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Using 'smartness' to reorganise sectors: Energy infrastructure and information engagement

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ABSTRACT

The second decade of the 21st century is distinctive by the rapid deployment of sensors, meters and other measurement technology that by their ability to detect and report data on events or changes in the environment are considered central in the reorganization of many sectors. The collected information is expected to improve efficiency and coordination, already enhancing the delivery of services in sectors such as health care, environment or entertainment. While infrastructural elements, such as roads, street lighting or waste containers, have traditionally been non-informational, now these kinds of elements are being furnished with sensors as part of an effort to change how their respective sectors operate. Energy sector, with its shift to the 'smart grid' infrastructure, provides a case study of how efforts at reorganising the sector are impacted by the relationship households develop to large quantities of energy information. Based on findings from studying 'smart grid' development in Japan, I argue that, to enable a reorganisation of the energy sector, extensive tailoring of information is required in order to engage users to develop an active relationship with infrastructure.

1. Introduction

The rapid development of information technologies provides opportunities for reorganising how different sectors of the economy and society function. Some scholarly analysis has already reported the variety of these possibilities. For example, information technologies have been used to harness information in order to reorganise the processes of academic libraries in America (Moran, 2001), the admissions procedures in the Norwegian higher education (Jansen and Lovdal, 2009), and the public sector administrative processes under the label 'e-government' (Algermissen, 2004). Clarke, Shim, Mamo, Fosket, & Fishman's, (2003) study of 'biomedicalisation', i.e. the transformation of the traditional sector of medicine into the contemporary biomedicine through advanced use of information management, illustrates how the role of information has increased over time in how sectors operate.

Concentrating on infrastructural elements of a sector is an opportunity to focus attention on the detailed impact of information as part of a reorganisation. Infrastructures are elements where information has traditionally played a small role. On the one hand, infrastructures are central to life in modern societies (Steele, Hussey, & Dovers, 2017), as the fixtures that the label infrastructure commonly describes, i.e. roads, the power grid or sewage systems (Pinch, 2010; Howe et al., 2016; Bulkeley, Castán Broto, & Maassen, 2014), illustrate. Infrastructures appear even more essential if one takes a view beyond these merely material aspects (Gartner, 2016) to consider e.g. their social and political aspects (Obertreis et al., 2016). Berlant (2016) calls infrastructures the "living mediation of what organises life" (p.393). However, our relationship to infrastructures has been characterised as typically somewhat aloof, with most scholars confirming Star and Ruhleder's (1996) analysis: an infrastructure is sunk inside other elements, it invisibly supports tasks, and it tends to become visible only upon breakdown. Intuitively, this accords with our daily experience, where most of us pay little attention to the electricity bill we pay, to the system by which we are able to consume water, or to the ways in which our waste materials are disposed, beyond the task of separating the recyclables from the non-recyclables. Thus, bringing information to an infrastructure, and by observing the consequences, allows us to observe how reorganising a sector, with information at the core, changes related processes and behaviours of actors.

This study uses the energy sector to consider how the bringing of information to infrastructure allows a reorganisation of a sector. Traditionally, the functioning of the electricity grid has relied little on information transfer between the utilities and the household-users (households being the consuming unit, as opposed to e.g. individual 'consumers'), with a bill and report of usage at a monthly interval from the former to the latter. The reorganisation of the energy sector with information has been designed with the introduction of the 'smart grid', which involves data collection at both supply and demand ends of the

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grid. A 'smart grid' allows frequent messaging between the energy provider and the household, mainly either for consumption data at 30 or 15 min intervals, and for signals of energy prices at any given moment. The data collection and messaging is aimed to facilitate the balancing of the grid, which is the critical requirement in the maintenance of appropriate supply of energy.

An essential feature regarding the 'smart grid', and its key novelty, is an attempt to enrol households into an active participant in the management of this new energy system, where they are expected to react accordingly when the electricity grid requires an adjustment. For example, when the grid demand load approaches peak levels, households are signalled price information with the expectation that they reduce their consumption, thereby lowering demand and reducing the need to fire up other, often costly and polluting, generation capacity. Yet, this active engagement with infrastructure, i.e. with the 'smart grid', contrasts markedly with our customarily passive relationship with the energy infrastructure of the past.

Household information engagement represents a core part of the energy sector reorganisation under the label 'smart grid' deployment, and thus a study of this engagement illustrates well the dynamics of information and infrastructure in sector reorganisation processes. This research has examined the impact on engagement of bringing information and information technology into an infrastructure, through a case study of 'smart grid' infrastructure development in Japan. Prior literature has suggested that infrastructures are both closely tied to organised practices as well as to socio-political interests, and thereby may be expected to lead to active citizen engagement, particularly as the new 'smartness' will make citizens more informed users. Yet, I argue that user engagement with information is dependent on whether information is tailored to users, or results in automation of operations. By this I mean that information has a quality which, when applied in large amounts at a frequent rate, induces automation that renders passive behaviour by users towards infrastructure. When tailored to their personal profiles or lifestyles, information is more likely to engage the users. This distinction has significant consequences for reorganising sectors, highlighting the need for a careful consideration of the specific relationship between infrastructure, information and user behaviour.

2. Theoretical background

2.1. Definitions

Literature on infrastructure suggests there are different views on how to characterise infrastructure, yet these views suggest a relatively close association between the nature of these material artefacts and the behaviour of the users. In its most ubiquitous and uncontroversial conceptualisation, infrastructure appears as material and technocratic (Gartner, 2016), such as roads, pipes, sewers and grids (Howe et al., 2016; Pinch, 2010). In the context of the Internet, 'information infrastructure' refers also to such items as wires and servers (Karasti, Baker, & Millerand, 2010) as well as "computational services, help desks and data repositories" (Bowker et al., 2010, p.98).

Yet, to consider merely technical or material artefacts is to view the idea of infrastructure in unnecessarily narrow terms. Their social and political aspects also merit attention (Obertreis et al., 2016). While infrastructures "allow for the circulation of other things, mediating resources and smoothing the function of capitalist transaction" (Howe et al., 2016, p.12), they help create a "self-governing hygienic, moral subject" (Joyce, 2003, in McFarlane and Rutherford, 2008, p.367). Infrastructures may also be seen to extend from the lower level of organising and maintenance of daily upkeep (Star and Ruhleder, 1996) to institutionalised services at national or international levels (Ribes and Finholt, 2009). Bowker et al.'s (2010, p.98) definition "pervasive enabling resources in network form" serves to underscore the broad sweep of this concept. These broader formulations suggest that human behaviour may be closely tied to infrastructure.

2.2. Relationality, politics and control

One of the ways that infrastructure is relevant for user behaviour is its relationality. Originally argued by Jewett and Kling (1991), the notion of infrastructure's relationality suggests that infrastructures appear to their users through regularised activities and practices (Bowker et al., 2010; Star and Ruhleder, 1996; Star, 1999). Hence, in this body of work the authors have sought to conceptualise infrastructure through the patterns of action, of assembly and of use (Berlant, 2016). For eschewing a circular argument, this work suggests then that as the patterned behaviour largely defines the structure, the characteristics of the infrastructure have less impact on behaviour. Moreover, this perspective appears to afford little consideration for a variety of possible meanings in the infrastructure itself.

Another perspective, that infrastructures are socio-technical systems (Moss, 2014; Hughes, 1983; Bowker and Star, 1999), opens more ontological possibilities in analysis. While these systems are considered mostly stable, they sometimes change, which provides a window for change also in user behaviour. The "immobility, obduracy and resilience" of infrastructures (Summerton, 1994; Hommels, 2005) relates to their systemic character, linked to a large variety of technical, social and institutional elements (Hughes, 1983; Carter, 2016). Thus, change, while infrequent for such systems, is likely to ripple through their many constituent elements. Although much of this genre of literature has focused on system characteristics (Ribes and Finholt, 2009) and prospects for system change (Bulkeley et al., 2014), some work has explored questions related to the use, and the development of new systems. One vantage point to change is 'experimentation', whereby new system solutions are tested. Due to the interconnected nature of these systems, e.g. technical experiments are likely to test also new practices, configurations of actors and other non-technical factors. Hence, experiments provide an opportunity to engage users into adopting new practices, such that follow the objectives of the new infrastructure system. Yet, as Bulkeley et al. (2014) note, experiments and the related new practices tend to face contestation from institutionalised practices and actors, and therefore there is no certainty that the new practices, and changes in user behaviour, will prevail.

Another vantage point to the socio-technical conceptualisation of infrastructure is to consider their political significance as a potential avenue to changes in user behaviour. When an infrastructure system is considered to consist of socially and politically important features, socially and politically aware citizens are likely to pay more attention to it. As an infrastructure exists closer to its audiences, it has greater potential to effect behavioural change in users. Rubio and Fogue (2013) describe a case where public space, i.e. a town square, was "technified" and the infrastructure was "publicized" to encourage public engagement and a rethinking of the political ecology of a specific space. These efforts were means to incorporate better the infrastructure into the public and political life of the community. Higher visibility of the infrastructure, e.g. of the energy and water systems of the community, opened the possibility to introduce new forms of participation and engagement. The authors sought to demonstrate with this case how concrete visibility of these typically background systems produced a higher awareness of concerns relating to these systems. At the same time, they make a strict distinction between the advancement of the social and political consciousness in the community and a direct effect of actual behaviour change, and they only indicate the former as a result of this project. While merely making an infrastructure more visible may not result in actual behavioural changes, as a possible indirect effect this publicization move aims to disrupt certain harmful dichotomies in this context, such as the separation between the individual and the collective good. Thus, politicising infrastructure and our practices around it may have indirect relevance to the issue, but there seems to be an absence of a direct, intentional impact for behavioural change.

A further aspect of the socio-political perspective of infrastructures