

# Taxonomy of Community Interaction in Crises and Disasters

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## ABSTRACT

Taxonomies are integral to systems engineering, as they structure our knowledge of a field and so provide the foundation for technological development. We contribute such taxonomies for the field of Community Interaction and Engagement in Crisis and Disaster Management, which represents the interface between members of the public who commit to relief efforts and established organisations that have a pre-defined role in crisis management. These actors are unified in their purpose to help those in need, but also set apart by their organisational structures and modes of operation. We classify the actors of Community Interaction and Engagement, as well as the interactions between them. Our contribution outlines areas where the application of Information and Communication Technology can offer benefits to Community Interaction and Engagement.

## Keywords

information and communication technology, sociotechnical systems, crisis and disaster management.

## INTRODUCTION

Citizens' behaviour in the event of a disaster or crisis has been subject to academic interest for decades. The earliest research on this matter dates back to the Halifax harbour munition explosion disaster (Prince, 1920). Later, the research conducted at the Disaster Research Center of the Ohio State University investigated the sociological and organisational aspects of the involvement of citizens in *Crisis and Disaster Management* (CDM). Especially the works of Dynes and Quarantelli and their classification of organisation types are still often referred to. Since the turn of the century, the introduction of global and ubiquitous *Information and Communication Technology* (ICT) provides affordable means of rapid coordination, resulting in new forms of cooperation. The emergence of volunteer groups, which independently organise and operate through online social media and digital communication services (Liao et al., 2016; Starbird and Palen, 2013; Twigg and Mosel, 2017), attests to the influence of ICT on CDM. Citizens can now react to an incident with great reach and speed (Palen and Liu, 2007).

For this paper, we denote as *Community Interaction and Engagement* (CIE) the confluence of such committed members of civil society and the established entities of disaster relief: emergency organisations, public authorities and civil defence. Citizens and communities have been overlooked as important actors in CDM, as the field was long considered subject to the sole command and control of governmental bodies or military forces (Dynes, 1994). Although communities of civil society and their efforts in crisis and disaster relief have long been part of the research discussed at ISCRAM, comprehensive taxonomy of their interactions with other actors has not been attempted. Addressing this gap in the existing body of literature, we propose two taxonomies, of actors and their interactions, to outline CIE.

As primary contribution, our description of Community Interaction and Engagement provides a basis for determining which interactions can be supported through ICT, and facilitates a profound design of technological systems to achieve as much.

## ORIGINS

We draw on insights from our own research efforts as well as related literature. Two research projects were especially influential on this paper:

- 1) ‘Resilience Enhancement by Advanced Communication for Team Austria’ (RE-ACTA<sup>1</sup>), concluded in 2015, aimed to bring the structure and best practices of a successful national volunteer programme to new media. Outcomes suggested that the lateral information exchange among volunteers and their individual initiative should be considered when designing for CIE (Auferbauer et al., 2016; Auferbauer and Tellioglu, 2017).
- 2) ‘New media technologies in crisis and disaster management for enhancing the resilience of communities’ (MEDIATOR), initiated in 2015, investigates the interaction between self-organising volunteers and the established organisations for crisis and disaster management in the context of the European migration crisis (2015). MEDIATOR focuses on interactions between formal and informal actors, as described from their respective viewpoints.

Both research projects follow(ed) an empirical approach that derives ICT for CIE through induction, based on the analysis of qualitative data from interviews and field observation. Representatives of formal organisations were involved in both projects, while unaffiliated and pre-registered volunteers participated in one project each. From RE-ACTA, we inferred a need to differentiate in more detail the various forms of volunteer engagement; a classification into ‘emergency organisations’ and ‘volunteers’ did not appear to sufficiently cover the actors of relief efforts. Data from MEDIATOR confirmed this by revealing well-organised and structured groups of volunteers that were active on a long-term basis outside the formal response system and beyond ephemeral actions of spontaneous groups. Ultimately, both projects prompted us to attempt a comprehensive taxonomy of interactions between the emergency response system and civil society as a foundation for the application of ICT in CDM.

## RELATED WORK

A typology of factors that influence multi-agency coordination has previously been proposed to the ISCRAM community by Curnin and Owen (2013). Their typology describes attributes of successful communication for coordination; whereas our present work aims to map out the purpose and participants of interactions. We consider the two synergistic, as the work of Curnin and Owen can be applied to each of the interactions we detail herein. Further, communication structure, channels and content during incident response have been described in a detailed, scenario based manner (Eide et al., 2013); primarily considering information exchange within the formal emergency response system, but lending some concrete examples for parts of the abstract taxonomy presented herein. Liu et al. (2013) provide a comprehensive review of existing ontologies and their applicability for CDM; within their conceptualisation of subject areas, our present work would likely concern ‘processes’, for which the authors report no ontologies similar to the one proposed herein.

## TAXONOMY OF ACTORS

In this work, we distinguish between actors based on their socialisation in the field of CDM, meaning their internalisation and incorporation of norms, values and social behaviours related to CDM. In Table 1, actors of CIE are shown in two categories, each ordered by increasing level of socialisation.

Together with established organisations, volunteers play an important role in relief efforts. However, the definition of ‘volunteer’ varies between organisations, context of activity and cultural background (Whittaker et al., 2015). As *unaffiliated volunteer* we define a person who is participating in relief efforts, but is not part of an organisational structure that has a predefined role or obligation in CDM planning. The unaffiliated volunteer acts outside of the formal crisis management system and has thus been referred to as ‘informal volunteer’ (Whittaker et al., 2015). The *pre-registered volunteer*, on the other hand, has signed up with a volunteer programme or platform (possibly managed by a formal organisation, see below) and has, as such, become part of an organisational structure (Neubauer et al., 2013). However, they have not entered a long-term membership association with a formal organisation for crisis management or disaster relief. *Affiliated supporters*, on the other hand, hold membership status with a formal CDM organisation, thus being subject to different obligations (e.g. mandatory training or adhering to the chain of command). They may be volunteers, receiving little to no monetary compensation for their contribution, or employed by the organisation they are members of, contributing as part of their gainful employment. Lastly, *affiliated decision-makers* are differentiated from

<sup>1</sup> <http://www.kiras.at/en/financed-proposals/detail/d/re-acta/>

affiliated supporters by being afforded enough authority through embodied cultural capital to make tactical or strategic decisions within the organisational structure. While these roles may be filled by volunteers, the term ‘volunteer’ traditionally has included primarily those that we have classified here as affiliated. However, unaffiliated volunteers and their consideration in crisis and disaster relief have increasingly gained attention (Barsky et al., 2007; Harris et al., 2017; Neubauer et al., 2013; Twigg and Mosel, 2017; Whittaker et al., 2015). They may be regarded as disturbance, as valuable resources or as critical factor for recovery, depending on the observer’s viewpoint (Rogstadius and Teixeira, 2013).

<b>Individual actors</b>	
Unaffiliated volunteers	Persons intending to participate spontaneously in relief efforts without prior affiliation to formal emergency organisations.
Pre-registered volunteers	Persons who have signed up for a programme or initiative and conduct their activity within its organisational boundaries.
Affiliated supporters	Persons who have membership status in a formal CDM organisation, who conduct their activity along its organisational structure.
Affiliated decision-makers	Persons who have membership status in a formal organisation, who are afforded decision making in its organisational structure.
<b>Composite actors</b>	
Emergent groups	Formed through the self-organisation efforts of persons as reaction to a crisis or disaster event.
Supporting organisations	Established organisations that participate in relief efforts, but do not engage in such activity as part of their regular operations.
Formal CDM organisations	Established organisations whose regular objectives include crisis and disaster management activities.

**Table 1 Taxonomy of Actors in Community Interaction and Engagement (Summarised)**

Individual actors, as they are outlined above, can form compound entities with a complex organisational structure. Most prominent among these are the established *formal CDM organisations*, whose regular functions include responsibilities in disaster relief. Emergency organisations, humanitarian aid agencies, civil defence and public authorities all have a pre-defined role in CDM; legally and socially, though their involvement and role varies based on cultural context. Their capacity and contributions are included in *a priori* planning. They rely on organisational structures, hierarchies and formalised procedures that have existed before the onset of a crisis, comprising the formalised side of CDM.

When unaffiliated volunteers coordinate to address perceived issues, emergence of organisational structure can follow, in the sense of institutions (Berger and Luckmann, 1967). *Emergent groups* form their own identity as a collective and build organisational structures to varying degrees of complexity. They are institutions *in status nascendi* and become more than a simple gathering of unaffiliated volunteers. Emergent groups may be organised with little vertical hierarchy, later developing more formal hierarchies and division of labour. We define emergent groups as a collective of individuals that has formed an organisational structure after the onset of a crisis or disaster, with the purpose of meeting challenges posed by the causal event. As with unaffiliated volunteers, emergent groups operate outside of formalised CDM system and often find no consideration in the planning of response efforts. For an in-depth discussion on the topic of emergent groups, we refer the reader to Drabek and McEntire (2003) as well as Twigg and Mosel (2017).

There are communities within the public whose structures have existed before the onset of the event, but were not established for CDM. These *supporting organisations* take on tasks that fall beyond their usual scope of activity to support relief efforts and keep their internal structures intact while doing so. Whittaker, McLennan and Handmer (2015), as an example for this type of organisation, note Four Wheel Drive clubs organising caravans, transportation and clearing debris in a bushfire event. Our classification closely follows the typology of organisations formulated by Dynes and Quarantelli (1976): formal organisations, supporting organisations and emergent groups correspond to Types I, III and IV, respectively<sup>2</sup>. Transcendence of this typology has been suggested (Drabek and McEntire, 2003; Schmidt et al., 2018), but lies outside the scope of this work.

<sup>2</sup> We have not explicitly included Type II as actor; we consider this to be constituted implicitly through formal organisations managing pre-registered volunteers and expanding in this manner to provide surge capacity.

**TAXONOMY OF INTERACTIONS**

In the context of CIE, we only consider such interactions as happen between an actor within the organisational system – c.f. (Luhmann, 1995) – of a CDM Organisation and one without. Further, we include those interactions that occur among individual volunteers, emerging organisations and supporting organisations. This excludes the interactions between actors within the organisational system of one or more formal CDM organisations. The taxonomy of interactions thus defined is summarised in Table 2 and described in detail below.

Category	Functions
A. Contribution	<i>Co-creating, Crowdsourcing, Crowdtasking</i>
B. Dissemination	<i>Warning, Preparation &amp; Education</i>
C. Experience	<i>Telling Stories, Sharing Knowledge, Feedback</i>
D. Coordination	<i>Awareness, Orchestration, Intermediation</i>
E. Personalisation	<i>Reception, Personal Mobility, Acknowledgement</i>

**Table 2 Taxonomy of Community Interactions**

**A. Contribution**

Under ‘Contribution’, we classify interactions to elicit action or information from other actors.

*Co-creation*

In the context of commerce, (autonomous) co-creation was defined as process where ‘individuals or consumer communities produce marketable value in voluntary activities conducted independently of any established organisation, although they may be using platforms provided by such organisations’ (Zwass, 2010). The resulting marketable value may be placed in commons, universally shared and accessible to all. The information flow in co-creation is that of all-to-all, whereby every participant eventually has access to the information provided by any other participant. Geiger et al. (2011) classify these interactions as ‘[i]ntegrative sourcing without remuneration’. When we consider ‘marketable value’ as being information relevant to crisis management, Zwass' definition represents an approach that is popular in the CDM context. Online social networks, Micro-Blogging platforms and messengers have been successfully used to gather and share relevant situational information (Alexander, 2014; Palen et al., 2009; Vieweg et al., 2010). Support for this activity has previously been considered a worthwhile goal for community infrastructure designed specifically for CDM (Wu et al., 2008). Similarly, many platforms for Volunteer Geographic Information (VGI) are based on co-creation (Haworth, 2016; Meier, 2012). The actors involved in co-creation are primarily unaffiliated volunteers, as both producers and consumers. Formal organisations may also benefit from becoming consumers of such information, if they have the capacity to do so (Alexander, 2014; Haworth, 2016; Simon et al., 2015; Tapia et al., 2011).

*Crowdsourcing*

This term encompasses a wide variety of approaches, whereby one sourcing actor elicits contributions from a ‘crowd’ of actors (Geiger et al., 2011). In differentiation to co-creation, the sourcing and contributing actors do not necessarily share peer status in this interaction. Not every actor in the system necessarily has the authority to source for contributions. Similar to co-creation, Wu et al. have also found this type of interaction to be a goal in the design of their Community Response Grid (Wu et al., 2008), though they restrict the applicability of this interaction to incidents that are critical neither in time nor severity. Tapia *et al.* have previously discussed crowdsourcing in the context of citizen science and how this approach can benefit CDM through event detection (Tapia et al., 2014). An example of crowdsourcing in CDM is provided by GDACSmobile, where the submission of relevant information is elicited by enabling a mission space for contribution by any member of the crowd. The manner of contribution is at the discretion of the participant, i.e., which information they submit is decided by their notion of what is important. Information submitted by untrusted volunteers is vetted by a central agency before being re-released to all users (Link et al. 2013, 2015). For an in-depth discussion on sourcing in the CDM context, we refer the reader to Liu's comprehensive crowdsourcing framework (Liu, 2014).

*Crowdtasking*

To elicit contribution through crowdtasking (Neubauer et al., 2013), a central entity sends a request for specific

information to a selected group of participants, qualified through their skill, experience, or physical location. Crowdtasking is a one-to-many interaction that does not necessarily make contributions available to the crowd. In contrast to crowdsourcing, this interaction usually employs micro-tasking to request specific action and does not allow the submission of information on the crowd's initiative<sup>3</sup>. The crowdtasking concept lends itself to a form of interaction oriented towards the Command and Control paradigm, such as between formal organisations and pre-registered or affiliated volunteers (Auferbauer *et al.*, 2016; Auferbauer and Tellioglu, 2017). The interplay of the examples we have given for crowdsourcing and crowdtasking in the CDM context has been previously discussed (Middelhoff *et al.*, 2016).

## B. Dissemination

The dissemination of information that is relevant to health and safety of citizens in a crisis or disaster represents an exchange between formal organisations and the public as well as unaffiliated and pre-registered volunteers. Whereas in many types of crises and disasters the active involvement of helpers delivers substantial benefits while hardly imposing any limitations on their engagement, there are clearly situations in which their participation should be carefully tailored to the situation on the ground due to concerns for their safety and wellbeing in the context of a dynamically developing situational picture. Technical means of one-to-many (i.e., multicast) or one-to-all (i.e., broadcast) communications are required to inform, warn or alert the potentially affected persons about the prospective or imminent dangers. The quality of such communication is an important factor in building community resilience (Cohen *et al.*, 2017).

### *Alarming*

It is imperative to reach all the potentially affected persons while minimising disturbances to all unaffected persons who should not be bothered with unsolicited information (Collins *et al.*, 2009). Traditionally, societies around the world have been relying on public radio and TV broadcasting and on siren networks in order to warn or alert their citizen about potential public safety-relevant dangers, whereas in recent years SMS, cell broadcast and mobile apps have been added to the portfolio of potential information channels (Gojmerac *et al.*, 2016; Preinerstorfer *et al.*, 2017). These technological advances allow crisis managers to make citizens aware of potential danger in a fine-grained, context-aware manner, alarming only those persons that would potentially be affected, while still increasing the coverage and reach of the dissemination of critical information. Citizens in large urban areas, for example, may be more reliably reached through their phones than via sirens, due to noise pollution and demographic factors (Gojmerac *et al.*, 2016).

### *Preparation and Education*

In the same manner as new ICT allows for a tailored dissemination of critical information in the response and recovery phase of a disaster, so does it also afford crisis managers new ways to prepare and educate citizens in between crises and disasters. The dissemination of information regarding environmental hazards to the local population has been argued to contribute to reducing the vulnerability of both individuals and society, due to an association between a person's risk perception and their disaster preparedness (Helsloot and Ruitenbergh, 2004; Miceli *et al.*, 2008). Social networks, multimedia content and web sites provide opportunities to engage citizens, e.g., in public health efforts (Merchant *et al.*, 2011). A wide variety of smartphone applications are already targeted at providing educational material to citizens (Bachmann *et al.*, 2015). Contemporary ICT could be used to further tailor and personalise the disseminated information to the needs and context of the recipient, as well as monitor their perceived and actual level of preparation.

## C. Experience

The exchange of personal experience among actors is a category of interaction that serves multiple distinct purposes, depending on recipient and intent of communication.

### *Sharing Knowledge*

The content transmitted during knowledge sharing includes best practices and lessons learned regarding the

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<sup>3</sup> We consider this sufficient differentiation between crowdsourcing and crowdtasking. However, the two are undeniably related: crowdtasking has been classified based on Liu's crowdsourcing framework (Liu 2014) by Auferbauer *et al.* (Auferbauer *et al.* 2016) and further fits the type of crowdsourcing process that Geiger *et al.* defined as 'selective sourcing without crowd assessment' (Geiger *et al.* 2011).

originating actor's past activity in their respective roles and fosters the collaborative learning of practically relevant knowledge, pertaining to disaster management processes themselves. The information flow in this activity is considered many-to-many; shared knowledge is accessible to all participants of the information system. Supporting this function for emergent groups and unaffiliated volunteers may require different approaches than knowledge management in formal organisations. Due to the high volatility of emergent groups, Majchrzak et al. (2007) suggest that a Transactive Memory System for such entities likely consists of links between tasks that are required and the skills needed to perform these tasks, rather the currently supported links between person and expertise. As the formation of a knowledge base and sharing mechanisms is a normal social process during institutionalisation, it will be necessary to determine the viability of ICT support during the different phases of formation.

### *Telling Stories*

Storytelling is an emotional way of sharing knowledge and creating interpersonal social reality. People connect to common narratives by talking about episodes through the filter of their socialisation. The psychosocial component to cope with distress is important, considering that volunteers are prone to higher mental health impact after volunteering in disasters (Thormar et al., 2010). The content of information exchange shifts, from purely practical subject matter, to experiences that have been stressful for the participant or accounts of their current situation. Participants in our interviews during MEDIATOR have stated that such exchange gives them the feeling of not being alone in their efforts, that their activity is not futile. One participant told us how regular exchange regarding their group's activity has become 'a form of self-help'. Representatives of formal organisations in our group discussions have shown awareness of the importance of this function. They report having established dedicated (digital) points of contact where volunteers can submit accounts of their experiences, and that this feature has found heavy use. Telling stories can either be done via many-to-many interactions, e.g., via a public forum (digital or physical), or in the form of many-to-one submissions of accounts to one actor. Said actor may then selectively disseminate stories they receive to the public.

### *Feedback*

Giving feedback is a one-to-one information exchange, where an individual volunteer submits an account of their experience to a formal organisation. This is intended to either provide emotional relief (regarding an experience that occupies the mind of the volunteer), or to improve the work of the formal organisation (as perceived by the sender). It is differentiated from knowledge sharing and telling stories by being targeted at one specific actor and the subject matter being not necessarily applicable or relevant to actors not involved in the exchange.

## **D. Coordination**

Coordination has been defined as 'the act of managing interdependencies between activities performed to achieve a goal' (Malone and Crowston, 1990) and interpreted as the arrangement of tasks for cooperation through organisation of activity that prevents loss of communication and efforts (Fuks et al., 2008). Solutions for coordination aim to facilitate that actions are planned and conducted in such a way that they utilise the synergies between them and avoid redundant activities in the pursuit of a common purpose.

### *Awareness*

It has been accepted for more than two decades that awareness of participants' activities is critical to cooperation, as far as computational support is concerned (Dourish and Bellotti, 1992). In the context of CDM, that means awareness regarding relief activities of other helpers, capabilities of actors (such as time to deploy, number of personnel and available equipment) and their know-how as well as their organisational structure (so far as it is relevant to coordination). This function becomes especially important when considering interactions between emergent groups and formal organisations: due to the volatile nature of emerging structures, it is difficult for other actors to keep track of their formation and establish contact with the right liaison. During group discussions in project MEDIATOR, formal organisations have reported difficulties when trying to establish communication with emergent organisations, because they were not aware of qualified<sup>4</sup> points of contact. Further, we found that formal organisations would appreciate more awareness regarding the presence and activity of individual, unaffiliated and pre-registered volunteers, to prevent them from overworking

<sup>4</sup> Qualified, in this case, does not necessarily mean that the liaison is in charge or speaks for all the group, but they need to have enough internal standing to act on information. This is particularly true for groups with less vertical hierarchies.

themselves and burning out; volunteers were reported to do shifts that sometimes span multiple days. Considering this, we feel that ICT could contribute through e.g. the concept of awareness by shared feedback: the ability to passively monitor other's action, through continuous and automated status updates, allows the tailoring of one's own contribution and elicits response (Dourish and Bellotti, 1992).

### *Orchestration*

Actors that 'understand' each other, in vocabulary and manner of organisation, can use the same communication channels to work towards a common goal and coordinate *ad hoc*. Orchestration has been investigated as happening between unaffiliated volunteers, resulting in emergent groups. Starbird and Palen (2013), for example, have reported on the work of the initiative 'Humanity Road', consisting of digital volunteers, which was orchestrated to support relief efforts by information processing. This initial orchestration has resulted in an organisational structure with formalised activity and processes. Another example of orchestration has been noted by Kaufhold and Reuter (2016) when they discussed the role of a 'moderator', filled by unaffiliated volunteers, who used social media to mediate supply and demand and to organise other volunteers. They further remark that coordination with formal organisations, in contrast, did not work through social media, which suggests a need for intermediation (see below). For a more in-depth investigation into orchestration, we refer to the publication of Liao et al. (2016).

We would remark that the endeavour of providing a specialised ICT solution for orchestration in CDM likely yields a questionable ratio of benefit to effort when unaffiliated volunteers are involved. In our current research on project MEDIATOR, we found that volunteers can well organise mature organisational structures for orchestration of work within large groups, without the help of specialised ICT solutions. Contemporary online social networks and messengers are sufficient for this purpose and indeed are preferred due to their familiarity. Such observation is in line with works that have reported on volunteer's creative appropriation of technology (Starbird and Palen, 2013; Volda et al., 2015) and social media being well suited for the purpose of volunteer collaboration in disaster response (Waldman and Kaminska, 2015).

### *Intermediation*

Intermediation focuses on bridging the gaps between actors that do not share common communication channels, vocabulary or organisational structure - i.e., cases where interoperability is low. It is not so much the task of coordinating actors in their cooperation towards a certain goal. Rather, intermediation aims at establishing a common ground that makes coordination and cooperation viable in the first place. Such intermediation can contribute specifically to the relation and interaction between unaffiliated volunteers, emergent groups, supporting organisations and formal organisations - actors who follow different organisational structures and are likely diverse regarding their regular activity outside of crisis or disaster situations. Research on a platform to match reports of displaced and found pets in the aftermath of a disaster (Barrenechea et al., 2015) is one example of intermediation through ICT. By providing an appropriate data structure and pulling data from social media into the platform, information is made more accessible to formal organisations (shelters) and exchange is facilitated.

In intermediation, social media channels alone appear to be of limited applicability. While they work well as tools for volunteers to orchestrate efforts with their peers, formal organisations have as of yet not institutionalised them for two-way communication (Alexander, 2014; Simon et al., 2015; Tapia and Moore, 2014). An approach to intermediation that is not primarily technological in nature is postulated by Zettl et al. (2017), who discuss the role of emergent organisations as intermediaries between spontaneous volunteers and emergency organisation.

## **E. Personalisation**

The transitory and self-motivated involvement of citizens (Hustinx and Lammertyn, 2003) requires affordance of greater mobility, regarding the manner of participation.

### *Reception*

Receiving (convergent) helpers is an interaction between formal organisations and unaffiliated volunteers. Due to the problems posed by convergence of people and goods (auf der Heide, 2003; Whittaker et al., 2015), unaffiliated volunteers may come to be seen as a complication, rather than a potential asset (Rogstadius and Teixeira, 2013; Skar et al., 2016). To mitigate this, solutions are required that support formal organisations in the reception of unaffiliated volunteers, while at the same time providing these helpers with information and

guidance. Arriving volunteers will be looking for information on the local situation and where to best apply their efforts. Formal organisations need to register arriving unaffiliated volunteers, to file their skills, capabilities and contact data, as well as to fulfil possible legal obligations. The On-Site Operations Coordination Centre by the United Nations Office for the Coordination of Humanitarian Affairs or the Volunteer Reception Center of the US Federal Emergency Management Agency address the reception of incoming helpers (relief organisations and volunteers, respectively). There have been no investigations into the viability of a digitalisation of this interaction, though the development of such a virtual reception centre could prove helpful (Waldman and Kaminska, 2015).

### *Personal Mobility*

Considering the transitory activity of unaffiliated and pre-registered volunteers, we see an opportunity for ICT to contribute by providing digital identification of helpers' skills, know-how and experience. This function offers a transfer of information from individual, pre-registered or affiliated volunteers towards multiple formal organisations with the goal of quickly signing up for relief activities via an established volunteer identity. Using the concept of cultural capital according to Bourdieu (1986), this means a symbolical representation of embodied cultural capital (of experience and know-how in CDM), potentially transferring it to an institutionalised state.

From an organisational perspective, this means the establishment of a meta-organisation that issues verification of volunteer data. From a technological perspective, such an infrastructure will require a data format and storage option for volunteer data and experience that offers high usability to the volunteer on one hand and meets the standards of formal CDM organisations on the other. We are currently not aware of any such format being widely accepted in CDM. A digital persona of the volunteer could be established at the initial registration (during reception, see above) and stored locally on volunteers' smart devices. From that point, it would be available to returning volunteers as rapid form of 'checking in,' acting as identification and verification. However, the establishment of a persistent digital identity immanently brings with it issues regarding privacy and social impact, potentially leading to discriminative treatment of volunteers based on their past activities.

### *Acknowledgement*

Acknowledging volunteers for their activity stands to reason as being a motivating factor in their engagement – c.f. (Liao et al., 2016). This may be achieved through acknowledgement and showing appreciation (Kriplean et al., 2008), highlighting the importance of a task for common goals (Zhu et al., 2012) or the impact it has on relief efforts (Voids et al., 2015). Our findings from group discussions with formal organisations show that they would appreciate a way to say, 'thank you' to volunteers, while interviews with members of volunteer groups suggest they draw motivation from acknowledgement by peers and formal organisations. Technological support for this interaction has not been extensively addressed. Providing a persistent digital persona for volunteers (see above) could enable such feedback and credit for the contributions of pre-registered and affiliated volunteers.

## **DISCUSSION**

### **Methodological Considerations in Taxonomy**

As Nickerson et al. (2013) have pointed out, the development of taxonomies for information systems has mainly followed an *ad hoc* approach, relying on the researchers' intuition for classification. We must count our present work among them. The taxonomy proposed herein, the dimensions and characteristics it uses for differentiation, have grown over the course of several research projects, instead of being established through a formalised methodology. Further, our classification of actors and interactions could be likened to a typology, based on sociological assumptions regarding volunteers and societal factors, rather than a taxonomy (Smith, 2002). However, Nickerson and colleagues also argue that 'a taxonomy is useful if others use it' and when it allows for observations that were not possible before. Our present work is intended to serve as basis for discussion and guidance – if it serves this purpose, which we are convinced it will, then it offers utility. Nevertheless, we aim for a formal taxonomy development approach in future work on this taxonomy.

### **On the Classification of Actors**

In our taxonomy of actors, we have used as differentiating factor their socialisation in the field of CDM, internalised in the form of long-lasting dispositions. This differentiation is not discrete. Rather, it is a continuum along the axis of the internalisation of the norms, values and social behaviours in CDM. This represents the

degree to which a person's perception, thought and deed are shaped and changed through identification with the field. Such classification draws inspiration from what Bourdieu has termed '*habitus*' – the key between individual behaviour and the social structure of a field, formed through learning processes specific to the field (Kieserling, 2008). Also from Bourdieu (1983) comes the concept of cultural capital, which, in its embodied form ('*Inkorporiertes Kulturkapital*'), becomes part of a person and thus habitus. When we say that socialisation in CDM is used as the distinguishing attribute, we refer to the actor's embodied cultural capital in this field: their attained and incorporated knowledge regarding such things as, e.g., nomenclature, organisational structure, forms of cooperation or processes being followed.

Conversely, the differentiation between affiliated supporters and affiliated decision-makers could arguable be made based on *institutionalised cultural capital* instead, such as, e.g., titles, rank or certifications, which can be used societally to determine the cultural competencies of a person. Such symbols are canonical and confer a different kind of cultural capital than the embodied form, i.e. 'the capital of the auto-didact, which may be called into question at any time' (Bourdieu, 1986). The circumstance that these symbols likely hold more value in a hierarchical context (such as most formal CDM organisations) than they would in emergent groups, where social capital potentially plays a larger role, suggests segmentation of the field (Anheier et al., 1995). A more thorough examination of actors in CIE through the lens of Bourdieu's theories appears an intriguing prospect for future work.

### Lack of Multi-Dimensional Representation

Any eventual taxonomy of CIE that aims to model a substantial part of interactions will necessarily be of multi-dimensional character; for classifying both actors and interactions. We expect distinctions to be added on multiple levels to the one-dimensional classifications in this paper. Given that the present work follows from research that is empirically disposed, space and time would be obvious candidates in the light of transcendental idealism. A spatial dimension may be introduced by differentiating between 'on-site' and 'virtual' actors (also: 'online' or 'digital'); such as in the case of volunteers (Kaufhold and Reuter, 2016; Schmidt et al., 2018; Starbird and Palen, 2013). Introduction of a temporal dimension may be based on the phases of the disaster management cycle; to differentiate in more detail the interactions we have presented. Further, our classification of interactions is based on the primary intent under which actors use ICT for interaction. It does not consider latent social functions of interactions; such as building trust (Hughes and Tapia, 2015), persuading actors (Vineyard et al., 2012) or building new structures (Liao et al., 2016).

### Global Applicability

From a constructivist point of view, we consider it important to note the cultural preconceptions that influence this work. Related literature we have considered is primarily published in Anglo-American and Western European venues and written in English, which is relevant both due to the cultural context from which data was drawn and when considering that the language being used itself exerts an influence. Cultural differences will, without doubt, affect the applicability of our taxonomies and any eventual technological framework based on them.

### CONCLUSION

There currently exists no comprehensive, systematic description, classification or taxonomy of Community Interaction and Engagement (or any otherwise named domain with a comparable definition). Because taxonomies are integral to systems engineering and provide the foundation for technological advances by structuring our knowledge of a field, we address this gap to facilitate future development of ICT. As the primary contribution of this work, we have provided two taxonomies for the context of CIE: one that classifies its actors and a second that classifies the interactions between them. They shall provide the reader with an improved understanding and overview of the different types of interaction in CIE and offer an outline for potential contributions through ICT.

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