding in relation to Twitter is the role of retweets. Retweets on Twitter can be considered as relevant information, and thus as an evaluation mechanism. The researchers found that the importance of a tweet depends on the number of retweets (Starbird et al., 2010). In relation to the usage of any social software, the researchers found that, besides the broadcast of information, brokerage is more common in crisis situations: Users are identified as *information brokers*, when they gather relevant information, prepare them and make them available to other users (Hughes and Palen, 2009). One last very important discovery that can be drawn from the texts is the fact that a *collective intelligence* protects from the spread of erroneous information (Vieweg et al., 2008). Missing information is detected, and corrected because a large group of people receives the information. This is an important finding that gives testimony to the validity of user-generated information.

The target of our research is to develop a communication and information platform that aims to continuously improve the cooperation for coping and recovery work between power supplier, fire-fighters, policemen, county administrations and citizens and that also takes into account medium to large power outages. In this paper we will not focus on power outages. Rather we will focus on designing effective inter-organizational communication, information and coordination processes and on developing new technologies. With our approach we aim to establish an infrastructure to continuously improve the exchange of information and the collaboration of the stakeholders that react to a power blackout. This includes maintenance workers, policemen, fire-fighters, the administrative bodies of cities, counties, states and the federal level and – most importantly – the people affected by the power outage (Balduin et al., 2010, Wiedenhoefer et al., 2011). Social Software applications can be helpful here, but we need to interpret the dynamics of their everyday use as much as we have to analyze the specific needs of the organizations involved in such a crisis scenario as actors with a 'serious' intent and a set of values, routines and responsibilities to which we should attend. White et al. (2009) point out that current social networking sites were developed for socializing, not as tools to ease the collaboration on issues and problems: How can the Social Software with its informal communication patterns and leisure-oriented use tradition become a part of a 'serious' work infrastructure (Pipek and Wulf 2009) that professional actors would rely on? Star and Bowker (2002) described the characteristics of an infrastructure not based on its material basis alone (which is the usual understanding in computer science that an infrastructure is a set of connected devices – maybe organized in layers - that provides a certain service) but also on what it means to the users/consumers of the infrastructure. Its taken-for-grantedness, its invisibility, the familiarization by participating in its practice and its immediate importance when it breaks down, gives us a perspective on what is needed to make a technology an infrastructure.

EMPIRICAL CASE STUDIES: USE OF SOCIAL SOFTWARE FOR CRISIS COMMUNICATION IN GERMANY

Many published research papers focus on crises in the USA. Hence, we want to observe the social software use in Germany. Our focus is to observe the role of the organizations using social software to keep in touch with affected people.

Case 1: Social Software use during the flight cancellation in the course of the volcanic eruption in Iceland in April 2010

The 2010 eruptions of Eyjafjallajökull in Iceland caused an enormous disruption of air travel across western and northern Europe over an initial period of six days in April 2010. Haarhaus (2010) wrote that some airlines used the opportunity and offered services to their customers through social software such as Twitter and Facebook while other companies went completely over the volcano eruption. Because of this article, we observed the activities of the airlines Lufthansa, EasyJet and AirBerlin on their Twitter and Facebook pages. The three airlines were mentioned in the article on the efficient use of social software. In our study the period between 15 April 2010 (eruption was first mentioned) and 22 April 2010 (resumption of air travel) was selected. We analyzed the Facebook walls and the Twitter pages of the respective airlines. Our explorative study aimed to understand the field and the motives of the airlines and citizen.

The observation of the Twitter pages showed that all three airlines provided news about the flight ban and volcanic ash. Most of the tweets provided a link to the news section of their own homepage. Thus, the subscribers had been constantly informed by the companies. Twitter was used well as a broadcast medium during the crisis situation by the airlines (Figure 2). The communication with the customer was observed on all three channels. Tweets with questions that were addressed to the companies were answered individually. In the channel of EasyJet, questions were immediately either resolved or the customers were linked to easyjetCare, a

special service-channel of EasyJet on Twitter. Although all three companies used Twitter as a broadcast medium and as a contact medium for customers the activities varied. While AirBerlin published 18 tweets in the period 15 to 22 April and answered only three personal questions, Lufthansa tweeted 69 times in the same period and answered about 17 personal customer requests. EasyJet showed the greatest activity on Twitter. In addition to the broadcasts of news, lots of personal tweets were answered, especially since this airline was operating on two Twitter-channels to provide customers with quality service.

On Facebook, AirBerlin posted news on their own wall but comments posted by users were not widely respected. This shows that AirBerlin did not consider Facebook as a medium for communication with the customer. This had been recognized by the Facebook users. Again and again, users answered to other questions that AirBerlin was not going to answer on Facebook. Facebook was also used as a broadcast medium by EasyJet and Lufthansa. The companies were also communicating with their customers. Almost all of the questions that were posted on the wall were answered by the supervisors of the profiles, although most were only referred to the service centre.

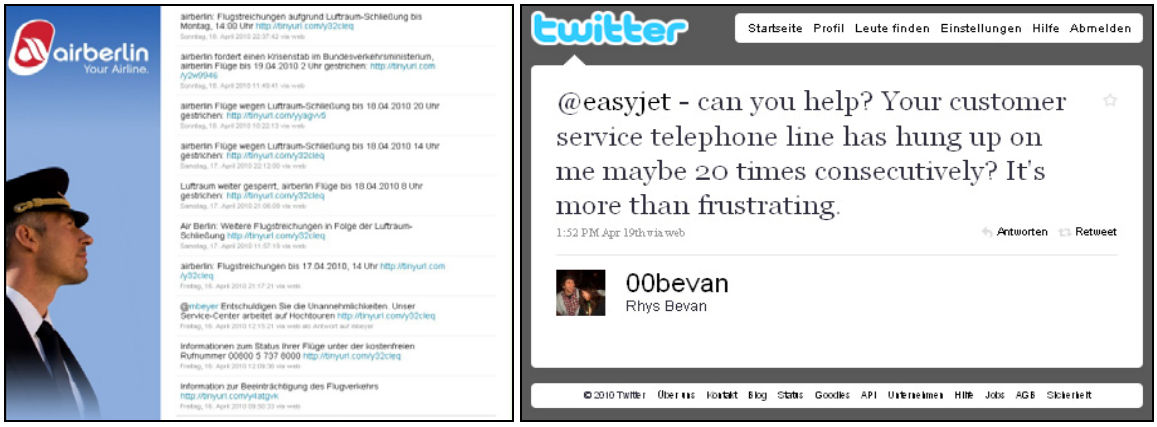

Figure 2: Examples of Social Software use due to the volcanic eruption in Iceland

As a summary, the consideration of the Twitter and Facebook communication within this crisis shows that social software is used by companies as a broadcast medium. Some companies see the potential of those applications to support the communication with customers. Viewed from the perspective of clients, Twitter and Facebook are accepted ways of contacting the company, although many customers wrote that the first contact was by phone or mail. Afterwards they used social software in order to get help.

Case 2: Communication via Social Software during the Love Parade disaster in Germany on 24.7.2010

On 24 July 2010, a stampede at the 2010 Love Parade electronic dance music festival in Duisburg, Germany, caused the death of 21 people. At least 510 more were injured. Especially in many TV reports shortly after the accident it was mentioned that some visitors used social software to warn about the crowds. Pictures taken by mobile phones and videos were offered as first sources, providing insights into the disaster. Because of these reports we observed the activity on Twitter, Flickr, and YouTube before and during the accident traced to investigate whether participants were able to deliver timely information for participating organizations and other visitors of the Love Parade by social software. To obtain relevant information we used the search engine Topsy (http://topsy.com) to search for tweets, for Flickr we used its own search. YouTube videos had been filtered with the aid of Google Video. We looked for Twitter messages during the period from 9 a.m. to 10 p.m. on 24 July 2010, uploaded videos with the same date and photos that were uploaded on 24 July 2010 before 6 p.m..

The search for Tweets provided 105 results containing the term "#LoveParade". This list can be regarded as incomplete but our aim was to focus on the tweets which were really tagged with this very good known term. Most of the tweets were posted only in the wake of the disaster. Some warned in advance of chaos and overcrowding. For example, a Tweet from 'sektorkind' *"Police says: area is full. No chance of admission. #Loveparade #duisburg"* tweeted at 4:47 p.m. about an hour before the mass panic (Figure 3, left). Helpful tweets were distributed mainly on the news portal 'Der Westen', a portal of the WAZ media group, the 3rd largest newspaper and magazine publisher in Germany. A news ticker about the Love Parade was created on this page. The news was also reported on Twitter tagged with #loveparade in short time intervals. The portal informed in advance of the accident on train delays, backlog of the crowd and the closure or congestion of the site. The tweets that followed the disaster are partly already known through the media. Entries such as "visitors of the #LoveParade be sure to keep calm. Do not go to the station. It's blocked! Pass this info on!" warn those affected to avoid further chaos and panic (Figure 3, right). Especially about the number of deaths and recommended ways to return home as well as other security measures were distributed. It is noticeable that even here some twitterers acted as information brokers and played a major role in providing information to

stakeholders. They collected information about the event from different sources and made them available via Twitter.

The search on Flickr showed, that only three photos were uploaded beforehand, showing the conditions at the Love Parade. One photo shows the crowded stairway to the festival site, posted at 5:42 p.m. Two pictures of another user, also taken by a mobile phone, show the tunnel to the festival site and people who climb over the embankment on the festival grounds. The images were posted at 2 p.m. and 2:24 p.m.. All other images which were identified as photos uploaded by visitors were either taken with digital cameras or mobile phones and had been uploaded later in the evening to Flickr. Images on Flickr allow reconstructing when images were posted online. Many photos have EXIF data, which is displayed beside the photo on Flickr. These data show both the camera model and settings with which the photo was taken, and the exact time of the recording and upload.

In the video portal YouTube the upload date is provided but the exact time of the upload cannot be determined. The Google-search on youtube.com with the exact phrase 'LoveParade 2010', the tag 'panic' and the period 24.07.2010 found 73 results. Parts of the results show footage and coverage from the TV and interviews with eye witnesses. Some videos are a compilation of images and text, as reminders of the disaster. Many of the results contain mobile phone videos, taken by visitors before and during the accident. Included are several videos delivering impressions of the event before the accident. For example, the tunnel and the staircase to the ground at various times before the panic, more or less densely filled. Other videos show the dense crowd at the accident site, or paramedics caring for the injured after the panic. The videos are often tagged with the exact time of recording which is added by the uploader as a comment. If this is not the case, other users asked for those meta data in the comments field on this video so the time information was added subsequently. Giving the recording time is a convention on YouTube that has evolved as a result of the accident. Users who asked for such times afterwards can be generally identified as information brokers who collected all relevant videos on YouTube and put them in a separate channel for information on the disaster. Some of the videos that show the locations before the accident were sent to the persons responsible for criminal investigations of the disaster - according to the description of the clips. Information brokers had the same intention. By tagging the clips and collecting available recordings, these users tried to gather possible information about the event.

Figure 3: Examples of Social Software use during the Love Parade disaster in Germany

The investigations on the activities on Twitter, Flickr and YouTube in consequence of the Love Parade disaster show that a significantly lower amount of information was provided in advance of the disaster. Only few images, tweets and videos warned in advance of the crowds. The bigger part of the information followed after the incident. Photos and videos showing the disaster were uploaded later in the evening or on the following day. The information provided by the majority of users was primarily used for an accident investigation, but could not act as a warning to other visitors. We observed that a flood of information occurred after the actual disaster. In the case of the Love Parade the mobile phone network collapsed – therefore, visitors had few chances to even be warned. In the observation of Twitter and YouTube we found that users tried to investigate or commemorate the victims after the events.

DISCUSSION

From our literature review and our observations we can conclude that services like Facebook, Twitter, Flickr and YouTube are appropriate tools for an exchange of information between citizens and organizations, also in Germany. All those applications can be used via mobile applications and not only via computer. The use of SMS - if no Internet is available - is also very important. Tagging can help to find information. Geotagging can also help, especially if you send messages or pictures with a mobile phone, because then the exact location of the described situation can be identified. This is important in case of fires, storms, floods or energy breakdowns. Especially if energy breakdowns occur, a mobile phone can provide important information. A Hashtag-Syntax can also help to order information and address it to issues, groups or individuals (Guy et al., 2010). Retweets can

confirm the importance of information (Starbird et al., 2010). Flickr has the opportunity to provide EXIF-Data that help to determine date and time of a picture. Facebook has a big potential as citizens can contact organizations without calling them which usually takes a lot of time.

From our point of view there are also many weak points. *YouTube* does not provide information on the place or time; users have to add them in a comment. *Flickr* supports the EXIF-Data but they depend on the device and may provide wrong data. *Twitter* can use the location of a tweet, but only if the message was sent by a mobile phone with a location sensor. If the user twitters from his computer, the location of the user profile is used but it does not have to be correct. *Facebook* is the most problematic service: Many companies use it for broadcasting but not as a communication platform. Also many organizations have no Facebook site and our impression is that others are not maintained very consequently. A problem is that the users communicate and use those systems just for themselves. But there are ways of how the official crisis management can use that information: During the flood in Saxony, the regional television channel MDR asked its viewers to act as reporters and to upload images of the floods on the MDR's website. People submitted over 1.000 images which documented the flood in various cities (MDR, 2010). A search for relevant photos on Flickr brought only one page of results; pictures that users put online without being asked for. We conclude from this observation that a specific motivation of the citizen and a central contact point generates more information than can be obtained through the people's own initiative.

As a consequence our goal is to recommend the creation of an infrastructure that combines the different online-communities, recommends functions and helps the official crisis management, to provide and receive information about the crisis (Figure 4). Integrated crisis communication, as an approach, which integrates all available communication-channels and information systems may address this problem (Neuhaus, 2010). The integration of existing information based on a monitoring of social software with crisis tags (Guy et al., 2010, Bellucci et al. 2010), the archiving of the material and the summarizing of material are required (Starbird et al., 2010), as pointed out in literature and our case studies. Also the archiving of relevant material for analysis and training (Reuter et al. 2009) can help to improve crisis management. Besides the integration of existing activities, an active participation through the publication of information (in all necessary social software), i.e. through communicating with citizens (Vieweg et al., 2008), through support of information brokers (Hughes and Palen, 2009), through recommendation of crisis tags (Starbird and Stamberger, 2010), and the request of specific information (MDR, 2010) is necessary. Palen et al. (2010) present a vision similar to ours and point out the transformational role of information and communication technologies to deal with the problem of quantity and quality of information. Our perspective focuses more on the design and use of an 'infrastructure': the design has to take local differences into consideration, if it is intended for a broader use (Müller et al., 2010).

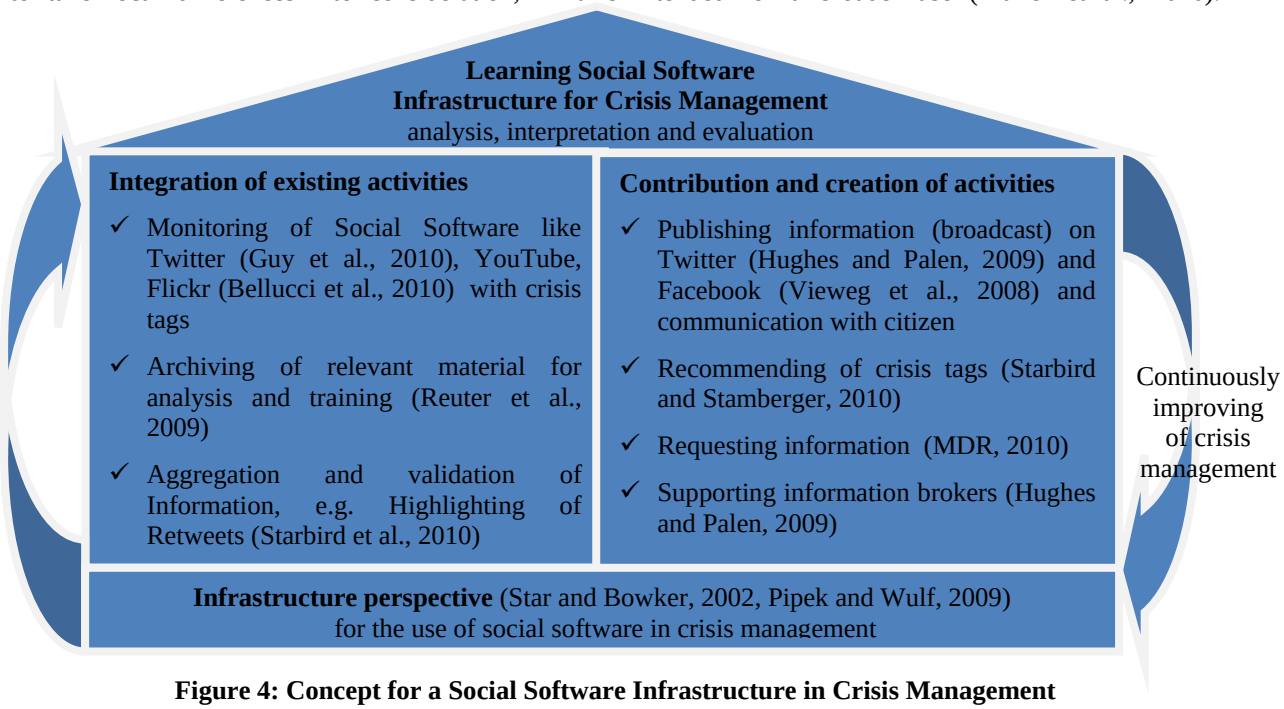

Figure 4: Concept for a Social Software Infrastructure in Crisis Management

Pipek and Wulf (2009) tried to create an inclusive perspective of all creative activities to establish a working infrastructure like our concept, which provides an integrated view on the design and use of such a learning infrastructure. This infrastructure emerges because of a perceived breakdown of classical mass media infrastructure, which does no longer fulfil all information needs. As a consequence of this the people rely on their social software infrastructure.

In order for social software to be 'discovered' as an important part of the work infrastructure in fire fighting, in police work, and in the maintenance work of the electricity network, it is also necessary to understand the information and communication needs for these groups of actors. Such we did as a first approach via 10 interviews and workshops with all relevant actors of crisis management: fire service, police, aid agencies, district administration and federal agency for technical relief. Furthermore we did participatory observations during the work in the control centre of the fire brigade. Several challenges wait for social software here: The professional actors feel very responsible for their decision, consequently they only want to act based on reliable information. In social software, this could be achieved by 'community scouts' who can be triggered to post information about what is going on. The publicity of this information would help stimulate similar information postings. Also, according to the principle of the 'wisdom of the crowd', information may become more reliable if it comes from different sources via different media. Tools to select and summarize as well as to access information quality can help informing the practice of (semi-)professional actors in emergency situations. Nevertheless, the development of such functionality will not be sufficient to make social software a part of the work infrastructure for crisis management. We believe it will also be necessary to involve individuals in crisis management to develop a use culture and a certain level of trust in social software. This could be achieved by fostering its use in non-critical situations of crisis management, e.g. for informal inter-organizational debriefing concepts or by initiating networks of practitioners based on social software as a basis for storytelling, knowledge management and an exchange of experiences.

These considerations result in a concept of using Social Software that provides a central, specific, crisis-management-related communication infrastructure with basic social network functionality at its core that matches the reliability criteria for crisis management infrastructures. On the other hand, it needs to be easy to integrate with existing Social Software Services to maximize its reach as well as its usefulness. It should provide a summary of social web activities with the possibility to read content and provide information not only for citizens but also to other relevant organizations involved in emergency response and restorations work (e.g. police, fire brigade, energy providers) (Figure 5).

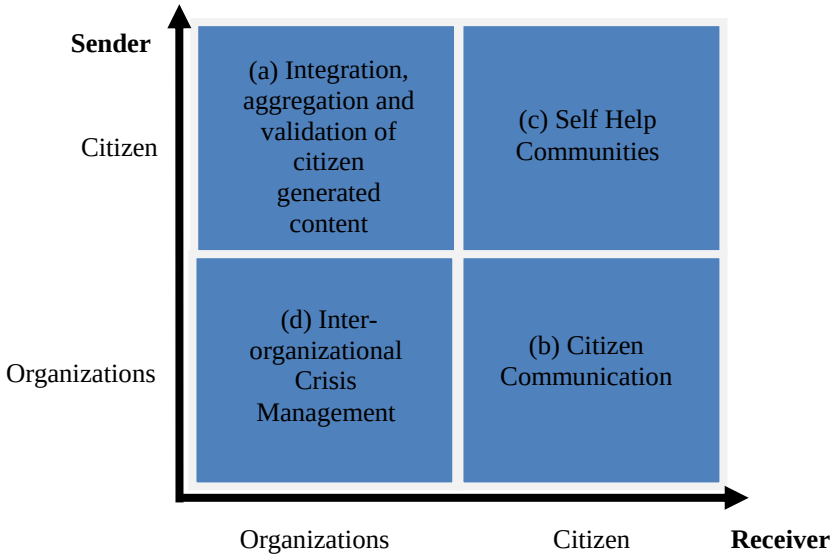

Figure 5: Communication Matrix for a Social Software Infrastructure

CONCLUSION

In this work, the question was how citizens can be involved through social software in inter-organizational crisis management. The contribution of this paper is to summarize the state-of-the-art in this field and to combine it with an work infrastructure perspective (Pipek and Wulf, 2009), which takes into consideration both the actual use of social software in crises by citizens (based on our two descriptive studies about the use in Germany) and the organizations' needs and concerns (based on interviews and participatory observations).

According to a definition of the term social software, restricting it to services that just need the Internet, a browser and a first selection of these services due to their rapid reaction capability, we found four classes of social software suitable as tool for crisis communications between citizens. We limited our study to those applications: *Facebook* as a representative of the social networks, *Twitter* from the category of micro-blogging services and *Flickr* and *YouTube* as photo and video sharing sites being among the social sharing services. A large part of the so far published work deals with the very general use of social software by the citizens in a crisis situation. All communication via the media was considered but it was not explicitly explained how citizens can be involved to provide information to relevant organizations in crisis management. Texts that addressed this

point tried to offer solutions in the form of concrete programs. In these texts only one social software service was included in the application design. The concepts cover only a portion of the spectrum of useful applications for social software. They provided good ideas but could not offer specifics about their all-encompassing solution.

In our own descriptive study we investigated the use of social software by people in Germany during two crises. In the first case of flight cancellations the study focused more on how citizens tried to communicate with organizations and companies. Thus, we viewed the Twitter and Facebook pages of the airlines during the ash-related flight cancellations in April 2010. The investigation yielded the finding that customers used social software after a failure of the conventional communication channels such as telephone calls and e-mail dialogues with companies. While this was for the citizens an almost self-evident communication use, the companies used Twitter and Facebook more as a broadcast medium. The dialogue via social software was of course not self-evident for everyone. In the second case, the general provision of information by participants at the last Love Parade music festival was investigated. We considered information on Twitter, Flickr and YouTube with reference to the disaster. As a result, we found that people did not provide information only because they had the possibility – they needed to be fostered. In the aftermath of an accident an information culture developed, available material was collected and conventions for a uniform database (date of the clip, collection of image sets and channels) were developed.

Based on the findings from the literature and our own observations, we think that certain types of social software have, especially in combination with mobile phones or other location-based media or various types of tags, the potential to involve citizens in crisis management. To make full use of potentials and to compensate existing deficits these individual services need to be integrated in a comprehensive application. Here, we think about an infrastructure for the (a) Integration of Citizen-generated content (gather citizen-generated information from various social software services and foster new necessary activities or behaviour), (b) for Citizen Communication (to quickly inform citizens and to communicate with citizens, also with regard to individual needs), (c) to foster Self-help Communities and to (d) support Inter-organizational Crisis Management (with a professional's crisis management community). This system should not replace other systems but help crisis managers to use the social web appropriately in a serious context.

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