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## Infrastructure Matters

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## Reflection note

# Infrastructure Matters

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I want to flag the contribution Ole Hanseth has made to scholarship through the critical interdisciplinary engagement he fostered between social scientists from my field, of Science and Technology Studies, and from Information Systems and socially-oriented computer scientists from related fields such as Computer-Supported Cooperative Work, Social Informatics and Human Computer Interaction (Monteiro et al., 2013). In this short overview I hope to highlight some features of the distinctive epistemic stance that emerged from a line of enquiry involving Ole and his collaborators at Oslo—and elsewhere (including NTNU, LSE, Edinburgh and Michigan Universities) over three decades. Others may be better placed to directly describe Ole's role in this dynamic research community which I only observed from a distance. However it was evidently highly collaborative, reflected in the involvement of various permutations of an evolving community in joint publication, with Ole at the heart of a more or less organised collective advancement of an analytical project. This note captures the appreciation amongst Edinburgh colleagues of that contribution.

My first contact with Ole Hanseth arose serendipitously in the early 1990s through Eric Monteiro, his colleague at Oslo University, who also had a joint appointment at Trondheim (now the Norwegian University of Science and Technology)—where Edinburgh had close links with the Centre for Technology and Society, our partners in the COST A4 European research collaboration on The Social Shaping of Technology. Ole and other Norwegian colleagues had, like us, been examining the increasing integration of computer systems within and between organisations and the consequent difficulties designing systems that could cater for the diversity of user contexts and needs. Hanseth, Monteiro and Hatling (1994; 1996) highlighted the consequent tension between the drive for standardisation to allow interoperability/ information exchange and the requirement for flexibility in the face of the diverse and changing requirements of an evolving array of users and uses (Hanseth et al., 1996) and the emergence in this con-

text of what they termed Information Infrastructures (IIs), defined as: “an interconnected collection of computer networks whose heterogeneity, size, and complexity will extend beyond those that exist today” (Hanseth et al., 1996, p. 409).

The II concept had been borrowed from the policy initiatives of the Clinton/Gore administration to promote (US) national- and subsequently Global Information Infrastructures. This was one of a number of attempts by researchers as well as policymakers to understand the challenges of developing information and communication technology networks by drawing analogies with the emergence of physical infrastructures like electricity, railway transport and road superhighways (Ashley, 2017; Kubicek & Dutton, 1997). The infrastructure metaphor was quickly picked up by several linked communities of STS writers seeking to characterise the distinctive features of emerging large-scale organisational uses of computer technology. Foremost here is the work of US Sociologists of Science, the late Susan Leigh Star, Geoff Bowker and others, then based at Michigan University. Thus Star and Ruhleder (1996) examined how heterogeneous occupational groups used computer networks to achieve effective collaboration across physical and disciplinary spaces (Star & Griesemer, 1989). Star and Ruhleder’s (1996) characterisation of the features of IIs has been enormously influential, and in particular that they are “built on an installed base” of existing systems and practices and become embedded into existing structures, social arrangements and technologies such that they only become “visible upon breakdown” (idem.:113).

Hanseth et al. (1996) in their analysis, had a more particular concern however. Their work sought to open up ICT system design practices and to highlight choices in system architecture. They contrasted the marked flexibility of the internet with its evolutionary approach to standardisation and overlapping cycles of (modularised) design and diffusion with other traditional forms of computerisation based upon sequential linear processes of requirements capture, design and implementation. They thereby highlighted the need to pay greater attention to differences between specific technologies—their technical dimensions and system development processes and the links between them (Hanseth, et al., 1994; Monteiro et al., 1994; Monteiro & Hanseth, 1996). The II concept thus opened up discussion about differing architectures and institutional forms and their differing distributions of agency particularly in relation to intermediate and final users. This concern with architectures and choice has continued though Ole’s work (Grisot et al., 2014), culminating in a recent paper focusing upon the linkages between technology architecture and the governance structures surrounding its innovation and deployment (Hanseth & Modol, 2021). This attention to the specificities of technological forms and innovation processes spoke directly to the concerns of Edinburgh’s interdisciplinary technology studies community and its social informatics cluster. This

insight had particular significance for Edinburgh STS scholars where Fleck (1988) had similarly highlighted the influence that adopters were able to exercise in building configurational technologies from selections of commodity and bespoke components in contrast to dedicated systems technologies (Fleck, 1988). We also appreciated Ole's epistemic stance. Drawing on ANT and other social science theories he offered a critical engagement with traditional technocratic and managerial approaches to systems development and implementation (Aanestad et al., 2024), moreover, within this, fostering a particular style of work geared towards opening up policy choices and engaging with practice in real-world situations.

Ole's distinctive analytical contribution attended to 'complexity' (Hanseth & Lyytinen, 2010) and the diversity of organisational practices and contexts of use. Factors which might otherwise be portrayed as teething trouble with the modernist project were seen to undermine the purposive efforts of managers and engineers: attempts to achieve control through informatisation were frustrated by the increasing heterogeneity of increasing extensive digital assemblages. Tensions e.g., between initial and emergent requirements or between standardisation and flexibility (Hanseth et al., 1996) generated unintended side effects and painful trade-offs that became increasingly obdurate/difficult to manage, underpinning what Ciborra, Hanseth and co-workers famously characterised as a shift "From Control To Drift" (Ciborra et al., 2000; Lanzara, 2009).

At this juncture, Hanseth crucially sidestepped the pitfalls of the interactionist turn. The shifting of social scientific attention towards local processes which had highlighted local improvisation in the conduct of organisational activities had offered enormously valuable insights and inspired an explosion of workplace ethnographies (Suchman, 1987). However their exclusive preoccupation with local process and the implied constant barriers to standardisation and integration missed the point that the network of networks was becoming increasingly extensive. Beyond emphasising the empirical diversity indeed uniqueness of user settings, such local studies lacked a clear pathway to practice. Hanseth and Lyytinen (2010) explored how enduring tensions could not simply be resolved but became a resource for reflexive practice, informing development strategies at different stages and locales in building and extending IIs (Hanseth & Lyytinen, 2010). Hanseth and colleagues articulated an evolutionary approach, revolving around the theorisation of information infrastructures as a distinctive sociomaterial form in an unfolding information society. Thus II represents an important substantive development and also requires new ways of theorising (and also, we argued, new methodologies (Pollock & Williams 2010)). Monteiro, Hanseth and Hatling from the outset emphasised that IIs are always unfinished:

infrastructures are constantly evolving and “always an unfinished work in progress” (Edwards et al., 2009, p. 365; cited in, Grisot et al., 2014, p. 200).

As a result, novel elements are erected on top of an installed base of prior practices, conventions and systems. This has implications for how we understand evolving IIs. Thus there is no single moment of creation of an II. Instead it was necessary to talk instead about infrastructuring as an ongoing practice of design, implementation and maintenance (Edwards et al., 2009). From this insight, a novel style of conceptualisation has emerged, focusing on the distinctive processes involved of grafting, weaving novel and existing elements together into functioning IIs (Monteiro et al., 2014).

The II perspective has been applied to many domains, including notably research activities (variously conceived as knowledge infrastructures (Edwards et al., 2013), or in the USA cyberinfrastructures (Edwards et al., 2007), and even Thinking infrastructures (Kornberger et al., 2019)). However the bulk of II studies have been in the area of health and social care—which arguably constitutes the paradigmatic domain for II studies. Distinctive features of contemporary health and social care digitisation give particular relevance to an II perspective: the extended history over the seven decades since the earliest computerisation efforts in hospitals of siloed systems, separately developed by previously fragmented services (e.g., typically separated between primary and secondary healthcare services, social care and care homes); recent policy and service drives towards integration between specialisms and service providers; the need to access historical records and the need to retain existing services as well as building new services which prevent a strip-out and replace strategy.

II scholars studying the development of health and social care infrastructures sought to critically appraise existing design and implementation practices, focusing on examining what factors drove particular design choices and implementation strategies in real world settings (Sahay et al., 2009). However II work here also reveals a more or less explicit normative, participatory and indeed activist commitment to explore how things might be otherwise (what Schot and Rip called “better technology in a better society” (Schot & Rip, 1997)). The II framework is readily applied to technology design and organisational transformation in health and social care e.g., to explore the potential contribution of ICTs to improving the quality and dependability of health service delivery and care provision (Aanestad et al., 2017).

Within this I must highlight the arguably exemplary application of the theoretical II framework to the activist participatory design tradition. This work opened up and elaborated a distinctive strategy for developing and sustaining health information infrastructures through the creation and promotion of the open source Health Information

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Systems Programme (HISP) in developing countries. After 30 years, HISP today extends to more than 70 countries (<https://dhis2.org/hisp-network/>).

Ole's conception of information infrastructure bore directly on two parallel strands of work at the University of Edinburgh—on information integration within organisations and on inter-organisational network systems eg eCommerce. Ongoing exchanges between Edinburgh and Oslo culminated in a joint Edinburgh/Oslo research workshop in 2006 which serendipitously coincided with a workshop on cyberinfrastructures organised by Geoff Bowker and other Michigan scholars. These culminated in a special issue of the *Journal of the Association of Information Systems* and led to a series of research workshops of Innovation in Information Infrastructures (III).

Nearly two decades later this exchange continues with the 7th III workshop in Barcelona in September 2024. The call for papers draws attention to a “distinctive analytical style” that has underpinned this productive engagement, revolving around work that is:

- fiercely empirical;
- conceptually dynamic with a focus on mid-range theory;
- paying detailed attention to the material;
- engaging with both immediate and broader, longer-term developments;
- concerned with how things might be done otherwise;
- interested in power, structure and agency.

I would close my contribution by pointing out that this analytical tradition and lively community in so many ways precisely exemplifies the kinds of approach that Ole Hanseth has been promoting over four decades.

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