

**[Robin Mansell](#)**

## Promoting access to digital knowledge resources: managing in the commons

**Article (Submitted version)  
(Pre-refereed)**

**Original citation:**

Mansell, Robin (2012) *Promoting access to digital knowledge resources: managing in the commons*. [International journal of the commons](#) . pp. 1-20. ISSN 1875-0281 (Submitted)

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Promoting Access to Digital Knowledge Resources:  
Managing in the Commons

by

Professor Robin Mansell

Department of Media and Communications  
London School of Economics and Political Science  
Email: [r.e.mansell@lse.ac.uk](mailto:r.e.mansell@lse.ac.uk)

14 December 2012

Submitted to the *International Journal of the Commons*, Special Issue on The Knowledge Commons: From Historical Open Science to Digitally Integrated Research Networks.

## ABSTRACT

This paper examines the potential for collaborations between formal science professionals and loosely connected online groups that employ crowdsourcing within the information commons. It considers the differences between scientists and other online groups' preferred modes of managing information production, circulation and application, distinguishing between 'constituted' and 'adaptive' authority and examining the extent to which these groups are engaged in curating the information they generate for the purposes of social problem solving. A small sample of crowdsourcing initiatives, drawn from the fields of astronomy and environmental science and crisis and emergency response, is examined based on desk research to illustrate the potential for boundary crossing between the domains of formal science and increasingly active loosely connected online groups which are engaged in activities giving rise to big data sets that may be ephemeral or may become constituted as 'useful knowledge'. The conclusion suggests several measures that would strengthen the foundations for collaboration and indicates avenues for further empirical research.

**KEYWORDS:** crowdsourcing, information commons, social technology, big data, authority, digital curation

## INTRODUCTION<sup>i</sup>

This paper examines how the formal institutions of science are responding to the challenges of the digital information commons, comparing this response to the way loosely connected online groups are responding to similar challenges. The digital information generated by both groups is increasingly a basis for social action across many knowledge domains. Both groups are developing novel arrangements, practices and norms for generating and accessing these information resources. I consider whether the responses of these groups are helping to reduce tensions which arise because of their very different perceptions of what constitutes usable knowledge. These differences are especially important in an era when digital networks are enabling new forms of collective action and in which there is increasing potential for collaboration between these groups.

The distinctive ways in which formal science professionals and loosely connected online groups regard the challenges of managing the digital information commons are discussed in the first main section, distinguishing between what I designate as ‘constituted’ and ‘adaptive’ modes of authority, two principal means through which these groups manage their online interactions. I emphasise the concern of formal science professionals with achieving curated stocks of information in contrast to the concern of many loosely connected online groups with generating ephemeral flows of information. This difference has implications for whether the activities of these groups are deemed to contribute to the accumulation of useful knowledge (Mokyr 2002), that is, knowledge that is maintained (curated in line with norms of formal science) as a basis for future social action and problem solving (Lindblom and Cohen 1979).

The discussion in this paper then focuses on a selection of commons-based information-related activities, illustrated by examples of crowdsourcing projects sponsored both by formal science and by loosely connected online groups. The analysis highlights differences between their emerging information practices, emphasising why, despite an increasing subscription by both formal science professionals and loosely connected online groups to the principles of open access to digital information, there is a need to build bridges between them that respect their distinctive approaches to collective action in the information commons. In the conclusion I suggest several avenues that may be pursued to enable enhanced collaborations between formal science and loosely connected online groups.

## SOCIAL TECHNOLOGIES AND THE INFORMATION COMMONS

Since the earliest spread of the Internet, scholars have been characterising it as a ‘social technology’, suggesting that digital hardware, software and their applications have social values embedded within them (Katz and Rice 2002). In the early 20<sup>th</sup>

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<sup>i</sup> A longer version of this paper was presented at the 1st Global Thematic IASC Conference on the Knowledge Commons, Université catholique de Louvain, 12-14 Sept. 2012. Gregory Asmolov, PhD candidate, London School of Economics and Political Science, contributed to the research for this paper and offered helpful comments on an earlier draft as did Dr. Gordon Gow, University of Alberta, Edward Steinmueller, University of Sussex, and participants in the conference.

century, this term was coined to designate any ‘system of conscious and purposeful organization of persons’ that yields beneficial outcomes for society (Henderson 1901:472). Nelson and Sampat (2001) employ this term to refer to modes of coordination that facilitate both markets and collective action, emphasising the institutional arrangements, practices and norms which enable the organization of social and economic activity. Social technology is clearly a central issue for the production of ‘useful knowledge’ (Mokyr 2002). With the proliferation of digital tools and online platforms that are available to formal science professionals and to loosely connected online groups, ever stronger claims are being made about the usefulness of the information they produce. This is particularly evident, for example, in the explosion of user generated content for mapping using both proprietary and open platforms. However, differences in their respective social technologies often create barriers to more fully realising the benefits from their contributions and these differences are not yet sufficiently understood.

This is especially so when the information activities of formal science professionals and loosely connected online groups occur in the information commons.<sup>ii</sup> Benkler (2004:1110) argues that information is commons-based ‘when no one uses exclusive rights to organize effort or capture its value, and when cooperation is achieved through social mechanisms other than price signals or managerial directions’. If we think of a continuum of authority for managing online relationships, adaptive authority may be identified as characterizing loose, bottom-up, often informal, forms of authority that are frequently associated with information activities of many loosely connected online groups that are taking advantage of the increasing scale, speed and reach of information networks. When this is the predominant mode of organising information production and use, stronger, often formal or constituted, forms of authority are not privileged as the social technology of choice.

In fact, some argue that hierarchical forms of authority which are often constituted through explicit reference to formal norms, what I designate as constituted authority, can be averted when the aim is to collaborate in the sharing of online information. For instance, digital technologies and networks are said to have the potential to enable universally distributed collective intelligence which is coordinated in real time (Lévy 1997) and to support the emergence of open collaborative and participatory cultures characterised by empowerment of citizens, flexible modes of organisation, that is by adaptive authority (Baym 2010; Castells 2009; Jenkins 2006). However, while there are many instances of information commons activity that favour non-hierarchical coordination or adaptive modes of authority, research evidence shows that in many loosely connected online groups (such as open source software development communities), power struggles occur over values, status and the roles of participants, and hierarchy and formality are not complete absent. This is so even when the norms of adaptive authority based on altruism and reciprocity for the management of the commons are very prominent (Berdou 2011; Mateos Garcia and Steinmueller 2008). Thus, it may be that the preferred means of managing activities in the information commons by loosely organised online groups differ from constituted authority only in the extent to which hierarchy is acknowledged explicitly.

There are those who argue that information commons activities that are not subject to

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<sup>ii</sup> See De Moor (2011) for a discussion of the changing usage of ‘common’ resources and ‘the commons’ and implications for analysis.

the constituted authority of private ownership rights risk outcomes that diminish social welfare because of a failure to generate incentives for the creative production of digital information (see Mansell and Steinmueller in press; under review for a critical discussion of this argument), resulting in a ‘tragedy of the commons’ (Hardin 1968). However, Hess and Estrom (2006) suggest that arguments about the tragedy of the commons refer specifically to a completely unmanaged common resource. They emphasise that there are many kinds of commons where the ‘outcomes of the interactions of people and resources can be positive or negative or somewhere in between’ (Hess and Estrom 2006:13). For instance, they suggest that a self-organised commons requires ‘strong collective-action and self-governing mechanisms’ (Hess and Estrom 2006:5). In the absence of strong collective-action of some kind, or constituted authority using my characterisation of online organisational modes, they argue there is a risk of problems in the use and governance of a commons. Thus, various combinations of constituted and adaptive authority may be present when open access collaboration occurs in the digital information commons.

So-called ‘open’ information activities increasingly involve participants from both formal science and loosely organised online groups. One key difference between them is the extent to which their respective social technologies give rise to opportunities for investing in the curation of digital information. In formal science, digital curation has a special meaning referring to ‘maintaining, preserving, and adding value to digital research data throughout its lifecycle ... in trusted digital repositories [which] may be shared’ (DCC 2012). It includes conceptualising, creating, validating, accessing and using, preserving, storing, reusing and transforming digital information. Research funders invest in digital curation with a view to the long term accumulation of useful knowledge. In contrast, in loosely connected online groups, more attention is given to what is referred to as content curation, that is, aggregating, distilling, sifting and selecting information, usually for a more immediate purpose (Bruns 2010). Relatively fewer resources are allocated to curation and fewer efforts are made to validate, preserve, organize and store information for reuse within the context of the purposeful sharing of digital information as understood by formal science professionals. Nevertheless, these groups are generating vast amounts of relatively ephemeral information, some of it captured by the digital platforms and classified, which could be digitally curated and applied in the generation of useful knowledge.

This difference creates problems for collaboration between the two groups. Key junctures for conflict include what information can be accessed and the nature (if any) of efforts to curate information. The principal social technology of formal science is constituted authority which enables information to be purposefully shared. Dasgupta and David (1994) argue that formal science disclosure is motivated by the contest for priority (acknowledgement of first discovery) and that claims of priority require full and accurate disclosure. As Mokyr (2002:5) says, ‘propositions are tested by consensuality’, following procedural norms. These observations interact with claims that formal science is becoming more open due to funder requirements for publicly accessible publication of research. In addition, online tools are expanding not only the technical practices of disclosure in formal science and, in the process, creating many new forms of data repositories and depositions, but also the range of ways in which information is sourced. For instance, the UK Royal Society (2012:7) now claims that ‘open inquiry’ is central to science, but that ‘opening up scientific data is not an unqualified good’ (Royal Society 2012:9). The preference for constituted authority is

intended to ensure ‘intelligent openness’ which results in data that are accessible, ‘intelligible to those who wish to scrutinize them’ and ‘usable by others’ (Royal Society 2012:7).

Implicit in this view is a resolution of conflict – ‘those who wish to scrutinize them’ and ‘usable by others’ avoids the question of *who* those others wishing to use the data might be. If properly vetted and funded (to recompense those with a commercial interest), the issue is resolved, if only by implicit reference to the qualified observer. ‘Others’ seem to need to be admitted as ‘qualified observers’ by the institution of formal science, thereby maintaining the privileged role or constituted authority of formal science. Within ‘open science’ projects access often is only granted to those explicitly deemed to be able to advance the aims of a given project (David, et al. 2010).

Formal science, however, must be increasingly flexible to accommodate a ‘data deluge’. The ‘big data’ era is one in which ‘vast volumes of scientific data are captured and generated by large scientific facilities, new sensors and instruments, interconnected networks, e-commerce, and computer models’ (Codata 2012,np). Science, engineering, medical research, the social sciences and the humanities, as well as education are becoming increasingly data-intensive and distinctions between qualified and ‘unqualified’ producers and users of information are blurring. However, issues around access to information resources generally are presented by formal science as concerning the effective use of digital platforms, changing cost structures of research, and problems of expanding access to data to both professionals and ‘amateurs’ (Dutton and Jeffreys 2010).

While formal science is beginning to embrace some of the norms of adaptive authority favoured by loosely connected online groups, qualms about losing control, not only of access, but of curation and of who should be qualified to offer a view on the meaning of the data collected, remain. This is evident in efforts to foster ‘citizen science’ or ‘science by the people’ (Silvertown 2009:4). Associated with voluntary citizen activity, Haklay (2011:np) argues that citizen science ‘can only exist in a world in which science is socially constructed as the preserve of professional scientists in academic institutions and industry’ and where scientists serve as the overseers of the information commons. Citizen science can be differentiated from community science which is more often linked to commons-based peer production and to what Callon and Rabearisoa (2003) call ‘research in wild’. They suggest that ‘it might be fruitful to consider concerned groups as (potentially) genuine researchers, capable of working cooperatively with professional scientists’ (Callon and Rabearisoa 2003:195). People are seen as being capable of contributing useful knowledge for social problem solving without the need for the norms of constituted authority provided by formal science. Citizen science continues to be regarded mainly as complementary or even subordinate to formal science (Stodden 2010). Citizens who contribute generally are seen as amateurs, rather than as ‘genuine researchers’ and there are few efforts by formal science institutions to invest in the ephemeral flows of information that citizens generate with a view to curating them. While some research councils may be adopting the discourse of ‘research in the wild’, it seems that they are continuing to adhere to the conventions best characterised as constituted authority (EPSRC 2012).

In contrast, adaptive authority typifies the management of digital information commons generated by the activities of loosely connected online groups whether purposefully or not. Shirky (2010:29) argues, for example, that an emergent participatory culture is giving rise to a 'cognitive surplus, newly forged from previously disconnected islands of time and talent'. This is evident in the case of socio-technical controversies where, as Callon observes, 'faced with the exceptional' (Callon 2003:40), explanations will be sought by people who do not know each other and may have no pre-existing consensus about the culture of knowledge generation. With the spread of online interactions, the 'overflowings' of groups historically excluded from the production, circulation and application of useful knowledge are likely to become more difficult to accommodate within the constituted authority approach of formal science. Even Shirky (2010:29), a strong proponent of the virtues of loosely organised online groups as a vast resource for information production, says that this kind of active engagement online requires employing some kind of authority.

Both formal science and loosely connected online groups are engaging in 'big data' activities and this is presenting new opportunities for the curation of ephemeral information flows in the interests of social problem solving. By some accounts, there is little possibility of productive discussion between these groups because constituted authority is seen as being about 'top down', hierarchical (exploitative) power, and adaptive authority, while 'bottom up' horizontal collaboration is associated by Shirky (2010) with consensual power. However, Callon's (2003) view of the emergence of concerned groups who resist designation as those to whom knowledge is offered and who persist in challenging institutions of constituted authority such as formal science, suggest that novel ways of collaborating with the institutions of constituted authority may be emerging.

In the face of rapid technological change and dynamic contestations over the framing of social problems a new paradigm (Kuhn 2000) or mode of managing the information commons might be emerging. Insofar as this is so, formally constituted 'open' science may find itself in persistent conflict with loosely connected online groups, thereby diminishing potentially useful contributions to knowledge. Formal science, with its attachment to constituted authority as a source of privilege and power, sometimes treats its movement toward an open information commons as a form of resistance to the enclosure of information in the proprietary domain (Boyle 2008). David (2005:20) observes that 'too much should not be made of the separation between the spheres in which information-goods are freely shared, and that in which access to them is tightly controlled by private profit-seeking agents. At least, it is important to notice that there is a region in which the two can overlap'. His concern is with overlaps within the domain of formal science. Equally important are overlaps between formal science and loosely organised online groups where there is increasing potential for drawing on the information activities of both to enhance social problem solving.

In summary, relatively little is known empirically about the actual and potential overlap between the constituted and adaptive modes of authority that are influencing the activities of these groups in the information commons. When bridges between them are either ineffective or absent, opportunities to reap the benefits of the application of digital technologies in efforts to find solutions to human problems are diminished. The ways in which formal science and loosely connected online groups



manage their activities in the information commons give more or less emphasis to constituted or adaptive authority. They also differ in terms of whether they are involved principally in the accumulation of curated stocks of information to which access needs to be negotiated or they are interested in activities that generate ephemeral information and offer real time access to information, but without the capacity to transform their information into curated stocks of information that may be of value in reuse.

In the next section I examine the way one form of online information activity, crowdsourcing, is being employed within the digital information commons. The analysis focuses on incentives for the generation of curated stocks of information as compared to the generation of ephemeral flows of information and on the modes of authority that predominantly characterise the activities of initiatives led by formal science and those led by loosely connected online groups.

## CROWDSOURCING IN SCIENTIFIC AND SOCIAL PRACTICE

Crowdsourcing refers to voluntary activities engaged in by participants in large-scale planned and spontaneous online interaction . Such activities are not always associated with the information commons since many are steered and captured for commercial purposes. However, ever more activities are directed at scientific or social (public) problem solving. Defined initially as an act whereby institutions outsource functions to an undefined open network, the meaning of crowdsourcing has been extended to the application of open source principles in any domain (Brabham 2012; Howe 2008; Malone, et al. 2009; Surowiecki 2004). Participants are often anonymous, but they are not always strangers. The use of wireless technologies and Internet tools by formal science and loosely connected online groups is resulting in an explosion of crowdsourced digital information. Access to these technologies is unevenly distributed globally (Graham 2011), but geodata collection, aggregation, analysis and publication are increasingly being supported by digital information commons platforms (Berdou, et al. 2012; Chilton 2010; Haklay 2010; Okolloh 2009).<sup>iii</sup>

Crowdsourcing activity may favour constituted authority or it may favour adaptive authority and there may be overlaps between the crowdsourcing initiatives of formal science and those of loosely connected online groups. In some instances, crowdsourcing may resemble ‘crowdpushing’ where third parties or a scientific institution play a significant role in deciding how information may be accessed and used and whether it will be curated for future use (Rudmark, et al. 2012). Indeed, crowdsourcing may be being fostering by a ‘new elite’ which is ‘wary of overtly signalling the power dimensions of crowdsourcing to those drawn to the call’ (Wexler 2011:15). The simple availability of these tools provides little insight into the way power relations among participants are being managed or whether there are incentives favouring new forms of cooperation when these activities occur in the digital commons (Quinn and Bederson 2011; Yap 2011).

Examples of crowdsourcing are examined below from both formal science initiatives and those launched by loosely connected online groups. The focus is on crowdsourcing applications in the astronomy and environment fields and on crisis and

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<sup>iii</sup> Platforms include those such as Ushahidi and OpenStreetMap for collecting data and by corporate tools such as Google’s Map Marker, TeleAtlas’s Map Insight and Navtek’s Map Reporter.

emergency response where activities are all, or in major part, occurring in the information commons.<sup>iv</sup> Information about each of the initiatives was examined to identify the organisation(s) that had mobilised them and to infer whether their affinity was to constituted or adaptive authority, and whether there was evidence of the curation of information generated by the activity. The analysis begins with formal science initiatives, then turns to initiatives sponsored initially by loosely connected online groups, and then to an initiative that has aspirations to achieve a hybrid model of crowdsourcing activity.

### *Formal science crowdsourcing*

In the formal science domain, LHC@home, for example, involves volunteers who offer the unused capacity of their personal computers to enable the European Organization for Nuclear Research (CERN) to run simulations using data from the Large Hadron Collider. GalaxyZoo, engages volunteers in the analysis of imagery from NASA's Hubble Space Telescope archive. Started by the Oxford University astrophysics group, it is part of the Citizen Science Alliance (CSA), a collaboration among scientists, software developers and educators who develop and manage projects using the time and abilities of a distributed online community to generate scientific results. Oldweather, also supported by CSA, is sponsored by a coalition of organisations including the UK Met Office, National Maritime Museum, the Atmospheric Circulation Reconstructions over the Earth project at Oxford University, and NOAA (National Oceanic and Atmospheric Administration) in the US. This initiative introduces a gaming element to attract participants. These projects are clearly mobilised and managed by constituted authority in the formal science domain and they aim to achieve curated stocks of information.

Somewhat ambiguous in terms of the authority model are projects such as WideNoise which aims to tackle noise pollution and to alert citizens to the urban soundscape. Mobilised by Everywhereaware (Enhance Environmental Awareness through Social Information Technologies), it is supported by the ISI Foundation, a private research

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<sup>iv</sup> The analysis is based on desk research examining information at project websites and other online sources; the Radiation Map and Russian Fires examples are informed by Asmolov's participation in these initiatives. The search focused on crowdsourcing applications in the astronomy and environment fields and on crisis and emergency response because these are prominent areas which have received attention in the literature. It is possible that a different selection of cases would yield a different picture of the relative weight of constituted and adaptive authority and of the propensity towards digital curation as discussed above. The websites for each example are listed here so as not to clutter the text:

<http://lhathome.web.cern.ch/lhathome/>; <http://www.galaxyzoo.org>;  
<http://www.citizensciencealliance.org>; <http://www.oldweather.org/>;  
<http://cs.everyaware.eu/event/widenoise>; <http://blog.cosm.com/2012/07/smart-citizen-project-from-barcelona.html>; <https://www.zooniverse.org>; <http://pybossa.com/>;  
<http://www.nightskiesnetwork.com/>; <http://www.letsdoitworld.org/> and  
[http://en.wikipedia.org/wiki/Let%27s\\_Do\\_It!\\_World](http://en.wikipedia.org/wiki/Let%27s_Do_It!_World); [www.usahidi.com](http://www.usahidi.com);  
<http://crisismappers.net>; <http://www.unglobalpulse.org/>;  
<http://globalvoicesonline.org/2011/03/25/russia-unexpected-results-of-radiation-mapping/>

institute in Italy, a consortium of European universities, and by European Commission funding. This suggests that it is managed by constituted authority, but it is unclear whether it is principally engaged in generating ephemeral information or whether it invests in the curation of information. Smart Citizen is a project which aims to enable residents to respond to environmental air quality and noise pollution issues. Still in fundraising mode, this project is supported by the Institute for Advanced Architecture of Catalonia, Fab Lab Barcelona, and Hanger, an art research and production center, a mix of organisations that might be expected to adhere to the precepts of constituted authority.

There is little indication of the extent to which resources are devoted to transforming ephemeral flows of information into curated information for reuse and further application. The mobilizers are mainly formal science institutions which are supporting 'open science' and targeting a pool of dispersed participants with varying skills. The participants themselves may be motivated by games, prizes, or recognition, or by their perceived contribution to scientific enterprise.

Some projects mobilised by formal science and informed by constituted authority do appear to be sponsoring ephemeral information flows. Cases include the CSA sponsored Zooniverse, an online hub for 'citizen science' projects (mainly about space). PyBossa is hosted by the University of Geneva and supported by the Open Knowledge Foundation and CERN's Citizen Cyberscience Centre. It provides an online platform for anyone to launch projects involving human cognition such as image classification, transcription, or geocoding. However, these kinds of projects seem to be regarded as instances of 'citizen science' in which formal science conventions are privileged (Haklay 2011; Cooper et al. 2007; Wiggins and Crowston 2011).

#### *Loosely connected online group crowdsourcing*

The boundary between formal science and loosely connected online groups in terms of the conventions of constituted and adaptive authority is particularly blurred in the following cases. These examples appear to be mobilised by individuals or groups that seem to have a preference for adaptive authority and the websites show evidence of the retention of digital information, but there is little sign that information is being curated in the service of problem solving in the scientific sense. Examples are: Nightskiesnetwork, a site for amateur astronomers who view and share broadcasts of the night skies using home-built observatories and which supports interactive responses to queries. This network is sponsored by donations, does not host copyrighted content, disallows the selling of content, and has clear norms governing the conduct of participants. Astronomers Without Borders promotes the sharing of data and knowledge. It has a project council, national coordinators, and is open, although it also has a private members space. This suggests that while adaptive authority may be privileged, it also adheres to some of the principles of constituted authority. In the public space, there is little indication of an interest in the curation of digital information, but this may be different within the private members' space. These science-oriented examples appear to be mobilized from the bottom up.

Crowdsourcing is being used to mobilise responses to environmental problems and crises following natural disasters. In some of these, the management of information commons created by citizen participation seems to be very predominantly aligned

with adaptive authority. For example, Radiation Map is a monitoring and mapping initiative of volunteer participants in the Russian Far East which was mobilised after the tsunami in Japan and the Fukushima radiation leaks (Plantin 2011). Citizens took radiation readings, analysed the data to assess the risk of radiation, challenged media reports and recorded areas of contamination in Russia. The information was ephemeral in that there was no link to Russian science or government institutions, but there were limited, resource constrained, efforts to curate some of the otherwise ephemeral information flows. Let's Do It World links mapping and monitoring of waste and illegal dumping with local citizen clean-ups. An open source World Waste Map supports the coordination of clean-up teams. In this case, the information is not time critical, it is curated 'content', but it is not validated by the norms of formal science. It is supported by business system software companies, a passenger and cargo shipping company, and non-governmental organisations. As such, it may be subject to tensions between the sourcing of digital commons and copyright protected information. There appears to be minimal effort devoted to digital (scientific) curation of the ephemeral information flows at this website, again mainly perhaps due to resource constraints.

A well-documented case is the deployment of Ushahidi following the Haiti earthquake to collect information and visualize data (Gao, et al. 2011). In this case, participants' messages were used primarily by international relief organizations. Mobilized by the Ushahidi Organisation (Ushahidi in Swahili means testimony) and International Network of Crisis Mappers, organisations preferring adaptive authority, it was also sponsored by Tufts University and the UN Office for the Coordination of Humanitarian Affairs. Although it is engaged in curating information and privileges adaptive authority, it faced the challenge of managing large quantities of ephemeral data and it included involvement of organisations operating mainly in line with constituted authority approaches. Another illustration of the use of the Ushahidi platform is Russian Fires, an initiative aimed at facilitating emergency response aid during wildfires in western Russia which threatened many lives (Asmolov 2010). Mobilised by volunteers, the principal purpose was not mapping or curating information, but instead, facilitating crowd-to-crowd responses. Activists mobilised volunteer fire fighters and produced instructions facilitated by an Ushahidi platform-based Help Map. Information was aggregated and organized by category, geolocation and time, but there is little evidence that the initiative was able to digitally curate (in the sense understood by formal science) the information for future reuse even though the information is organised by category, time and location.

In contrast to the formal science constituted authority initiatives which tend to be technocratic and oriented to producing scientifically validated information, adaptive authority initiatives often are mobilized in conflict situations between local groups and government authorities and local groups of concerned citizens who are seeking to develop an evidence base and action plans (Callon 2003; Haklay 2011). In addition, the initiatives of loosely connected online groups often employ adaptive authority and generate large amounts of ephemeral information. In many instances, they are the result of 'hastily formed networks' (Denning 2006; Yap 2011) which may dissipate when the focus of the initiative becomes less salient or pressing. This makes it difficult for such groups to acquire the means to ensure that their data are transformed from accumulations of largely ephemeral, unmoderated or validated information into

digitally curated information that could be valuable to formal science professionals and/or to governments or public authorities with a remit for social action.

### *Hybrid crowdsourcing*

A final example is Global Pulse, an initiative explicitly aimed at convergence between practices associated with both constituted and adaptive authority and with building capacity for curating large volumes of otherwise ephemeral digital information. Global Pulse was presented by the United Nations as a Real-Time Big Data initiative. It was launched in 2009 to employ innovations in digital technologies to ‘help decision-makers gain a real-time understanding of how crises impact vulnerable populations’ (UN Global Pulse 2012: i). The initiative aimed to support call logs, mobile banking transactions, user-generated content (blog posts and Tweets), online searches, and satellite imagery. It was intended to rely on crowdsourced data collection and analysis to provide information to complement official statistics, survey data, and early warning systems. The aim was to combine sources of information to create verified information resources, providing feedback to policy makers and practitioners in the field that would reduce time gaps between information collection and institutional responses for humanitarian assistance and emergency relief.

Unsurprisingly, given the different social technologies of constituted and adaptive authority employed by formal science and loosely connected online groups who were to participate in this crowdsourcing initiative, it has encountered conflicts associated with privacy and ethical issues around data collection (including the willingness of local participants to be interviewed) and around issues of information access and sharing. In addition, some of the data upon which it relies is held by companies, formal science institutions and governments, leading to legal challenges over information access, to disputes about information secrecy and to concerns about the reputations of the participating organisations.

Global Pulse brings together in the digital information commons organisations which privilege adaptive authority such as OpenStreetMap which is engaged in ‘crowdfeeding’ (Meier 2009), by providing a basis for rapid action responses based on ephemeral information. It also works with United Nations organisations which privilege constituted authority and different knowledge cultures with respect to privacy, data control, and information verification (UN CITO 2012). UN officials suggest that ‘organisations involved in crises often develop what we call “point solutions”, instead of “integrated solutions”, to manage crisis information’ (Stauffacher et al., 2011: 5), highlighting the tensions between the priorities formal institutions and loosely connected online groups. One experienced crowdsourcing practitioner observes that ‘balancing top-down and bottom-up requires more serious reflection than its previously been given’ (Currion 2011: 40). In crisis and emergency situations, the emphasis is often on citizens and immediate action, regardless of how ephemeral the information is (Fung, et al. 2007; Gow and Waidyanatha 2011).

The verification or curation standards of formal science do not accord with action-oriented crowdsourcing initiatives even when the aim is to strengthen the basis for coordinated collective action. Thus, while crisis and emergency response agencies are taking advantage of crowdsourced information using Twitter, Facebook and many other open digital platforms, they tend to do so within an overarching framework for

managing inter-agency procedural approaches which continues to privilege constituted authority and this often does not coincide with the values of those engaged in bottom up crowdsourcing activities (Goldfine 2011).

*Summary*

The matrix in Table 1 locates the examples discussed in this section along two dimensions: primary social technology (constituted or adaptive authority) and primary information approach (curated - in the sense intended by formal science professionals – or ephemeral). Developments may be underway that would suggest a greater blending of approaches than is visible in this static classification and which would be revealed by further empirical research. The aim of this discussion is to highlight the conflicts that are likely to emerge in cases where crowdsourcing involves multiple groups with different approaches to collective action in the digital information commons.

Table 1: Mode of Authority and Information Perspective

<b>Authority</b>	<b>Digital Curation of Information</b>	<b>Ephemeral Information</b>
<b>Constituted</b>	LHC@Home GalaxyZoo Oldweather <i>Global Pulse</i>	Zooniverse PyBossa WideNoise Smart Citizen
<b>Adaptive</b>	Radiation Map Haiti Ushahidi <i>Global Pulse</i>	NightSkies Network Astronomers Without Borders Lets Do It World Russian Fires

Examples of crowdsourcing projects are depicted in Table 1 to illustrate the different emphases on constituted or adaptive authority and on managing access to digital information resources, in some cases, favouring efforts to digitally curate information and, in others, preferring to generate timely information that, for the most part, remains ephemeral. In the case of initiatives in the ephemeral information column there may be efforts to curate information in the sense intended by those interested in content curation as discussed in the first main section of this paper. However, even when content curation is built into the online crowdsourcing platform design, it does not undergo the kinds of curation processes expected by adherents to the norms of formal science professionals.

The institutions of formal science, government and other public organisations tend to favour the top right hand cell of the matrix. Constituted authority is characterised by hierarchical practices and by an effort to control and validate information in accordance with received scientific method. Adaptive authority favours bottom up initiatives usually sponsored by loosely connected online groups as indicated by the lower half of the matrix. This analysis is presented at a meso or group level. In some cases, of course, individual participants in crowdsourcing may have multiple identities, participating in both formal science and loosely connected online group

initiatives. The extent of such boundary crossing opens an interesting avenue for empirical study.

It might be argued that the only solution to ensure the digital curation of ephemeral information flows is a move into the constituted authority/curated information quadrant of the matrix. This might be achieved by invoking laws of copyright to secure rights of access to use this information and to create incentives for its curation. However, the rapid spread of commons-based online crowdsourcing arguably is changing this singular view of the best way to generate usable knowledge. Relatively little attention is being given to the future shape of commons-based initiatives that struggle to build bridges between these forms of constituted and adaptive authority. To create opportunities to curate large amounts of data, we know that collective action aimed at managing the commons requires a framework of rules that is well matched to local needs and conditions, involves opportunities for participation in changing the rules, and encourages respect for the norms of disparate commons-based groups (Ostrom 1990). In the contested arenas of big data and crowdsourcing that aim to provide commons-based information welfare enhancing solutions, it is essential to better understand the variety of approaches that is being developed.

It is crucial to emphasise that ‘technologies are not merely tools or techniques, but entail a constellation of methods, materials, interpretations, conventions, understandings, skills, theories and social relations that collectively constitute a socio-technical system or ensemble’ (Hackett 2011: 28). This preliminary analysis of the two dimensions in the matrix in Table 1 and the selected crowdsourcing initiatives shows that there is boundary crossing within the spaces created by the digital information commons. Whether this gives rise to more systematically curated and accessible information that can be applied in response to societal problems appears to depend on the aims of those involved, the identities of the mobilisers, and the primary intended beneficiaries. Other factors include ease of participation, the skills base required, and by whom competence for participation is assessed. All these would benefit from in-depth research based on comparative case studies.

## CONCLUSION

Too little is known about how design principles for the information or knowledge commons apply in large, complex, commons like the information commons (Hess 2012). Such principles encompass the issues of authority that are central to the analysis in this paper. Instances where formal science and loosely connected online groups are experimenting and learning to address challenges at the intersections depicted by the cells of the matrix in Table 1 are proliferating. Formal science proponents of constituted authority may seek to limit access to information resources by proponents of adaptive authority and they may persist in underinvesting in the curation of the ephemeral information generated by loosely connected online groups. They may seek to bypass all those who do not conform to their norms for validating digital information as useful knowledge. As the ‘big data’ phenomenon continues to challenge both groups, there is a need for empirical examination of who is being included and excluded from constituted authority-led information initiatives (Boyd and Crawford 2012).

Alternatively, the Global Pulse initiative provides one early, not yet fully successful, example of the possibilities for building bridges between proponents of constituted

and adaptive authority in the information commons. It suggests that solutions can be negotiated, but that proponents of constituted authority will need to become more attuned to the dynamics of producing large ephemeral flows of information, to the exigencies of immediacy and real time challenges, and to adaptive authority modes of organisation in the information commons.

From the perspective of formal science and other top down constituted authority institutions such as government agencies and United Nations organisations, adaptive authority seems to present threats when loosely connected online groups start to compete for the resources required to curate information. They may be charged with degrading the information commons if they do not operate in line with constituted authority conventions of information verification. Nevertheless, when ephemeral information flows are generated, loosely connected online groups are often motivated to curate their information, although voluntary subscriptions to the online activities may not provide sufficient financial resources to do so or they may not be sufficiently embedded in the cultures of their communities (Gow and Waidyanatha 2011).

Policy measures may be needed to underpin collaborations between formal science and loosely connected online groups through contract agreements to finance the curation of information to foster new forms of hybrid approaches to managing the information commons. This approach is likely to fail, however, if contracts are used to exert constituted authority through inflexible demands with respect to who may access information, to impose rules with respect to the collection and retention of data that may be resisted by local groups or to delay the use of information in order to engage in time consuming verification procedures. Loosely connected online groups are likely to resist agreements of this kind.

Effective policy measures require a better understanding of emerging hybrid forms of collective action if they are to encourage the application of ephemeral information flows to both time critical problems and for the accumulation of useful knowledge as a basis for learning how to address future problems. Within formal science there is an intense debate about the enlargement of the information public domain and provisions for 'fair use' of copyright protected information (DuLong de Rosnay and Carlos De Martin 2012:xvi). Conflicts here are about the information ownership model. This paper indicates that it is also essential to focus on the conflicts between alternative means of managing collective action within the information commons itself.

This is an issue that goes beyond a consideration of the rise of the new invisible college of science based on global digital interactivity (Wagner 2008). It raises questions about how the increasing granularity and modularity of information related activities supported by new technical designs for interaction in the information commons (Benkler and Nissenbaum 2006) are likely to be accommodated in the medium term by formal science professionals and by loosely connected online groups. If we are to maximise the potential societal benefits from greater synergies between the online activities of formal science and those of loosely connected online groups, it is insufficient to argue that all that is required is to liberate information from the prevailing copyright regime or harness the potential speed and reach of distributed networks in generating data. Much greater effort must be directed to understanding the dynamics of the full array of online information and communication practices in the information commons.



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