Digital platforms for environmental sustainability: Empirical studies in the Norwegian petroleum sector

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Abstract

This short paper presents selected results from my research on the *digital transformation* that is occurring across the Norwegian oil and gas industry, and its relationship with issues of *environmental sustainability*. Digital transformation is here used to describe how work is not automated, but deeply transformed by the introduction of digital technologies. Rather than a merely technical issue, this transformation occurs as a network of economic, sociopolitical, technical, and environmental factors in the oil and gas sector. I will discuss this aspect by analyzing one empirical case; the development of real-time systems for monitoring environmental risk during oil and gas offshore operations. My results invite researchers and practitioners working with digital systems for environmental risk assessment to take into better account the way digital representations of the environment are never independent of the material and socio-political conditions of their production.

Introduction

This article presents the results of my research in the field of Information Systems, a branch of computer science that elaborates methods and theories to better understand how Information and Communication Technologies (ICT) are developed and used by individuals or groups in different parts of work and everyday life, from companies, to healthcare, the public sector, and entertainment. We in the Information Systems field like to see ourselves a bit like a bridge between the worlds of industry and research. I belong to a research group at the Norwegian University of Science and Technology (NTNU) in Trondheim, headed by prof. Eric Monteiro and comprising myself, senior researcher Thomas Østerlie, and PhD student Mina Haghshenas. We are broadly concerned with the study the development and use of distributed information systems in different areas: the oil and gas industry, environmental monitoring research, and healthcare. Our focus aims to shed light on the way modern technological arrangements – under popular banners such as the Internet of Things (IoT) and Industry 4.0 – are *changing rather than replacing human work*, and thus the way humans make sense of the world. Here, I will focus on my contribution to one of my group's studies: the implementation of a digital platform for monitoring environmental risk during oil and gas offshore operations in real time.

The study covers a span of almost six years. It started in early 2012 when I began my PhD at the Department of Computer Science at NTNU (2012-2015) and it constituted the main case study for my research, as part of my collaboration with a large Scandinavian oil company (dubbed "NorthOil" to maintain anonymity). NorthOil has been actively developing a new online infrastructure to monitor the health of the subsea environment (corals, fish, and other marine biomass such as plankton) (Figure 1). The company and its industrial partners worked on the development of novel algorithms to predict possible risks for the subsea marine resources in real time, especially before and during well drilling. The aim was to supplement traditional methods of assessing environmental risk only *after* a pollutant has been identified in the water, with an approach to *prevent* any harm to marine life. Indeed, the traditional method of assessing environmental risk on the continental shelf is generally offline. Usually, environmental experts from third-party service companies conduct offshore monitoring campaigns every third year. The common practice is to collect samples of the water to measure its pH, of the sediments on the seabed, and of the benthic flora and fauna around an installation. Samples, pictures, and measurements are later taken onshore and analyzed, with temporal gaps of 9-12 months. The parameters for collection vary depending on the availability of detailed guidelines from authorities.

The main environmental resources that the new online platform developed by NorthOil and its partners has been set to monitor are fish species such as Atlantic cod and herring, and cold-water coral reefs, mainly for the following three reasons. The first motivation is commercial: the Norwegian continental shelf is one of the world's main fishing grounds for cod and herring. The second reason is technical: the acoustic sensors used to detect the fish could only detect fish with a swim bladder – an air-filled organ that allows the fish to float. Fish without a bladder, such as mackerel, although commercially relevant, were not visible to the instruments, thus not tracked. The third reason is social: the Norwegian continental shelf is home to the world's largest population of a cold-water coral species called *Lophelia pertusa*.

Finally, this study acquired a political flavor. The main area where NorthOil has concentrated its efforts is the seabed off the Lofoten-Vesterålen-Senja region in northern Norway – the only portion of the continental shelf where operations are not allowed by the Norwegian authorities because of the vulnerability of the natural resources, but which constitute an important door to the Arctic. The issue of granting – or not granting – oil and gas companies permission to operate in the area is constantly at the center of heated debates in the Norwegian parliament, and one of the main driver of the coalitions among the bigger and smaller parties (F. M., 2017).

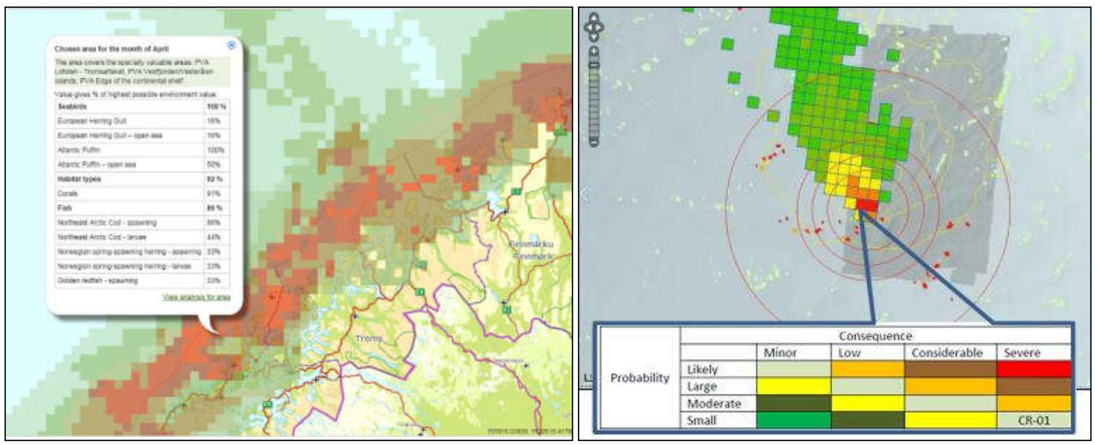

Figure 1. Two mockups of the online approach developed by NorthOil and its partners. Left: The seafloor outside North Norway is divided in squared areas. The risk for each area is estimated to range from high (red) to low (green), based on the amount of fish currently located there (adapted by NorthOil from havmiljø.no). Right: Reproduction of a map of the sea floor and modeling of the spreading of rock particles and other cuttings predicted to be generated during a future drilling activity. The identified coral reefs and the discharges are marked in different colors based on the level of risk (red, orange, yellow, green). The risk matrix (below) indicates a small probability of severe consequences for coral structure CR-01 close to the drilling point.

As I moved into my current position in 2015 as postdoctoral researcher in the same department, I continue to analyze the data I collected during my PhD to produce different insights and analyses. Together with my former PhD supervisor and colleague Eric Monteiro, we have developed a conceptual framework to understand the use of digital platform that ensure environmental sustainability within the existing structures of a controversial sector such as the oil and gas industry (see for example Parmiggiani and Monteiro, 2016).

More recently, we have analyzed the link between the technological aspects of development with scientific discussions on the climate change in light of the "Arctic oil rush" (Luhn, 2016). On the one hand, oil and gas companies push technological and social boundaries to extract oil in the Arctic, where an estimated 25% of the remaining unexplored oil is located (Bird et al., 2008), but which is vulnerable to pollution and hosts the richest fishing grounds on the planet. On the other hand, the permanent Arctic ice is melting because of human-induced climate change. This situation has thus provided an unprecedented scenario for understanding how digital innovation is intimately related to measures of assessments of sustainability. Prior to one of the recent licensing rounds where operational blocks were assigned to oil companies in the Barents Sea, the Norwegian government proposed to push northwards the border of the permanent ice in the Norwegian Arctic. The argument was that the ice, now melted, would not hamper human operations (Koranyi, 2015).

Method

Following one of the traditions in Information Systems, the type of research that I conduct is empirical – or field-based (a field is a site that the researcher considers worth investigating). Findings from this type of research can be used to understand how digital systems can be better and more effectively developed and used. The evidence we collect is qualitative – that is to say, based on non-numeric data such as interviews, documents, images, notes or recordings taken during field observations. By analyzing these data, we abstract patterns and themes that are then developed into either a better insight into a specific empirical problem (in this case, the adoption of digital platforms for sustainable oil and gas operations); or a theoretical framework that explains the phenomena observed (Oates, 2006).

The method I adopted to *collect the data* for this research is ethnographic (Myers, 1999), an approach that originates in anthropology the researcher 'immerses' herself in a reality and spends a considerable amount of time with a selected group of informants. In my case, I obtained access to NorthOil's research center in Norway. My data consist of observations, interviews, informal conversations, and documentation, occasionally assisted by Eric Monteiro. The primary source is observations. I conducted the fieldwork three days a week on average in the period April 2012–April 2014 and one day a week in the period June 2014–December 2014. The primary setting was an office with five NorthOil employees involved in different environmental monitoring projects, but I also travelled to the headquarters of NorthOil and its partner companies on several occasions to participate in meetings and workshops. In addition, I conducted 38 interviews with environmental experts, IT advisors, and engineers both at NorthOil and at the partner companies. Finally, I was granted access to current and historical internal documentation (e.g., MS SharePoint team sites, Internet-based public information). The *data analysis* process was conducted in subsequent steps, by confronting the emerging theoretical themes with my colleagues.

On a personal level, the fieldwork activity has been the main motivation for learning Norwegian. Despite having spent one semester as a visiting master student at NTNU in 2010, I did not speak Norwegian when I began my PhD in February 2012. The activities I had to study, however, were conducted only in Norwegian, so I had to learn the language as I was conducting my study. It has been a steep and stressful learning curve which has resulted in hilarious situations – for example, I once sat in a meeting for four hours, listening to a project manager complaining about a certain "dokker" that had not done a proper job. After the meeting, I asked one of my office mate at NorthOil who this "dokker"-person might be. That was my first, head-first encounter with trøndersk. In general, I must thank my co-supervisor Vidar Hepsø for always taking the time to answer my questions when I did not understand something, and for teaching me that the letter "h" in Norwegian is an important one.

Results and Conclusion

One of the contributions of my PhD and postdoc research is a conceptual framework to describe how digital transformation changes and is changed by our perception of what environmental sustainability – and therefore risk – mean. Our conception of environmental risk and the technologies that we use to assess it are always mutually influencing each other: we know only what we can measure, and the more we measure one phenomenon, the more our understanding of it evolves (see also Parmiggiani, 2015).

In general, the results of my PhD work point to one key observation: *the representations of the environment that inform decision-making processes are always constructed*. This provocative statement aims to underline that baselines – in this case environmental trends – are never neutral. The algorithms which compute them turn nature into ordered 'facts' for professional audiences: the models of the environment are neither complete nor accurate but serve purposes related to situated tasks or problem solving (Edwards, 1999), e.g., allowing engineers to answer such questions as "*Is it safe to drill here?*" Adding on to this, we find that the data that constitute facts invariably involve the material/technological means by which they are known: *what we know is how we know it* (Bowker, 2005). This theme is also relevant on the level of national and international forms of governance, which tend to regulate organizational activities by conflating measures of environmental sustainability with the availability of baselines of environmental behavior. For example, the European Union requires to assess the environmental impact of new technologies against "*the current state of the environment (baseline scenario)*" (European Environment Agency, 2015; European Union, 2014). The "baseline" is assumed to be a reliable 'photograph' of the state of the environment.

On the contrary, my analysis hopes to raise awareness on what we talk about – or do not talk about – when we talk about the environment, and thus on the definitions of a quantified 'object' against which a digital system should be sustainable. Ultimately, we should remember that the process of turning nature – which is undifferentiated and continuous – into discrete facts defines what counts as a baseline environment. This process is guided by both pragmatic (*What can be measured?*) and political (*What is relevant/interesting to measure?*) purposes. In the case of projects like the one I study, for instance, due to the reasons I sketched above, corals and some commercial fish species are often at the center of attention, while marine mammals are not considered. On the one hand, only some fish species are measurable, and on the other, the corals make a good impression on the newspapers for the public. The corollary of this finding is that we, as scientist, should remember that environmental risk assessment practices do not provide an absolute truth about nature, but are meant to turn nature into relevant and meaningful facts for various professional audiences to allow them to answer pragmatic questions about the sustainability of their activities, and to inform government policy. Paying better attention to the way this process evolves in the age of digitalization could therefore enable us to better inform industrial activities and government policies.

To conclude, this topic is, I admit, politically controversial on the light of the recent debates about "fake" or "fabricated" news. As sociologist of science Bruno Latour recently pointed out in a popular interview, however, saying that representations of the environment are constructed does not mean that they are fabricated. Quite the opposite, it is part of long-standing research tradition recognizing that there is no distinction between the social and technical elements of science (de Vrieze et al., 2017).

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