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Reflection note

Smart Environments?

Reflections on the role of metaphors in IS

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1   Introduction

Our cities, landscapes, institutions, and homes are increasingly being equipped with sensors that glean information that is being processed by algorithms and visualized to serve as a basis for decision making. Such Internet of Things (IoT) infrastructures are shaping our societies in novel ways. They also facilitate new ways of engaging with the natural environment. This calls for attention to how they are brought into being. In this essay, I will reflect on the role of metaphor in developing IoT infrastructures for governance in public sector. The affinity for metaphor among IS scholars was one of the first things I noticed as a Ph.D. fellow entering the IS field from a background in social science and the humanities. I found that metaphors have a prominent role in IS, both as tools for thinking about complex phenomena and as aids for guiding the development of information systems and information infrastructures. The dual agenda of IS—seeking to understand and explain as well as informing practice—accentuates the importance of attending to metaphor in this domain. This insight was the motivation for a discussion about metaphors among IS scholars in the 1980's, which I will elaborate on below. I will, however, argue that the time is due for rekindling this conversation both because the understanding of the relation between technology and society has evolved and because the objects of IS studies itself has changed considerably, from small information systems to information infrastructures that are near-ubiquitous.

I will make two main claims. The first is that metaphors are analytical devices that help us make sense of the world, but they become normative devices when being used to design and im-

plement new systems and technologies. Therefore, we must reflect on the relationship between constructivist and normative aspects of metaphors. The second claim I will make is that many of the metaphors used in IS generate dualistic views of the world. This was problematic already in the 1990s when the 'organization' was the main analytical entity and is today even more so because of the emergence of IoT infrastructures that increasingly blur the boundaries between public and private, work and leisure, and bodies and machines. I use the metaphor 'information is intelligence' in the context of design of IoT infrastructures for public sector governance to show the implications of this, and eventually suggest alternative metaphors.

2 The use of metaphor in IS

In 1979, metaphor was brought to attention across many different research communities by the publication of the edited book "Metaphor and thought" (Ortony 1979). Some of the contributions to this book challenged the prevailing understanding of metaphor as merely serving rhetorical and poetic purposes and as hampering the scientific aim of providing objective descriptions of the world. With the concept 'generative metaphor', Donald Schön (1993) argued that the metaphor we use for making sense of a problem will also guide which solutions we are able to imagine. The year after, George Lakoff and Mark Johnson (1980) published their book "Metaphors we live by". They argued that metaphor "provide a partial understanding of one kind of experience in terms of another kind of experience" (1980, p. 154), and hence does not merely describe reality, but influence what becomes real to us. This constructivist approach to metaphor gained traction in IS and the related field of organizational studies through the 80's and 90's (Boland Jr 1987; Hirschheim and Newman 1991; Kendall and Kendall 1994).

In Scandinavian IS today, metaphor is viewed as a conventional tool for analysis as well as design of information systems. The metaphor 'information infrastructure development is cultivation' (Aanestad 2002; Dahlbom and Janlert 1996; Hanseth and Lyytinen 2004) is a central example. Nevertheless, I will argue that the time is due for rekindling the discussion about the constructivist role of metaphor in IS. There are two reasons for this.

First, the epistemological debates that framed the discussion about metaphors in the 80's and early 90's have changed. The opposing perspectives of technological determinism, claiming that technology is the key mover of history, and social determinism, claiming that social forms determine what kind of technology is being developed, was replaced by postmodernism, which claimed that reality is contextual and socially constructed. Hirschheim's (1986) dual metaphors of 'technology as tool and man as craftsman', and 'technology as governor and man as machine' illustrates the distinction between technological determinism and social determinism. An example of postmodern metaphors in IS is Claudio Ciborra's collection (2002), which challenged the prevailing rational view of system development and acknowledged that "our involvement with systems is driven by an anticipating, mood-affected vision that relentlessly navigates, discovers, and encounters the world" (ibid., p. 6). On this side of the century, the postmodern rejection of material aspects of reality-making was countered by perspectives that emphasize entanglement and mutual becoming of technology and social forms. Actor-network theory (see for instance Ciborra et al. 2000; Walsham and Sahay 1999), and socio-materialism (Orlikowski 2007) are

such perspectives that have been used in IS. An example of a socio-material metaphor is 'imbrication', the laying of tiles in a fish scale pattern, suggested by Paul Leonardi (2011; Leonardi and Rodriguez-Lluesma 2012) to stimulate attention to how social and material agencies differ. While the use of metaphor in IS has evolved with the understanding of the relation between technology and society, the reflection about metaphors as constructivist and normative devices in the development of information systems and -infrastructures has not kept up with this development.

The second reason why the time is due for reviving the discussion about metaphor in IS is that the object of study in IS has changed considerably, from information systems internal to organizations to information infrastructures with a global span, and to platforms that combine data from an increasing variety of sources, blurring the boundaries between public and private, work and leisure, bodies and machines. By prioritizing the managerial perspective, established IS metaphors such as 'information infrastructure development is cultivation' (Aanestad 2002; Dahlbom and Janlert 1996; Hanseth and Lyytinen 2004) might divert our attention from the urgent issue of the performativity of IoT infrastructures. As our lives are increasingly characterized by algorithmic phenomena (Parmiggiani et al. 2016); i.e.; phenomena that are brought about by algorithms, we need metaphors that can help us engage with this in analysis as well as in design. In the following, I will reflect on this in the empirical context of the emergence of IoT infrastructures for governance of urban and natural environments.

3   'Smart' infrastructures for governance

A much-used metaphor for conceptualizing IoT infrastructures is 'information is intelligence' (Boland Jr 1987; see also Hirschheim and Newman 1991). This metaphor is informing 'smart city' initiatives where smart implies the human capacity for making decisions based on the analysis of different kinds of information. What is easily hidden by the metaphor 'information is intelligence' are other strategies for resource management, such as forming and nurturing relations with allies and relying on tacit knowledge and embodied experience. Thus, imagining 'smart' infrastructures in public sector can result in infrastructures that sideline the political work and the experience-based judgment that is central in decision-making processes in public sector.

The reproduction of bias and prejudice is another risk of using the metaphor 'information is intelligence' in the development of IoT infrastructures for governance purposes. A 'smart' system for administrative casework will access information from previous, similar cases, identify patterns of decision making and recommend a decision based on that. If bias and prejudice have influenced previous decisions, this will be reproduced. Moreover, if the system is conceptualized as 'smart', in the sense of competing with or being better than the human capability for information processing, it will be difficult to challenge the decisions made. Another problem is that the caseworker's sense of accountability might be eroded. If a system perceived to be 'smart' processes the case, the case handler might feel less responsible for the decision she makes. An alternative to conceptualizing IoT infrastructures as an emulation of human intelligence is hence to use metaphors that render them as an assistive technology that will support the execution of experience-based judgment. IoT infrastructures for governance can for instance be conceptual-

ized as an extension of the civil servant's memory and sensory apparatus, rather than as 'super brains' that feed civil servants with decisions to be executed (see Carbonell et al., 2016 for an extensive discussion of the use of metaphors associated with the human brain in the development of artificial intelligence).

I have argued that the choice of metaphors in developing IoT infrastructures in public sector influence how the practice of governance is understood, and hence influence how society develops. I will now go on to discuss what kind of consequences the role of metaphors in the development of IoT infrastructures can have for how we relate to the environment.

4   Infrastructuring environments

In his reflection about the connection between infrastructure and modernity, Paul Edwards (Edwards 2003) argues that constructing infrastructures is to construct a particular kind of nature, nature as apart from, as 'Other' to, society and technology. Infrastructures constitute an artificial environment. Infrastructures channel or reproduce the properties of the natural environment that we find useful or comfortable, and leave out those properties that we find dangerous or uncomfortable. We channel water into our houses in convenient amounts and temperatures. Electricity infrastructure allows us to keep our buildings lit in the middle of the night and enjoy a comfortable indoor temperature in mid-winter. Dikes make people able to live in blissful ignorance of the tides, which orchestrated the daily life of their ancestors. Edwards argues that this appropriation of properties of the natural environment has influenced how we, people living in industrial and post-industrial societies, experience nature. Infrastructures "structure nature as resource, fuel, or 'raw material,' which must be shaped and processed by technological means to satisfy human ends" (Edwards 2003, p. 4).

Guided by the metaphor 'information is intelligence', the current development of IoT infrastructures seem to represent a new way of rendering nature 'raw material' to be processed to serve human needs. The new raw material is data generated by sensors, and these data are processed by increasingly advanced algorithms. The product is information that can be used to make existing services more efficient or less resource demanding, and to develop new kinds of services. Data about traffic can be combined with data about air quality, and possibly also be combined with data from personal health-monitoring apps to provide information about whether to bicycle or to drive the car to work.

The algorithmic phenomena (Parmiggiani et al. 2016) generated by IoT infrastructures make the environment available for some interventions while other possible innovations are left out. When this infrastructuring of the environment (Blok et al. 2016) is guided by the metaphor 'information is intelligence', the modernist imaginary of nature as 'other' to society and technology (Edwards 2003; see also Latour 1993) will be perpetuated. This is problematic because the conceptual separation between human beings and our natural surroundings has had dire consequences that we are probably only seen the beginning of, with extreme weather causing frequent disasters. Rather than infrastructures that render the world out there as 'raw material' to serve human needs, we need infrastructures that keep humans committed to an ontology of interdependence.

5   Towards metaphors that highlight interdependence

The emerging IoT infrastructures in public sector can be allowed to perpetuate the modernist imaginary that renders nature as matter that can be controlled by humans. Alternatively, they can be designed to challenge this ontology and facilitate a more sustainable worldview. This will be a worldview that highlights entanglement of and interdependence between all animate and inanimate elements. Attending to the metaphors that guide design will be a part of this work. This implies challenging dualist metaphors of technology-society relations. It can also entail looking for metaphors in streams of research that have challenged the modernist imaginary for some time, such as the study of multispecies co-existence in Science and Technology Studies (STS) (see Haraway 2016), as well as developing new metaphors that are particularly suited for IS.

One example of challenging the 'smart' metaphor can be found in urban geography.

Mike Crang and Stephen Graham write about urban IoT infrastructures as 'sentient cities' (2014). While 'smart city' draws the attention to how government and business actors harvest and process information from the urban environment, 'sentient city' highlights how the urban environment is turned into an entity that is able to sense us, the citizens. By ascribing the agency to the environment rather than to the civil servant or the data analyst, the image of 'sentient cities' can inspire the development IoT infrastructures where the city, forest, or ocean's need for conveying information to us, the humans, is prioritized over the need for humans to glean information that feeds into our preconceived structures.

Another challenge to modernity's myth of human control over the environment is Steven Jackson's 'broken world thinking' (2014). Broken world thinking implies taking breakdown and decay rather than novelty and progress as starting points for developing infrastructures. Everything will sooner or later fall apart, hence the question 'how will this work?' is no more important than the question 'how will this fall apart?' Broken world thinking is a reminder that building IoT infrastructures means eventually producing e-waste. It can also help maintain a focus on mitigating the societal consequences of the breakdown of public sector infrastructures.

Metaphors are used to guide the development of IoT infrastructures, but metaphors and other rhetorical and visual devices for simplifying and ordering complex phenomena are also important outputs of IoT infrastructures. Data from sensors embedded in the city or in nature can be presented in dashboards that use familiar experiences or phenomena to enable the user to make sense of them. Through visualizations of data, IoT infrastructures can reproduce taken for granted visions of the environment, but they can also challenge them and suggest alternative orderings. The anthropologist and STS scholar Atsuro Morita (2016) provides an example of how the Chao Phraya delta in Thailand was historically viewed as an extension of the sea into land. In the 20th century, the delta came to be understood as an extension of land into the sea. How the delta was viewed had consequences for what kind of infrastructure that was developed. The old infrastructure was aquatic, with canal networks and houses on stilts. The new was terrestrial, with roads and irrigation systems that reclaimed land from erosion. When central Thailand experienced severe flooding after the turn of the century, evoking the ancient view of the delta as aquatic rather than terrestrial was a key factor in developing a solution for flood management (Morita 2016). Societies all over the world have to contend with increasingly volatile weather.

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Strengthening established practices might not be sufficient for addressing this. The capacity of IoT infrastructure to produce, combine, and visualize different kinds of data can be utilized for highlighting other attributes of the environment than we normally pay attention to and through this perhaps foster new adaptive practices.

6   Metaphors as repertoires for knowing and knowledge making

I have argued that the emergence of IoT infrastructures calls for renewed reflection about the constructive and normative aspects of metaphors in IS. In conclusion, I will draw the attention to the STS scholar Helen Verran's (2002; 1998) understanding of 'imaginaries' to approach metaphors as repertoires for knowing and knowledge-making. This conceptualization challenges views of knowledge as a stable body and encourages attention to what can be seen and imagined by means of alternative metaphors. Acknowledging the constructivist and normative capacities of metaphors we use also reminds us that we are responsible for what we choose to highlight and what we choose to hide.

References

Aanestad, M., (2002). *Cultivating Networks: Implementing Surgical Telemedicine* (Thesis, Dr. Scient.). University of Oslo, Oslo.

Blok, A., Nakazora, M., and Winthereik, B. R., (2016). Infrastructuring Environments. *Science as Culture*, (25:1): 1–22.

Boland Jr., R. J., (1987). The in-formation of information systems. In: *Critical issues in information systems research*, R. J. Boland Jr and R. A. Hirschheim (eds.), John Wiley & Sons, Inc., pp. 363–394.

Carbonell, J., Sánchez-Esguevillas, A., and Carro, B., (2016). The role of metaphors in the development of technologies. The case of the artificial intelligence. *Futures*, (84): 145–153.

Ciborra, C., (2002). *The labyrinths of information: Challenging the wisdom of systems*, Oxford University Press, Oxford.

Ciborra, C., (ed.), (2000). *From control to drift: The dynamics of global information infrastructures*, Oxford University Press, New York.

Dahlbom, B., and Janlert, L.-E., (1996). *Computer future*, Unpublished manuscript.

Edwards, P. N., (2003). Infrastructure and modernity: Force, time, and social organization in the history of sociotechnical systems. In: *Modernity and technology*, T.J. Misa, P. Brey and A. Feenberg (eds.)., Cambridge, Massachusetts: MIT Press, pp. 185–225.

Hanseth, O., and Lyytinen, K., (2004). Theorizing about the design of Information Infrastructures: design kernel theories and principles, *Sprouts: Working Papers on Information Systems*, (4: 12).

Haraway, D. J., (2016). *Staying with the trouble: Making kin in the Chthulucene*, Duke University Press.

Hirschheim, R. A., (1986). The effect of a priori views on the social implications of computing: the case of office automation. *ACM Computing Surveys (CSUR)*, (18: 2): 165–195.

Hirschheim, R., and Newman, M. (1991). Symbolism and information systems development: myth, metaphor and magic. *Information Systems Research*, (2: 1): 29–62.

Jackson, S. J., (2014). Rethinking repair. In: *Media technologies : essays on communication, materiality and society*, T. Gillespie, P. J. Boczkowski and K. A. Foot. (eds.), MIT Press, Cambridge, pp. 221-339.

Kendall, J. E., and Kendall, K. E. (1994). Metaphors and their meaning for information systems development. *European Journal of Information Systems*, (3:1): 37–47.

Lakoff, G., and Johnson, M. (1980). *Metaphors we live by*. University of Chicago press, Chicago.

Latour, B., (1993). *We have never been modern*. Harvester Wheatsheaf, New York.

Leonardi, P. M., (2011). When Flexible Routines Meet Flexible Technologies: Affordance, Constraint, and the Imbrication of Human and Material Agencies. *MIS Quarterly*, (35:1): 147–167.

Leonardi, P. M., and Rodriguez-Lluesma, C., (2012). Sociomateriality as a lens for design ; imbrication and the constitution of technology and organization. *Scandinavian Journal of information systems*, (24:2): 73–82.

Morita, A., (2016). Infrastructuring Amphibious Space: The Interplay of Aquatic and Terrestrial Infrastructures in the Chao Phraya Delta in Thailand. *Science as Culture*, (25:1): 117–140.

Orlikowski, W. J., (2007). Sociomaterial practices: Exploring technology at work. *Organization studies*, (28: 9): 1435–1448.

Ortony, A., (1979). *Metaphor and thought*. Cambridge University Press, Cambridge.

Parmiggiani, E., Monteiro, E., and Østerlie, T., (2016). Synthetic situations in the Internet of Things. In: *Beyond Interpretivism? New Encounters with Technology and Organization: IFIP WG 8.2 Working Conference on Information Systems and Organizations, IS&O 2016, Dublin, Ireland, December 9-10, 2016, Proceedings*. Springer, pp. 215–228.

Schön, D. A., (1993). Generative metaphor: A perspective on problem-setting in social policy. In: *Metaphor and thought*, A. Ortony (ed.), Cambridge University Press, Cambridge.

Verran, H., (1998). Re-imagining land ownership in Australia. *Postcolonial Studies: Culture, Politics, Economy*, (1:2): 237–254.

Verran, H., (2002). A postcolonial moment in science studies alternative firing regimes of environmental scientists and aboriginal landowners. *Social Studies of Science*, (32: 5–6): 729–762.

Walsham, G., and Sahay, S., (1999). GIS for district-level administration in India: problems and opportunities. *MIS Quarterly*, (23: 1): 39–65.

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