



Environmental communication in the Information Age: Institutional barriers and opportunities in the provision of river data to the general public



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ARTICLE INFO

Article history:

Received 19 November 2014

Received in revised form 14 August 2015

Accepted 15 August 2015

Available online 20 September 2015

Keywords:

Environmental regulator

Governance shifts

Innovation

ICT

River level

Scotland

ABSTRACT

In an era of increased human pressure on planet Earth, sound environmental governance regimes are more important than ever. Digital technologies are increasingly turned to by environmental regulators to aid governance and communication. We examine the 'behind the scenes' institutional dynamics of a public body in its digital information provision (specifically dynamic river level information). Based on in-depth interviews with staff across a large environmental regulator we have brought to light four pivotal areas of institutional dynamics: (1) institutional priority and path dependency; (2) management and resources; (3) institutional identity and interdepartmental dynamics; and (4) ability and willingness to change. We gained insight into explicit and covert barriers and opportunities in relation to digital information provision that are likely to occur in other public institutions too. Besides identified barriers that were of a technical, structural, managerial or cultural nature, arguably the most important barrier was conceptual, i.e. the prevalence of 'efficiency and efficacy' perspectives on information and communications technology (ICT) amongst staff, in which ICT is primarily perceived as a neutral solution in itself to a wide variety of issues. Opportunities were nonetheless present in the form of enthusiasm and some critical thinking about digital innovation among staff, and an emphasis on the importance of stakeholder inclusion in the design of ICT. We conclude that there is a need to connect institutional social learning with the development of 'conceptual perspectives' on ICT, in which ICT is not seen as a solution in itself, but as a set of tools in a wider transformational process, or as a lens to look at existing or new practices. This is more likely to strengthen cornerstones of contemporary environmental governance, such as improved information access and reconceptualisations of 'traditional' barriers of uncertainty, liability and distrust in relation to information provision.

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1. Introduction

1.1. Government, governance and ICT

The impacts of Anthropocene human activity are putting 'planetary boundaries' under pressure (Galaz, 2014). The role

and influence of national states to address society's failure to deal with environmental challenges (the 'Anthropocene Gap') is subject to debate (cf. Armitage et al., 2012; Duit, 2014). Still, states remain a prominent coordinator of environmental governance, i.e. "the set of regulatory processes, mechanisms and organisations through which political actors influence environmental actions and outcomes" (Lemos and Agrawal, 2006: 298). But their current approaches to facilitating interactions with and between markets, communities and international organisations (Eckersley, 2004; Galaz et al., 2012) often reveal 'democratic deficits', making them ill-suited "to respond to ecological problems in a reflexive and

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concerted manner” (Eckersley, 2004: 14). A potential route to overcome such deficits may be through the adoption of information and communications technologies (ICTs), which have revolutionised the capacity to gather, analyse, disseminate and use environmental information (Esty, 2004; Mol, 2006). Indeed, Castells’ notion of ‘the Information Age’ – in which the development of ICT has become a shaping principle of contemporary societies (Castells, 2010) – is also befitting the environmental domain, as ICT increasingly structures environmental management and governance (Mol, 2006, 2008). The latter has also been transformed under the influence of macro-level political reform from the 1990s onwards, partly in response to mounting public criticism and growing socio-ecological conflicts (Blackstock et al., 2005; Ioris, 2008). Many Western states are believed to move away from conventional forms of government as a result of so-called governance shifts (Keulartz and Leistra, 2008). These are supposed to represent a move away from centralised, top-down and expert-based regulation to an agenda of participatory and inclusive forms of governance (Van der Zouwen, 2006; Pahl-Wostl et al., 2011).

One level on which such governance shifts could take place is that of national public bodies or institutions (i.e. organisations invested with authority to perform tasks on behalf of society – Castells, 2010) responsible for environmental policies and regulation. Their environmental information provision to the general public is an area potentially strongly impacted by ICT developments, as well as by governance shifts. Such communication is expected to move away from a traditional one-way model of information provision in which recipients are treated as silent, passive and uniform. Instead, there would be increased sensitivity to the needs, identities and discourses of different user groups, and attempts to move beyond one-directional channels of communication in favour of open dialogue and interaction. One of the main rationales is that the users’ input may lead to a higher degree of citizen engagement, so that ‘passive’ users become ‘active’ stakeholders in integrative environmental management with enhanced outcomes (Mostert, 2003; Mackay et al., 2015). The growing body of literature on e-governance (and e-government) is testament to these developments in changing modes of communication (Marche and McNiven, 2003; Torres et al., 2006). The adoption and promotion of e-governance has been claimed to be one of the greatest innovations in the public sector (Chadwick, 2003), with (potential) benefits including heightened levels of transparency and accountability of the public sector (Potnis, 2010), increased efficiency, reduced operational costs, and corruption prevention (Saxena, 2005). On the other hand, many challenges remain (Dawes, 2008), including the protection of citizens’ privacy (Jho, 2005), and the actual implementation of technologies (Allen et al., 2001).

While improved information provision may be a matter of self-interest for public authorities to increase public participation, it may also be a necessity to help maintain public support and legitimacy when dealing with complex, multidimensional environmental issues. Underpinned by the possibilities of the Internet and other ICTs, and in line with international legislations, conventions and programmes that promote public access to information (Mathur, 2009), innovation in institutions’ policies and practices may often be required to reach higher standards of information provision.

1.2. Institutional reform and ICT adoption

Environmental public authorities face new questions about how to improve information communication in ways that foster stakeholder engagement and increase the efficiency of public policies and regulation (Paavola et al., 2007; Mathur, 2009; Arts

et al., 2015). Mol (2008) shows how traditional approaches revolve around command-and-control mechanisms, economic cost of information provision, strict regulatory action, and information ownership regulation. Under new conditions of the Information Age and governance shifts, these approaches are inadequate to deal with contemporary socio-environmental challenges relating to, for example, information disclosure, transparency and reputation (Mol, 2008). Barriers are also constituted by institutions’ habitual modes of operation. In the face of complex, multi-level problems with high levels of uncertainty, public sector organisations often embody a culture of compromise. Dominant values such as standardisation and formalisation add to stability and predictability but discourage individual initiative and risk-taking and are therefore not conducive to innovation; such risk avoiding cultures have been called “rather dynamic in their conservatism” (Bekkers et al., 2006: 13).

A requisite for public bodies to improved information provision in the Information Age is the adoption of novel ICTs (Mathur, 2009). But this may not be a straightforward process, as it can break accepted patterns and influence practices beyond its own realm (Lanzara, 2009). Here, we examine public body reform in relation to an institution’s capacity to adopt digital innovation, and ask: *What are the institutional dynamics relating to digital information provision by an environmental regulator, in the context of the Information Age and governance shifts?* To increase the scope for depth of understanding of this fundamental relationship between institutional dynamics and information provision, we take a case study approach (Flyvbjerg, 2006) and focus on an environmental regulator in the United Kingdom (UK).

1.3. Context of study

In their evaluation of ICT modernisation across several European countries, Bekkers and Korteland (2006: 41–42) typified dominant political values in the UK as “responsiveness, efficiency, and value for money”, and they identified the dominant shift as one “towards citizens”. The goals identified by these authors comprise: meeting the demands of citizens and businesses, improved public and civil service delivery and Information Age government. Our focus is on Scotland, a country that has been part of the UK since 1707, but that has been in the process of Devolution over the last decades (e.g. Scottish Parliament was re-established in 1999). In this semi-autonomous form, Scotland has responsibilities over environmental policies and environmental regulation, and relatively new governmental bodies that aim to progressively implement the supposed ‘positives’ implied in the discourse of the governance shifts (Scottish Government, 2009; Arts et al., 2014). The Scottish Environment Protection Agency (SEPA – established as a result of the Environment Act, 1995) is an executive non-departmental public body of the Scottish Government and Scotland’s main authority on environmental regulation. For this reason, and because of its sheer size as a public body in the Scottish context (22 offices and around 1300 employees), SEPA is an appropriate case study on ICT related issues.

Water management is arguably one of the most dynamic parts of SEPA’s regulation duties. Being the leading agency responsible for the implementation of the EU Water Framework Directive (2000/60/EC), SEPA was required to construct a novel set of governance mechanisms. Before this, water management had been the exclusive task of technical experts (Pahl-Wostl et al., 2007), but now SEPA had to take into account socio-economic aspects of environmental systems (Blackstock et al., 2005; Tippett et al., 2005; Macleod et al., 2007). It appeared that such aspects were hard to achieve in practice (Mostert, 2003; Blackstock et al., 2005, 2006; Ioris, 2008).

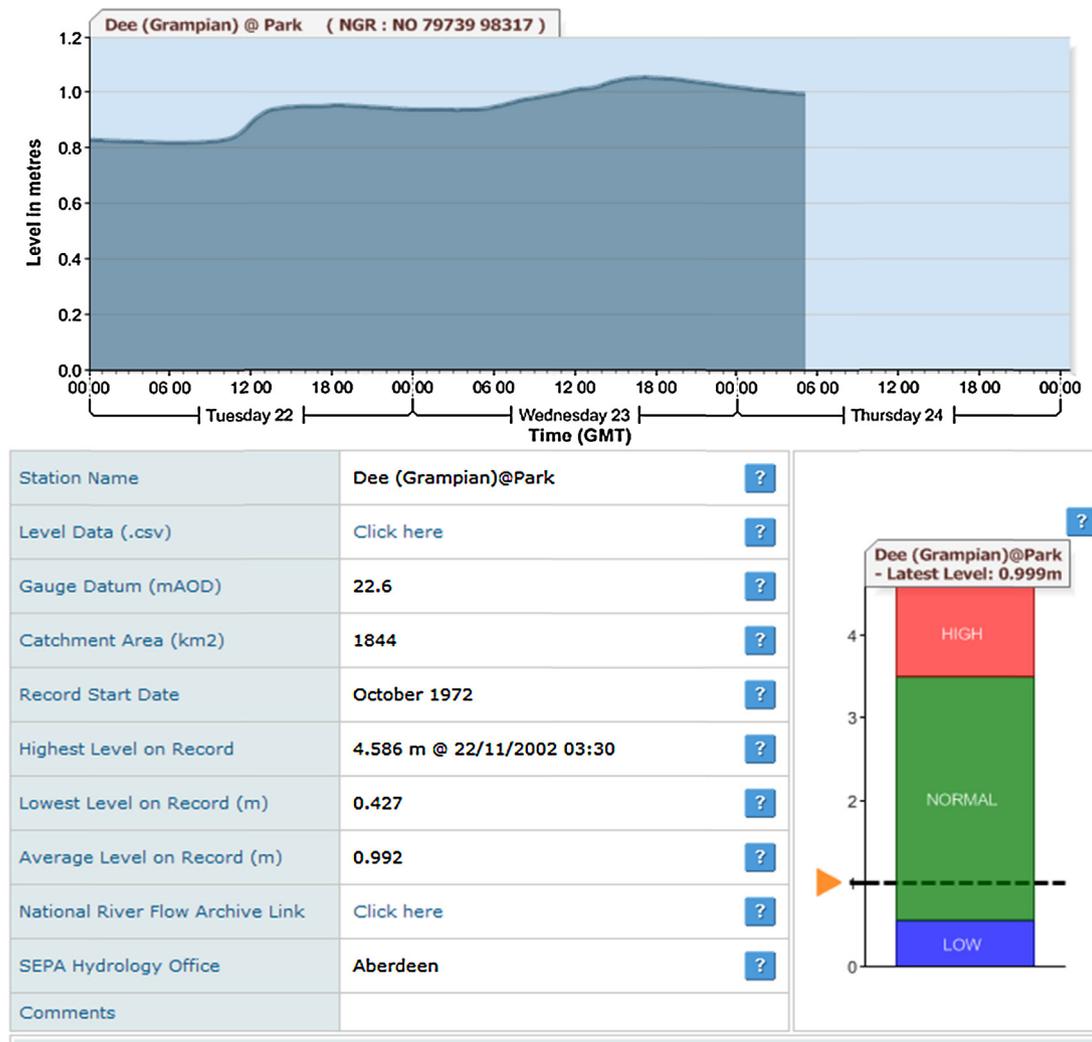


Fig. 1. Example of a SEPA river level web page.

For the purpose of our investigation, we focus on SEPA's river level web pages (<http://apps.sepa.org.uk/waterlevels/>) – an example of the organisation's digital information supply (Macleod et al., 2012; Arts et al., 2015). They comprise dynamic information (understood as data plus context), updated once a day or more. With on average more than two thousand visits a day between 2011 and 2014, the river level web pages are amongst the most popular pages of SEPA's entire website (based on Google Analytics data). The development of these web pages started in the year 2000 with river level graphs of about 30 river gauging stations on SEPA's Intranet. This information was then also put on the Internet and that of more gauging stations gradually followed. In 2014, river level information was presented from 333 gauging stations at 232 rivers in 107 catchments across Scotland. The online presented information for each gauging station consisted of a graph capturing river levels over the past few days, a table with general information such as “average level on record”, and a scale which put the last recorded river level into the context of previously recorded levels at the station (see Fig. 1). River levels are primarily recorded by SEPA to calculate flows in the river, which is important for water management water including flooding events (cf. Black and Cranston, 1995; Hannah et al., 2011). While SEPA's statutory obligation includes the provision of a flood warning service, it is not legally obliged to communicate river level information to the general public, and as such it can be seen as an additional service that SEPA provides to the public.

2. Methodology

After a review of SEPA's policy-documents and regulatory procedures, and preliminary meetings with some of its managers, we held in-depth interviews with various members of staff. The latter was required to address our research question because the institutional dynamics surrounding the communication of environmental information were not visible to outsiders, nor did it emerge from our review of documents issued by the regulator. This approach was in line with a so-called ‘practice based approach’, which emphasises the importance of the values of actors, the roles they adopt and the contexts in which they operate (Van der Arend and Behagel, 2011). In the fifteen semi-structured, in-depth interviews, eleven of which were held in person in different SEPA offices and four over the phone, we operationalised the research question by examining four main areas: (1) historical developments of the current river level pages; (2) how current digital communication within SEPA is valued and envisaged for the future; (3) the main drivers and inhibitors of innovation in online information communication; and (4) how developments around river level information provision sits with other communication, information technology and cyber-infrastructure developments. With regard to all four topics, we encouraged interviewees to critically reflect on their organisation. In return, anonymity was guaranteed to allow interviewees to speak freely about their organisation. It was recognised by all those involved that the

research was dealing with sensitive issues, as it required a critical reflection upon the performance and possible shortcomings of the regulatory body.

Interviewees were identified through a 'snowball method', that is, starting from our main points of contact, we asked for recommendation of other relevant interviewees within SEPA. We specifically asked interviewees to nominate relevant colleagues from a range of departments, and if possible also operating on different managerial levels. The criterion of 'relevance' was defined by the interviewees' involvement either with the river level web pages, or digital innovation. Our sampling strategy resulted in (the desired) representation of: (1) staff across different managerial levels – from individuals in top management to regionally and locally operating hydrologists; and (2) all the relevant SEPA sections to our research focus including Communications, Ecology, Environmental Strategy, Hydrology, Information Systems, and Scotland Environment web. Despite the sensitivity of the research topic, the response rate to invitations was around 90%.

All interviews were recorded (mean duration: 43 min) and transcribed verbatim. Following a pilot read of the transcriptions, the text was coded (in NVivo10) according to central, thematic nodes that emerged from the data. The results are presented in Section 3, where a plain description is provided of the most salient interview outcomes. Section 4 provides the authors' interpretation thereof (following the method of interpretative analysis – Yanow, 2007) and puts the case study findings in a wider context.

3. Results

3.1. Institutional priority and path dependency

Attitudes among SEPA staff towards the river level web pages were equivocal. On the one hand, the pages were widely recognised as successful and seen as a vehicle that could help SEPA to reposition itself in Scottish society as an environmental champion, rather than a regulator. On the other hand, there was a realisation that presentation of river level information to the general public was not part of SEPA's statutory duties, as opposed to SEPA's flood warning obligations (a recurrent contrast raised by interviewees). The latter therefore received institutional priority and was seen as an area "under such intense scrutiny, [both] political and from communities affected". Various interviewees pointed out that SEPA deliberately kept its flood warnings and river level information separate. It was made clear by interviewed hydrologists that river level information should not be used as a basis for flood risk assessments because of potential accuracy and updating issues. However, the interviews disclosed some other possible motives for keeping the two aspects separate. For instance, the river level web pages were not designed to be resilient in case of a technical break-down. One interviewee illustrated the non-strategic, ad-hoc early development of the pages by saying: "this was [a] best attempt at guessing what people would want to know". Another motive was wariness – both from a hydrological and liability point of view – of users inferring conclusions about flooding on the basis of river levels. Nonetheless, most interviewees indicated that numerous river level web pages visitors used them specifically because of an interest in flooding. Although various potential reasons for doing so came to the fore (e.g. flood information not being specific enough, or issued with too much delay), the key point raised by the interviewees was that the current flood warning system passively encouraged citizens to visit the river level web pages.

3.2. Management and resources

Many interviewees pointed out that financial and human resources were an important limiting factor of external information provision. This was deemed to be especially true for the river

level web pages, which had been developed over the years by virtue of a few very dedicated staff members. One interviewee pointed out: "people are saying 'yeah, we should be putting this stuff on the web', but (...) we keep shrinking and we keep losing people". A different interviewee had a similar point of view: "all of our resources and costing are taken up on [statutory] obligations so there is not really anything left over for what we like to be able to do". However, an interviewed senior manager said on the matter: "The organisation is very keen to use other approaches to meet our objectives, much more than before (...) it is about looking at sort of stepping aside from our regulatory powers and thinking, well, is there another way of doing this?" This latter quote is exemplary of other comments made by SEPA managers in which they reversed the issue of a shrinking budget to an opportunity for the organisation.

SEPA managers also pointed at the parallel development of Scotland Environment's website (SEweb <http://www.environment.scotland.gov.uk/>) – a website that aimed to bring together information held by a wide range of Scottish environmental organisations for different audiences (SEPA provides half of SEweb's funding, and is the lead organisation in this partnership of twenty Scottish environmental organisations). On the one hand, SEweb was seen by several interviewed managers and other staff as SEPA's flagship of best practice for developing novel ways of engaging with the wider public. Some interviewees thought that SEweb embodied SEPA's future external information provision: "more interactive" and "digital". On the other hand, it was argued by one interviewee that it had been set up "wrongly" because "what was not identified at the beginning was what the demand for it was, who the audience was". As the single ICT project that received a substantial amount of funding, there was also a concern that it took human and financial resources away from other areas within the organisation that could benefit from such innovation. However, on the positive side, according to some managers, SEweb could accelerate technological innovation in other areas, creating new linkages and synergies within (and outside) the organisation.

3.3. Institutional identity and interdepartmental dynamics

Some interviewees were critical of their managers' 'synergies with a shrinking budget' rationale. One person pointed at an expected gap between "people's ambition" and what "we will achieve". This appeared not to be solely due to lack of resources. According to many interviewees, communication between SEPA departments was suboptimal: "SEPA is almost split into two distinct parts": regulation and information. Others referred to "disconnects" between departments, or the "siloes" structure of the organisation. An interviewee explained that SEPA is a geographically distributed organisation across the whole of Scotland, which often made in-person meetings difficult. Furthermore, with integrated approaches becoming more important, work required input from multiple departments. Decisions on the river level web pages, for example, were the product of SEPA's Hydrology, Communications, Flooding, and IT departments. This added to the complexity of managing and further developing the pages, and as one officer pointed out, this complexity made it unclear from whom one needed to get permission to advance matters on that front. One manager spoke of staff guarding their disciplinary boundaries: "these frontier areas between disciplines that just do not get explored, which is disappointing". Critical thoughts also extended to external communication. Departments usually brought in staff from Communications as "an afterthought", whereas they should be consulted "right at the front end". Related to this suboptimal use of expertise was the feeling by interviewees that there was, on the whole, a lack of communication skills among staff. One interviewee in particular was self-critical on this topic: "I am not an expert in

asking people about stuff. My specialism is in telling people about stuff. (...) So it is kind of... different set of skills for me". And this was observed by another interviewee for the institution at large too, stressing the divide between scientists and regulators. "Are we equipped to communicate in a modern sense?" asked another interviewee. SEPA is not quite, and new staff would need to be employed for that, this person suggested.

3.4. Ability and willingness to change

Most interviewees were optimistic about SEPA becoming increasingly proactive in its external information supply, and many highlighted discontinuities with traditional institutional governance. 'Good communication' was generally described as (1) understanding the user and (2) tailoring language and content to the user. Despite the stated optimism, the development of the river level web pages was generally deemed suboptimal in the present-day context. Furthermore, the way interviewed SEPA staff thought about ideal information provision linked up to a new set of ideas about how SEPA should present and position itself in society. Related questions raised by the interviewees were: how SEPA should engage with stakeholders, and whether the latter are water managers or members of the general public visiting the river level web pages. Rather than focussing on "what the organisation wanted to get out there", there was a widespread belief that stakeholder engagement and co-development of digital innovation was important. The SEPA department responsible for river basin planning, particularly in their engagement with farmers, was recognised by several interviewees as spearheading this movement; by means of a broad range of engagement strategies, such as workshops and one-to-one visits, the involved SEPA staff was "not going [to farmers] with a tick-box mentality" and so "their approach becomes tailored". For many interviewees the notions of good communication and stakeholder involvement indicated wider institutional change. "I think the organisation understands that it needs to connect and interact with society, with the general public (...) and that is certainly the impetus behind a lot of the projects we are working on at the moment".

There were various explanations as to what prompted this change, including proactive senior managers, gradual mentality change across the organisation since the 2000s, and SEPA's "transformational change programme" (which dated from 2009 and aimed to deliver "an excellent customer experience" – SEPA, 2010: 38). While many interviewees argued that this wider institutional change went beyond managerial rhetoric, many of them did question the extent to which the envisioned management plans were implemented on the ground.

4. Discussion

We investigated the institutional dynamics around digital information provision by a regulator, and paid specific attention to the current context of the Information Age and governance shifts. Our case study approach allowed us to reveal institutional dynamics around digital information provision by a governmental body, which otherwise would remain largely invisible to the outside world. Whilst focussing on one regulator brings with it the specificity of the case, the importance of our findings lies in the fact that governmental bodies around the Western world are subject to 'pressures' flowing from the Information Age and governance shifts. Based on our findings, we expect that ambitions of governmental institutions in the Information Age have been nurtured by the opportunities that new ICTs provide. Information communication is often viewed to provide a vehicle to materialise such ambition. The envisaged benefits, such as transparency and public service improvement (Shadbolt et al., 2012) link in with the

broader political agenda of governance shifts that comprise a transition from government to governance (Keulartz and Leistra, 2008). The empirical results of this study brought to light four key areas of institutional dynamics that relate to these ambitions and agendas: (1) institutional priority and path dependency; (2) management and resources; (3) institutional identity and interdepartmental dynamics; and (4) ability and willingness to change.

4.1. Unfolding key areas of institutional dynamics

From the identified key area of *Institutional priority and path dependency* (Section 3.1) it can be derived that the barriers formed by ad hoc development of the river level web pages over time, and the lack of institutional priority, have resulted in segregation of two information platforms: river level web pages and flood warning information provision (note that the English equivalent of SEPA, the Environment Agency, integrates the two, and several interviewees argued that their institution in Scotland should do the same). The current situation may suit SEPA well: it can argue that it does provide those looking for extra river information with more (and almost real-time) information, yet it can deliver this at low cost and with minimal liability. This clear-cut split between river level and flood warning information provision – that, as we have seen, encourages citizens potentially affected by flooding to visit the river level web pages – is illustrative of 'old' approaches to information provision that in the long term are likely to be inadequate to deal with socio-environmental challenges (Mol, 2008). Moreover, it sits uncomfortably with the ambition and agenda that the regulator itself pursues. Indeed, the overall promises of the Information Age and governance shifts have not been materialised within SEPA on this point. The situation may give rise to issues with information access and transparency: many users may be subscribed to one system and not be aware of the other, and there is no full disclosure about the reasons for the clear-cut split to the public. In turn, these issues may act as barriers to optimal information provision to society, as well as to new relationships with stakeholders (Mostert et al., 2007; Bergsma et al., 2012).

Another key area was that of *Management and resources* (Section 3.2). What is clear from the friction between the senior management's 'synergies with a shrinking budget' rationale, and a critical stance towards this rationale by others within the organisation, is that there are conceptions of what the regulator 'owes' to the public. The first was formed by interviewees who strictly adhere to the importance of statutory obligations. The second was expressed by those who feel that the regulator has duties related to environmental information provision that go beyond that. The latter position was regularly underpinned by the notion that SEPA is partly funded by 'taxpayers' money, and that therefore all information SEPA holds should be open and freely accessible to members of the public. Whether the 'synergies' rationale can actually be realised remains unclear. Blackstock et al. (2005) emphasise the day-to-day pressures for SEPA staff, and as a consequence of those pressures a tendency of staff to stick to one's disciplinary expertise. Importantly, the managers proclaiming the 'synergies' rationale demonstrate a 'technological perspective on ICT', which revolves around efficiency and efficacy (Van Duivenboden et al., 2006). This approach can be described as 'instrumental', because ICT is seen as a set of neutral solutions, and foremost as a means to support organisation-related goals and interests (cf. Bekkers et al., 2006). The technological perspective lines up with approaches to the use of ICT by public bodies in the UK and more widely (Bekkers and Korteland, 2006; Shadbolt et al., 2012), and sits uncomfortably with the notion that a lack of financial resources is widely-recognised barrier to digital innovation (Tippett et al., 2005; Kamal, 2006).

With regard to *Institutional identity and interdepartmental dynamics* (Section 3.3), we found that many interviewed staff were critical of their institution's internal and external communication practices. There was deemed to be suboptimal communication flow (cf. Mostert et al., 2007) and little room for change (cf. Bergsma et al., 2012) between departments. However, the concealed issue within the institution is not primarily about the need for improved information communication, but about how this could be achieved. Crucial to that question is how a regulator is perceived by its own staff – notably what they think the regulator 'is for' and 'should be'. The friction comes down to a discord, with the regulator being seen as an institution of rigour, objectivity and sound science, but also with the realisation that it has a duty to the general public to communicate in understandable, non-technical language. The new conditions brought about by the Information Age and governance shifts do not come with hard-and-fast rules as to how such discord should be mitigated. But where a regulator is to increase its profile as a champion of the environment, and the central role it wants to play in people's daily interactions with the environment, our results show that ideas of rigour, objectivity and sound science may need to be re-conceptualised from within the institution itself.

The area of *Ability and willingness to change* (Section 3.4) provides pointers for how new conceptions of 'traditional' ideas like rigour and objectivity could be achieved. These pointers resonate strongly with literatures on social learning (Blackmore, 2007; Blackmore and Ison, 2007; Jiggins et al., 2007, see also 'adaptive capacity of institutions' – Gupta et al., 2010). From the way the focal institution engaged with farmers in river basin planning for example, there appears to be a feedback loop that marks a transition from a one-directional message transfer to a partnership approach. Staff perceptions about cultural shifts within the institution also suggest that relevant developments on this front do occur. The large variety of frames and actors on different levels as apparent from the interviews is conducive to that process (Mostert et al., 2007; Bergsma et al., 2012). In time, this may allow for double loop social learning, i.e. the inter-departmental reframing of issues and concepts (Pahl-Wostl et al., 2011), and subsequently shared social learning between the institution as a whole and other stakeholders in river management (Tippett et al., 2005; Pahl-Wostl et al., 2007).

5. Final discussion and conclusion: connecting social learning to conceptual perspectives on ICT

Against a backdrop of 'planetary boundaries' under pressure (i.e. the need to deal with the 'Anthropocene gap'), and an altering role of the state in environmental governance (e.g. to mitigate 'democratic deficits'), new possibilities for the application of digital technologies arise. Development of ICTs that are central to the Information Age, as well as new conceptualisations with regard to the role of government (governance shifts), provide institutions with seemingly better tools to meet demands. If successful, the consequences would not only entail more data access for larger groups of people, but also a move away from a "top-down political culture" where "the state becomes a powerful data monopoly, able to structure and homogenise the interactions between itself and its citizens" (Shadbolt et al., 2012: 16). Instead, improved communication would foster stakeholder engagement and improve the quality and efficiency of public policy and regulation (Paavola et al., 2007; Mathur, 2009).

Rather than normatively assessing whether this narrative holds true for our subject of study, we investigated the institutional dynamics relating to digital information provision by an environmental regulator. We brought to light four pivotal areas of such institutional dynamics and gained insight into where (explicit and

covert) barriers and opportunities lie, which is an important step towards the realisation of the envisaged ambitions and agendas. The nature of identified issues and barriers in the process of information provision was wide-ranging and included: (a) *technical*: accuracy of information, update speed, resilience of web pages; (b) *structural*: liability issues, input requirement from many departments, lack of communication skills among staff, path dependency; (c) *managerial*: no institutional priority, minimal resource allocation, status quo not inconvenient; and (d) *cultural*: lack of inter-department communication, or communication seen as an afterthought. These findings correspond to literatures on ICT innovation in which it is not depicted as a matter of linear design (albeit subject to drifts and shifts – Ciborra, 2000), but as a dispute-based process (Lanzara and Patriotta, 2001). A key similarity of our findings to other research on institutional innovation is that the most serious problems for the effective development of ICT are often not the result of "sloppy technology" or "inefficient standard setting", but due to "misunderstandings and ambiguities (...) [resulting] from normative gaps and incoherence, and more generally from pre-existing, engrained institutional practices" (Lanzara, 2009: 34).

Opportunities were visible in the form of enthusiasm about digital innovation among staff and an emphasis on the importance of stakeholder inclusion in the design of ICT. Although there was critical thinking on the role of ICT, managerial and instrumental 'efficiency and efficacy' perceptions tended to dominate. This was arguably the most important barrier related to information provision that emerged from our analysis. ICT was often perceived by staff as a solution in itself (cf. 'technological perspectives on ICT') and not as a set of tools in a wider transformational process, or as a lens to inspect existing or new practices and interaction (cf. 'conceptual perspectives on ICT') (Bekkers et al., 2006; Bekkers and Korteland, 2006; Van Duivenboden et al., 2006).

It is likely that such a more reflexive approach towards ICT and information provision would not only create more realistic baselines of what may be expected of institutional innovation, it would also naturally link up with instances of double loop social learning, i.e. where issues, concepts and solutions are reframed together with other stakeholders. This connection between institutional social learning and the development of conceptual perspectives on ICT, we argue, is a crucial nexus for improving institutional information provision in the context of governance shifts and the Digital Age. This connection is also more likely to provide promising answers to the issue of seemingly out-dated and inadequate conceptualisations found in our analysis such as inflexible dealing with liabilities, risk, and uncertainty about information and scientific evidence more generally through disclaimers and rigid, top-down protocols (cf. Brugnach and Ingram, 2012). Instead, building trust among governmental and civil society stakeholders through consistent procedures and openness about limitations of data collecting and processing, could constitute a fruitful step in the process of genuine social learning. Short-term institutional agendas, aims and interests, as well as hypes about digital innovation (Meijer et al., 2009), are then replaced by a focus on concrete societal problems and opportunities (Van Duivenboden et al., 2006), and critical and constructive approaches to ICT-driven public innovations.

Acknowledgements

The authors thank SEPA, as well as all interviewees for their time, effort and openness. We are also grateful to two reviewers for their constructive comments. The research described here was supported by an award (EP/G066051/1) made by the RCUK Digital Economy programme to the dot.rural Digital Economy Hub at the University of Aberdeen. We also thank the 'Science without Borders Programme' funded by CNPq, Brazil (314033/2014-9).

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