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Supply of Online Environmental Information to Unknown Demand: The Importance of Interpretation and Liability Related to a National Network of River Level Data

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ABSTRACT *Public authorities that collect data on the environment increasingly offer online public access to information, but they do not always consider by whom such information is used and for what purposes. And where they do, demand may not be homogenous or sufficiently known, thus adding to the difficulties of which information should be presented in what ways. Here we discuss the main issues in the process of supplying online environmental information to unknown demand, as identified by interviewees from both sides of online environmental information supply. Our focus is on river level information collected and presented by the main Scottish water regulator. Two main areas came to the fore:* liability *of the supplier regarding consistency and quality of the provided information; and* interpretation*, related to discrepancies between science-based expert and layperson understandings. In light of the new societal role that this regulator aspires to – that is, replacing 'command and control' regulation with 'command and covenant' stewardship – this case study offers insight into the two areas proved key to institutional decision-making about environmental data display, thereby generating new insight into the dynamics of a digital society.*

KEY WORDS: communication, information governance, sensor network, dynamic data, user group profiling

1. Changing Nature of Supply and Demand of Online Information

In line with wider programmes that promote open public data (G8 Open Data Charter and Technical Annex 2013), and policy frameworks such as the EU Directive on public access to environmental information (2003/4/EC) and the Aarhus Convention (1998), public

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authorities that collect data on the environment are increasingly inclined to offer public access to online information (here understood as data with context). This may also be in the interest of public authorities themselves if they aspire – or are encouraged by government – to a new societal role, away from 'command and control' towards 'command and covenant' types of natural resource governance (Arts & Leroy 2006). The basic idea is that improved access to environmental information nurtures engagement with the (local) environment and may even lead to citizens contributing to the management thereof (Measham & Barnett 2008; Harding-Hill 2012). As such, this idea connects to other concepts that are deemed good practice within recent natural resource management discourses, such as stakeholder inclusion (Fleischhauer *et al*. 2012), citizen science (Bäckstrand 2003), integrative natural resource management (Macleod *et al*. 2007) and social learning (Blackmore & Ison 2007).

The changing nature of supply and demand is also strongly influenced by developments in information and communications technology (ICT – especially the internet) which have been shaping many aspects of contemporary societies (Castells 2010). In the environmental domain, sensor networks and other novel geospatial cyberinfrastructures, for instance, have revolutionised the generation of (real time) data, and thereby provide new opportunities for data and information communication (De Longueville 2010; Campbell *et al*. 2013). As a result, public authorities that seek to explore new (often digital) possibilities for interaction with citizens find themselves reconsidering traditional communication forms of one-directional information flow. But there are many barriers within public authorities that inhibit adaptation of digital innovation, related to, for example, lack of human and financial resources, path-dependencies, silo-ed departments and agencies, bureaucratic procedures and differing views on the remit of digital technology (Kamal 2006).

Arguably featuring less prominently in the literature are examinations of issues relating to the process of supplying of online environmental information to unknown demand. Public authorities, particularly environmental regulators, may hold such large quantities of data that it is not obvious what should be made accessible, how material should be presented (e.g. raw data or also interpretation thereof), or in which way demand should influence information management and supply. It may also be unknown who would use the data and for what purposes. In this paper we aim to establish what the underlying processes are of these barriers to improved information supply. More specifically, we ask: *What are the main issues in supplying online environmental information to unknown demand?*

2. Methods and Focus of Study

2.1. Methods

We answer our research question on the basis of a participatory research project (wikiRivers) in close cooperation with Scotland's largest environmental regulator (Scottish Environmental Protection Agency – SEPA). wikiRivers aims to further understanding and increase the effectiveness of environmental information communication, and explore new applications of digital technology (Macleod *et al*. 2012). We conducted 15 semi-structured, in-depth interviews (11 in person, 4 by phone) with SEPA staff across the organisation and in different levels of responsibility. Interviews were transcribed verbatim and analysed with NVivo 10 software. To supplement understanding of the supply side, we also interviewed 32 randomly selected users of the river level web pages (semi-structured phone interviews).

2.2. Focus of Study: Scotland and SEPA's River Level Web Pages

Scotland is a particularly interesting case for our study given that it has relatively new governmental bodies. SEPA, for example, was established in 1995, just ahead of Devolution. Since the arrival of the EU Water Framework Directive (2000/60/EC), SEPA – responsible for its implementation – had to significantly alter the way it regulated Scotland's water environment. Instead of upholding a strict 'command and control' regime driven by technical experts (i.e. the conventional approach in SEPA's existence), it had to start considering socio-economic aspects of environmental systems (Blackstock *et al*. 2005). However, such rhetoric and intentions are notoriously hard to achieve in practice, and while progress has been made on this front, there is still much room for improvement (Ioris 2008).

Our project is centred on SEPA's best visited part of its website: the river level web pages (http://www.sepa.org.uk/water/river_levels/river_level_data.aspx). Each page provides dynamic river level information (updated once a day or more) for one of 333 gauging stations across Scotland, divided over 232 rivers in 107 catchments. The online information from each gauging station consists of: (i) a graph depicting the river level over the past three days; (ii) a table with general information about the station; and (iii) an indicator that puts the last recorded water level into the context of previously recorded levels at that station. One of the main reasons for SEPA to record river levels is to calculate river flow rates, which are used, for example, for the anticipation of flooding events (cf. Black & Cranston 1995). While SEPA's statutory obligation includes flood warning service, SEPA is not legally obliged to communicate river level information to the public, and as such this information provision can be seen as a gratuitous service. Google Analytics software shows that the river level web pages have drawn on average around a million visitors per annum in recent years.

3. Results

3.1. Context: Historical Development of the Pages

The river level web pages have always been a one-directional information source. They started off as an experiment in 2000 by a small group of SEPA hydrologists, who uploaded river level graphs for about 30 gauging stations to the internal SEPA computer network. About three years later, the SEPA web team took an interest in it, which resulted in apresentation of graphs from about 90 gauging stations on the Internet. In 2006, a new data management system came into place which facilitated central collection and organisation of all hydrometric data. This made it easier to put internal information online, and in the years thereafter there was a gradual increase in the number of gauging stations for which data was presented online. SEPA launched a mobile version of the website in April 2013. From the very start, the drivers for developing the web pages seem to have been indistinct. One interviewee thought that it happened along the lines of 'hey guys would it not be great, we could put our data on the web', whereas a different interviewee stated that the only reason for it appearing on the website was 'because (…) we already produced this information for our own internal uses'. There was agreement, however, that the development was ad hoc, low key and bottom-up. 'We struggled for years to get funding', noted one of the people involved from the beginning; 'we had just sort of steal time (…) because there wasn't any corporate priority for it'. The current river level web pages, said one interviewee, were the result of 'a best attempt at guessing what people would want to know'. As

such, the development of the current pages exemplifies SEPA's 'old' ways of one-directional information communication, but today, 'engagement' (with stakeholders) is one of three core values in SEPA's current Annual Operating Plan (SEPA 2013).

3.2. Regulatory Liability: Separation from Flood Warning System, and Quality of Information

Our interview data brought out that a structural barrier within SEPA towards a more proactive supply of river level information is related to two spheres of regulatory liability. First, the river level pages are currently entirely separated from the SEPA's flood alert system (in contrast to, for example, the English equivalent of SEPA, the Environment Agency, which presents river level graphs in combination with flood warning messages). A member of SEPA staff justified this situation by pointing out that that the river level web pages are not designed to be resilient under circumstances of heavy online usage (in contrast to the flood warning system). However, flood alerts and flood warnings are often not locality specific and, as acknowledged by interviewees from both the supply and demand sides, this situation drives citizens to visit the river level web pages, and subsequently make inferences about local flood risk on the basis of the presented river level information and other (online) information available, such as weather forecast.

As one interviewee puts it:

> If you live in a region that is dominated by a river and there is a gauging system and you know there is information on SEPA's website (…) albeit there might not be a flood warning (…) but if I can go on their website and it is telling me that the river is half a metre below its danger threshold point then I am going to do that.

The outcomes of potential inferences may be less reliable than hydrologists' assessments (if these were sufficiently location-specific) and for that reason potentially more hazardous in a high flood risk situation (cf. Boyes & O'Hare 2003).

The second sphere of liability concerns quality (precision, consistency, accuracy) of information; the idea among some of the SEPA interviewees that the current river level information will need to be further quality-controlled and processed by staff before it can function as a solid basis for more advanced presentations of river (level) information aspects. Interestingly however, interviewees from the demand side were well aware that the information they currently use may not always be as accurate, precise or consistent as it could be (e.g. a desire for more frequent update was repeatedly put forward). Yet, there was a general sense that any information (with a predominantly acceptable level of quality) is better than no information, and none of the interviewees hinted at perceiving SEPA as liable for any inferences drawn by the interviewees on the basis of poor quality information. Instead, non-availability of any information from the gauging stations that SEPA may hold, such as flow, water temperature and precipitation records, was bemoaned.

3.3. Interpretation: Discrepancy between Science-Based Expert and Layperson Understandings

The interviews brought out a clear discrepancy between science-based expert and layperson understandings. For instance, a SEPA hydrologist pointed out:

> we get quite a number of people who will ask us for the average daily level at a station, which is actually a totally meaningless statistic because it is not a normal distribution, so when they ask that question they do not really know what they are wanting (…) we have to spend half an hour on the phone with them and figure out what it is that they are trying to figure out.

But the issue can also relate to differing interpretations of the same information (cf. Bracken *et al*. 2013), and how that is subsequently used for a user's river activity or specific interest. Many interviewed users found the 'current level indicator' not useful, as it often did not correspond to their experience of the actual river level. Particularly when the river level was deemed very high, it was often not reflected by the 'current level indicator' as 'high' but instead as 'normal' – because of the normalising effect of extreme historic records. From the interviewed fishermen it was also clear that they tend to interpret river level in the context of summer lows rather than absolute lows, and moreover prefer information to be communicated in imperial rather than metric units. It could be said that these points are a matter of SEPA's Communications department to deal with. However – and more fundamentally – what is also denoted by the difficulties of connecting these different understandings is that SEPA itself is ambiguous about how it should go about in external river level information supply. It wants to maintain an image of rigour, objectivity and sound science. However, it also realises that it can reach most members of the public if it communicates complex information in commonly understood language.

4. Discussion and Conclusion

Derived from our interviews, two main barriers to supplying online environmental information to unknown demand, are liability and interpretation. With regard to liability, we observe a discrepancy between safety for the supply side in information that it does not communicate (i.e. the regulator not being liable for, e.g. potential data quality issues), versus potential risk for the demand side in making inferences about flooding in the absence of sufficient information. We argue that accountability of the supplier to users of information does not only need to relate to consistency or quality of the provided information itself. Protocols for data collection, as well as openness about potential errors and uncertainty may equally function as trust-building blocks (cf. Mol 2008). It seems there is also scope for sharing responsibilities with local citizens in terms of control and surveillance without compromising rigidity of data collecting protocols (e.g. reporting on the state of a gauging station by a local fishing community) (cf. Bäckstrand 2003). Such two-directional engagement could result in more integrative interaction between all stakeholders because of the blurring division between demand and supply (Montanari *et al*. 2013, cf. 'adaptive co-management', e.g. Berkes 2009).

Concerning the issue of interpretation, it should be considered whether user groups profiling and subsequent tailoring of information according to those profiles, is a desirable way forward to bridge discrepancies between science-based expert and layperson's discourses (cf. Dewulf *et al*. 2011), as well as a way for authorities to better connect with the public. In SEPA's case, it has committed itself to providing (paying) customers, partners and other stakeholders with 'excellent environmental information and advice' (SEPA 2010: 14), and 'to embed a culture of the customer and customer excellence' (p. 38). In general terms, like other public organisations with a range of customer groups, SEPA

needs to be clear on the role it wants or needs to fulfil in society. In concrete terms, it has to decide which 'customers' to prioritise and target specifically. This question is also related to the remit of SEPA as a non-departmental public body of the Scottish Government; for a large part it is funded by taxpayers' money. With regard to the river level web pages, it arises from the interviews that perceptions within SEPA are ambiguous; are its targeted 'customers' commercial businesses who pay for the river level information, or perhaps any member of the general public using the information? Still, the majority of SEPA interviewees think that information communication to the wider public has priority, but then the question arises whether the main focus should be on the main user groups within that collection of the wider public.

The challenge of any information provisioning will be to not lose sight of minority user groups (Warren 2007), and indeed to consider to what extent lack of internet deprives other information users from access. Furthermore, it should be borne in mind that – at least in case of river level web pages – many user groups apply their own calibrations and interpretations in relation to their activity or interest. In that sense, a strong argument can be made for easy accessible information that allows for (bottom-up) technical developments such as apps. Facilitating such processes by public authorities through the provision of expertise could further cement interaction with stakeholders, while not forgetting that different user groups have more or less resources and expertise to process information.

These challenges are essentially about the democratic content of information governance, and it is unlikely that public authorities will find guidance for this in its stipulated statutory obligations (in the case of SEPA, see Blackstock *et al*. 2006). Fortunately, amongst the views of the SEPA interviewees to deal with such challenges, there are many parallels with studies on ICT innovation in the public sector that argue for: continued 'market' research; a better connection between institutional agendas and broader societal agendas; a focus on concrete manifestations of the problems at micro-levels; engaging with all stakeholders (including 'hidden' ones); and the bringing together of these differing perceptions in a creative setting for further solution development (Van Duivenboden *et al*. 2006; cf. Montanari *et al*. 2013).

Still, many practical, and ultimately also moral and political questions about the democratic content of information governance and distribution need to be discussed and dealt with in this process of supplying online environmental information to unknown demand. In the context of the (by environmental public authorities) desired transformation towards new societal roles, this should not be left in the hands of those authorities alone (Dunleavy *et al*. 2005; Bergsma *et al*. 2012). Moreover, it is important that all stakeholders involved are aware of and reflect on their own views on technology (Bekkers *et al*. 2006), and how these relate to political values (Bäckstrand 2004).

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