Chapter 14
Studying Technologies *in Practice*: "Bounding Practices" When Investigating Socially Embedded Technologies

Pernille Bjørn and Nina Boulus-Rødje

14.1 Introduction

The idea of socially embedded technologies (SET) constitutes a new approach into ICT research, one which has emerged from the European communities of research on computer-supported cooperative work (CSCW). SET is based upon the fundamental assumption that we need new ways to conceptualize research on design, which takes into account peoples' social practices without limiting the human interaction to an individual computer-user relation. People and practices are much more than their relationship with a technology, and thus the concept of "user" is problematic. We see ourselves as researchers who embrace the new agendas of SET, and in this chapter we will then explain approach and suggest ways for thinking differently about design. When studying *technologies in practice*, we ground our work within the CSCW tradition for workplace studies (Luff et al. 2000; Randall et al. 2007). In recent years, we have conducted research in the healthcare arena, studying patient tracking and triage systems in emergency departments (Bjørn and Balka 2007; Bjørn et al. 2009; Bjørn and Hertzum 2011), investigating the introduction of electronic medical records in primary and acute care settings (Boulus 2004, 2009, 2010; Boulus and Bjørn 2007, 2008), as well as studying the practices of monitoring patients with heart failure in a tele-monitoring setup (Andersen et al. 2010). We believe the healthcare arena to be a perspicuous setting for studying technology as socially embedded since it covers heterogeneous work practices, varying technical competencies and complex organizational arrangements. We have conducted both single-site and comparative studies (Boulus and Bjørn 2007; Balka

P. Bjørn (✉) • N. Boulus-Rødje
Technologies in Practice Research Group, IT University of Copenhagen, Copenhagen, Denmark
e-mail: pbra@itu.dk; nbou@itu.dk

V. Wulf et al. (eds.), *Designing Socially Embedded Technologies in the Real-World*,
Computer Supported Cooperative Work, DOI 10.1007/978-1-4471-6720-4_14

et al. 2008), and all of this work took place in Canada, Norway, or Denmark. In each of these studies, we applied ethnographic methods to examine the collaborative and complex practices of the particular site, with the aim of developing theoretical concepts useful for describing and articulating practices while informing the design of technologies that support the local and situated practices (Schmidt 1998). More recently, we have started to reflect on what these types of engagements mean for research and for practice, with the aim of continuously sharpening our research practices (Bjørn and Boulus 2011; Boulus-Rødje 2012).

One key challenge is that the "ethnography for design" approach embeds a sequential order to design procedure. We *first* study current practices and *then* design technology (Wulf et al. 2011). This sequential approach does not necessarily fit well with dynamic and constantly changing real-life practices, where technologies and practices are continuously redesigned and reorganized. To study technologies in practice, we have to reconsider how we think about our research approach, moving from a sequential ordering toward focusing on aspects of multiplicity (Law 2004) where technology and practices are dynamic and heterogeneous assemblages.

In this chapter, we explain how we can apply the focus on multiplicity when studying technologies in practice. We explore how this approach, foundationally, does not view technology design as sequential, and thus argue that it might be a way to move away from a linear design agenda toward an emergent perspective. We propose to take multiplicity as the starting point and to view practice and technology as intertwined. This means that when investigating the world, we must find a way to view the world as multiple, rather than consisting of dualities of practice and technology. We argue that to make sense of the world of technologies in practice, our work as researchers is to pull together and tease apart dynamic and multiple entities. We constantly create and recreate boundaries, "cutting" the world in the way that Barad (1996) suggests. We refer to this work as *bounding practices* (Bjørn 2012) and argue that the entities we study are dynamic, and we play an active part in shaping the entity under investigation. The boundaries of a technology are constituted in enactment. Enactment refers to "the claim that relations, and so realities and representations of realities . . . are being endlessly or chronically brought into being in a continuing process of production and reproduction, and have no status, standing, or reality outside those processes" (Law 2004, p. 159). In other words, we never simply observe an external reality that exists prior to or independent of its representations; rather, through engagement in representation, reality is performed—it is enacted (Law 2004). Thus, we cannot study technology independently of practices. The notion of enactment is used to emphasize that the world is performed through sociomaterial practices. In this chapter, we illustrate how this analytic lens can help us understand technology as a dynamic and multiple entity. We propose that to study design, we must take into account the sociomaterial practices that make the technology. Sociomateriality offers an analytical lens where neither artifacts nor people are single entities with inherent predefined properties. Instead, people and artifacts are made through relations: "[T]o be is to be related" (Mol 2002, p. 54).

We begin this chapter by introducing the ethnography for design approach and its related history. We then bring forward the sociomateriality approach, exploring how to comprehend technology and practices as multiple. Next we introduce the concept of *bounding practices* to describe the research activities required to study technologies in practice. We present one ongoing research project—technologies for democracy—to illustrate how bounding practices can help us to analytically understand what makes the technologies in this project. We then discuss the impact of this approach and where it might take us, and we finish by offering our conclusions.

14.2 Studying Technologies in Practice

When Schmidt and Bannon (1992) wrote what can be seen as the manifesto of CSCW research, the two prevailing issues within the CSCW community were (1) studying the basic nature of collaboration and (2) using this knowledge to design collaborative technologies (Schmidt and Bannon 1992). Back then the CSCW approach was challenging the dominance of office automation research by questioning basic fundamental assumptions about CSCW research. These led to the arguments that no formal description can fully capture collaborative work, that it is impossible to anticipate every contingency which might occur, that collaboration is open ended, that there will always be exception handling, and, finally, that plans are resources for work and that these are different from the actual work (Schmidt and Bannon 1992).

At this time the design community extended an invitation of collaboration to social scientists, and efforts were made to bring ethnographers into the field of computing. To acknowledge "the social" within technology design, the research agenda of CSCW was founded on interdisciplinarity. However, inviting ethnographers into the field of computing to learn from their methods also changed the field itself. Whereas ethnography is generally a descriptive discipline, the ethnographers entering the CSCW domain had to adjust their interests or, as Schmidt and Bannon put it, "enter, and you must change" (Schmidt and Bannon 1992, p. 11). Thus, although ethnography initially did not necessarily have an explicit change agenda, by entering the field of computing, the agenda was introduced. This new agenda for computing research as well as for ethnography became formulated in terms of ethnography for design (Bentley et al. 1992; Hughes et al. 1992, 1995), where the main interest is studying practices with the aim of supporting technology design (Blomberg et al. 1993). Over the years this agenda of bringing ethnography and design together has been discussed extensively (e.g., the Coordination Debate: Suchman 1994; Winograd 1994; Grudin and Grinter 1995), but arguably few ethnographic studies have succeeded in creating relevant design implications for technology innovation. Bridging between the two worlds of ethnography and design can also be referred to as the divide of CSCW (Schmidt 2009) or the problem of "implication for design" (Dourish 2006). From these debates we have learned, at the

very least, that translating ethnographic findings into design implications is difficult and requires additional academic work from a diverse group of collaborators representing the different disciplines to bridge the gap. Often articles dedicated to discussing this transition focus on explaining ethnography while paying less attention to explaining the actual move from ethnography toward design. While there is a general agreement that we can extract requirement specifications and recommendations from ethnography for a particular user group, it is much more difficult to figure out how exactly ethnographic insights can add to design. This has led to several papers dedicated to producing findings in either one area (e.g., ethnography (Hartswood et al. 2003; Svensson et al. 2007; Møller and Bjørn 2011) or design (e.g., design (Dourish and Bly 1992; Gutwin and Greenberg 2002; Yamashita et al. 2008). However, it is not easy to find papers that aim to contribute to both fields. There are, of course, a few exceptions (Bardram and Bossen 2005; Bjørn et al. 2009; Wulf et al. 2011).

Although this divide is still a relevant issue for CSCW research, there is a distinct difference between the situation back in the 1980s–1990s and that of today and as we look toward the next decade, namely, the escalation of new technology inventions and their quick adaptation in the everyday lives of people. Today, we find the constant and rapid release of new technological devices (e.g., tablets and smartphones), new collaborative applications (e.g., Google Docs and Dropbox), and new apps (more than 100 new apps are released on a daily basis)—and people quickly adopt these devices and collaborative technologies into daily life. This offers a distinctly different situation from the studies of adaption of collaborative technologies back in 1992 (Orlikowski 1992).

In Orlikowski's (1992) study of Lotus Notes, she explained why collaborative technologies implemented in organizations did not lead to "instant collaboration" but instead required organizational implementation where people learned why they were using the technology, the basic nature of the technology, and then developed technology-in-use practices. There was a general consensus among researchers that collaborative technologies are more complex to handle than single-user systems, for example, in terms of adaptation, difficulties in evaluation and cost/benefits (Grudin 2004). However, in present-day western societies as well as in growing economies, ICT technology has become both mundane and ubiquitous. People are more likely to adopt new and unknown technologies with little hesitation. Thus, we might ask whether the time for CSCW researchers to conduct long-term, in-depth ethnographic studies in order to inform design is changing. By the time we complete our ethnographic study, new technological opportunities have already emerged, practices have already changed and so have the conditions surrounding these practices. Thus, we join other researchers (e.g., Pipek and Wulf 2009) in the attempt to remove the strict and simplistic separation between design and use, since the term "design" risk is misleading the focus to only concern the technological "artifact" while neglecting the surroundings by which the technology is to be enacted.

Therefore, as researchers who believe in designing high-quality collaborative technologies based upon an in-depth understanding of practices, we have to adjust

to the contemporary changes around us and find new ways to study practices and technologies in a timely manner without abandoning a critical approach. The question then is how can we conduct solid academic research on socially embedded technologies when the social and the technical continuously and rapidly change?

14.3 Sociomateriality and Bounding Practices

If we are to redirect our research approach to the study of *technologies in practice* toward an approach, which takes into account the inseparability and multiplicity of the technology and the social, we first need to define what makes practice and technology. For this purpose, we to turn to sociomateriality (Leonardi et al. 2012; Jones 2013) as the theoretical foundation that can help expand our empirical views when studying technologies in practice. So what is practice? Applying the lens of sociomateriality, practice is the connections that hold together heterogeneous actors, artifacts, and activities (Orlikowski 2007). Practice is the entwined nature where neither artifacts nor people are single entities with predefined and inherent properties; instead the social and the material are inseparable and constitutively entangled (Haraway 1991; Barad 1996). Practice is a tangle of strings. Haraway (1987) uses the metaphor of a ball of yarn to explain practice. In the ball of yarn each string represents one cut down into reality. If we pull one string and follow it through the tangle of multiple strings, we learn how "this entity" is tangled into many other strings, each adding to the comprehension of the one string and the relations that make the string (Haraway 1987). Each string comprises the sociomaterial relations of technology and practice. The tangle is flexible, dynamic, and multiple. The strings can be pulled in different ways, bringing forward particular connections while moving others to the background. Each molding activity of the strings is part of what makes the entity of practice.

Applying the lens of sociomateriality, technology is never a stable entity; instead, it is always dynamic and multiple. Viewing technology as a dynamic entity is in line with the basic assumptions about collaborative technologies in CSCW, namely, that we cannot anticipate all contingencies, that collaboration is open ended, and that exception handling will always exist (Schmidt and Bannon 1992). However, in the early writings of CSCW, technology—which although could be technically reconfigured—was a relatively stable entity, while the social practices surrounding the technology were malleable. We propose in this chapter a different argument, namely, that technology is not simply a single entity. Instead technology is emergent in use—in the sociomaterial practices. This dynamic perspective on technology means that the boundaries for what makes the technology are not predefined by the technical artifact. Instead the boundaries for what makes the technological artifact come into being through the enactment of the sociomaterial relations which change over time. Technological artifacts can therefore be seen as a hyphenated structure of relations, where the relations are multiple and changing over time. The word processor that we are using to write this chapter is part of the technology

relations that we are enacting. The entity might, at some point, emerge as [word processor-chapter-book-editors-coauthors-empirical work-literature] while at other times as [word processor-Internet-laptop-reference tool-reviewing chapter-book-editors]. Placing the social and the technical as "one entity", as one wholeness, "does not signify the dissolution of boundaries. Boundaries are necessary for making meaning" (Barad 1996, p. 182).

The sociomaterial perspective implies that all practices are part of the tangle of practices, which, in theory, are never ending and inclusive. However, not all relations are salient at all times. Those relations that act and are enacted create the boundaries for what is to be included or excluded from the unit of analysis. The question then becomes, how can we study something that does not have predefined boundaries? It means that studying technology in practice is not just about opening the black box of technology and retrospectively analyzing how it became stable (Latour 2005). Instead, opening the black box of technology requires us, the researchers, to search and identify the boundaries of that box at a particular point in time. Thus, the perspective on design of technology without predefined boundaries pays attention to the work of identifying boundaries over time as well as taking active part in changing these boundaries. In other words we, the researchers, and their methods, participate in the enactment of what makes the technology. "The argument is no longer that methods discover and depict realities. Instead, it is that they participate in the enactment of those realities" (Law 2004, p. 45).

The world is composed of entangled, complex, and multiple relations of technologies and practices. This makes the work of the researcher attempting to access, map, and analyze these relations more challenging, since there is no one set of relations existing out there ready to be mapped. Instead, when studying technologies, we at all times have partial access to part of what makes the technology. The critical question then becomes, how do we know that these are the relevant relations for our purpose? When we study and design technologies without predefined boundaries, we need analytical tools and instruments that can help us comprehend the world (the tangle) not simply as an untangled complexity but as an investigation of where the important enacted relations become visible, available, and salient. We refer to this work as *bounding practices* (Bjørn and Østerlund 2014). Bounding practices is work required to zoom in on a technology—a particular interest—and investigate all relations that are part of the technology while creating the boundaries for what makes the technology. Bounding practices is the work required to pick and pull the strings in the entangled yarn in order to identify the different relations and decide how to draw the boundaries around the entity being studied. Bounding practices "has a double meaning – namely to bind together, as in hyphenated-structures, *and* to set the boundaries for what makes the entity, as in [bracketing structures]" (Bjørn 2012). Thus, the work we, the researchers, have when we study technologies and practices as dynamic and ever-changing phenomena includes the work of identifying and deciding how to pull out strings within the practice—strings which are critical to understanding the object of interest and reveal interesting and relevant sociomaterial relations in the hyphenated structure. We will now illustrate the application of this approach.

14.4 The Democratic Technologies Project

The second author is currently involved in a large research project called *DemTech* (2011–2016), studying democratic technologies. The project brings together computer scientists and social scientists with the aim of studying the design and implementation of electronic voting technologies. DemTech is a strategic research project where one key goal is collaboration between researchers and industry. Therefore, the project has different partners, including two IT vendors[1] and the three biggest municipalities in Denmark. The project started in July 2011, with ethnographic observations of the parliamentary election in Denmark, including following closely the planning, implementation, and evaluation phases of the election. The research team conducted formal and informal interviews with different policy makers and municipal employees. Furthermore, the team attended seminars for municipal employees (one that prepared staff for the upcoming election and one that evaluated the election), conducted and participated in several meetings with different stakeholders, organized a public event at the parliament and workshops with both academic and nonacademic audiences, and participated in various public debates in the media.

What is particularly interesting in the DemTech project is that it illustrates how the technology in question is a dynamic entity that is changing over time and where the researchers are actively taking part in (re)defining what makes the technology. Furthermore, the role that the ethnographic observations play in this research project is quite different from merely providing requirement specifications for a prototype. In this way, the conventional sequential process of first ethnography and then design is not appropriate for this kind of research.

14.5 Democratic Technologies as a Sociomaterial Entity

In this section, we will demonstrate how the technology in the DemTech research project took different forms over the period of the project. In particular, we will pull different strings in the ball of yarn which makes "democratic technologies" and explore the sociomaterial matters at different points in time. Each time we pull a string, we bound the technology in particular ways, and it is within these bounding practices that the technical artifact emerges as an enacted sociomaterial artifact. We will present three concrete parts of the DemTech project and pull out how the "democratic technologies" were bounded at that time. The examples we chose all relate to the early stages of the research project and as such reflect upon the initial grant proposal and to how it was forced into a "traditional" sequential understanding of *first* conducting ethnography and *then* designing. However, in practice, this approach sets constraints for what actually turns out to be the important

[1]This was the case at the time of writing this chapter; however, the project no longer has the two IT vendors as partners.

research findings for such projects relevant for both research and society. Thus, our argument concerns how some of the funding agencies tend to perceive ICT research in an old-fashioned perspective and a suggestion into how we can conceive optimal opportunities for future ICT research.

14.5.1 Grant Proposal

When the DemTech grant application was originally submitted to the Danish strategic research council, the argument was that although computers have already began replacing different parts of the democratic process (e.g., calculating seat assignments in parliament), and although this technological change has often been ascribed different advantages (e.g., in terms of efficiency and finance), it also brings about different risks. Therefore, the aim of the project was to provide insights into ways to modernize the elections without jeopardizing fundamental and crucial principles upon which democratic elections rest. It is important to keep in mind that while many countries across North America and Europe have been suffering from declining voter turnout, Denmark has had one of the most stable trends with an average voter turnout of approximately 85 % for parliamentary elections.[2] Danes are generally perceived to have a relatively strong trust in their electoral system and in democracy. What is at stake here—democracy—is thus a very precious and well-oiled machine that has been built through many generations. It is, therefore, of utmost importance to make sure that digitalizing elections is done in a manner that it preserves the strong tradition of democracy in Denmark. The DemTech funding proposal reflects on some of the views that claim that the digitalization process of elections is inevitable and the question is thus not if this will happen but rather how and when this will happen. These views see technologies in an almost wholly positive way, increasing voter participation and making elections more inclusive by encouraging the youth, the elderly, and the people with disabilities. The question that remains is, how can the elections be modernized without jeopardizing its trustworthiness and the trust of the voters? Research in the DemTech project is expected to explore this question by studying existing election practices in order to ultimately propose and experiment with different technological innovations. In a way, it can be said that the project mimics to some extent the way in which ethnography for design has been portrayed since the beginning of the CSCW field.

14.5.2 Parliamentary Election 2011

Three months after the official launch of the DemTech research project, the prime minister of Denmark called for parliamentary elections in June 2011. While in many countries parliamentary elections take place every 4 years, this is not the case in

[2] http://archive.idea.int/press/pr20011120.htm (27 May 2011).

Denmark where these elections can take place any time before the maximum length of parliament, if the prime minister decides to call for such an election. The research team was thus thrown out into the field to conduct preliminary ethnographies of the election practices. "Democratic technologies" initially concerned "e-voting" machines and the focus was on how these machines could replace the actual processes which are part of elections (e.g., ballot casting, ballot counting, etc.). The preliminary ethnographic observations brought to the foreground the various artifacts that emerged as relevant and crucial for making the election process democratic.

When we lift the curtain and look inside election practices, we see that these practices stretch beyond election day. For instance, election practices are enacted not only on the day of election; they exist also during several months of preparation where election officials (i.e., municipal workers) work long days in order to be able to get everything ready. Furthermore, election does not end on election day; various election officials continue to work weeks after the election, reporting summaries to the different authorities, evaluating the election, etc. It becomes quickly clear that the actual ballot casting is only a very small part of the large sociomaterial machinery which makes "technology for democracy." Observations of the election revealed the importance of the different artifacts which are part of what makes "technologies for democracy." This included, for example, the ballot boxes at the election locations, the curtains and the voting booths, the ballots and the voters cards, the lists of political candidates, the many rubber bands and Post-It notes, the pencils used for marking the ballots, the local volunteers and municipal workers, the laws and regulations for tallying and for ensuring the presence of representatives from political parties, etc. All these are sociomaterial components, which are a critical part of what contributes to the relatively high trust in elections in Denmark. While giving a complete description of all the sociomaterial practices involved in elections is not the intention of this chapter, our main point is that the "democratic technologies" were clearly much more than "e-voting machines"; these include complex practices where artifacts and people engage in particular ways to ensure the trustworthiness of the election. Exploring the different bounding of what makes "technology for democracy" over time from the grant proposal toward the different activities conducted as part of the research project, interesting transformations emerge. What is part of "technology for democracy" initially is changed over the period of the project. The entity "technology for democracy" becomes inclusive of new relations while excluding other relations. One can say that particular aspects of the entities are bracketed out, while other aspects become bracketed in. As can be seen from the above, the "technology for democracy" as a sociomaterial entity has thus changed since writing the research proposal.

14.5.3 Political Agency

During the DemTech project, the research team received several invitations from the different partners, which gave the project the opportunity to have political agency. However, each opportunity constituted invitations into supporting the different political agendas of a diverse set of people.

A workshop was organized by the Ministry of Finance and Interior in order to initiate a debate about e-voting technologies. The research team was invited to assist with organizing and holding the workshop in collaboration with the Danish Board of Technology (Teknologirådet). The research team accepted the invitation which was seen as a way to facilitate and participate in the political discourse around e-voting technologies in Denmark. Different social groups were invited to participate in the workshop, including municipal employees, different kinds of experts (IT, law, etc.), technology critics, hackers, and activists, all with different perspectives on "democratic technologies." The activists and technology critics were questioning the municipalities' interest in e-voting and asked whether there was any solid business case behind the wish to implement e-voting technologies. Questions were raised about the cost of e-voting technologies and about whether there was any solid and scientific evidence backing up the expected benefits of these technologies. Furthermore, the IT and security experts expressed their concerns while explaining that none of the technologies available today were secure enough against tampering and hacking attempts. Thus, during the workshop, the "technology for democracy" was constantly redefined.

In general, it can be said that the workshop led to questioning several basic, yet taken for granted, assumptions, for example, that the implementation of e-voting technologies will inevitably happen as part of the modernization process and that this will lead to cost reductions, increased efficiency, etc. Although e-voting technologies were at the center of the debate, the workshop also invited municipal employees in order to include their insight about the current work practices, procedures, and traditions surrounding elections. This was followed by a presentation by the second author summarizing the insights from the preliminary ethnography during the 2011 election. This presentation focused on lifting the curtains behind elections and unpacking the various organizational processes and sociomaterial practices that take place when organizing elections. It became evident that a greater understanding of the current paper-based system would be beneficial, if not necessary, before considering any e-voting technology. In other words, before discussing the requirement specifications for the new electronic system, we needed to investigate in greater depth the current practices, regulations, and traditions surrounding elections.

This workshop can, to some extent, be conceptualized as a design workshop where the space for design extended the boundaries of the technical artifact. The "technology for democracy" was no longer a simple and clear black box of e-voting technology that *must* come into existence. Instead the construction and existence of the technology were questioned by some of the workshop participants. In this particular case, the role of the researchers was not merely to identify requirement specifications (which in and of itself is a difficult task requiring in-depth understandings of technological opportunities) but rather to facilitate a critical discussion about e-voting technologies and enroll the different actors and voices that are relevant. Thus, the researchers' contribution was participating in and influencing the discourse on what constitutes the technology, rather than merely listing requirement specifications.

During the short period of the research project, the team received various invitations from different stakeholders. Initially the research team collaborated with two smaller municipalities, but during the project they received requests from other municipalities who wished to join the project. In another incident, the municipalities invited the research team to *join the effort to change the law* in Denmark that does not permit experimenting with e-voting technologies. The municipalities invited the researchers to study their work practices and help them *showcase the need* for e-voting technologies. In a difference incident, one of the vendors invited the researchers to conduct experiments and test his e-voting machines with real voters. In this case, the researchers did not accept this invitation. They feared that participating in the vendor's experiments might risk their position as it was important for them to protect their independent academic and scientific voice. Finally, the researchers were invited to meet other stakeholders and businesses involved in elections in different countries (i.e., Africa, the Philippines, and Egypt). In November 2011, after the popular uprising, some of the team members who went to Egypt to participate in initial discussions were interested in e-voting technologies.

Around the same period, the research team was also invited to work with the ministry. Thus, part of the research team's activities became to advise and guide the ministry about the topic of e-voting. These engagements and relations with the municipalities, the vendors, and, not the least, the ministry have given the researchers a unique opportunity to participate in influencing policy and the debates about e-voting technologies in Denmark. At the same time, it has been immensely important for the researchers to preserve their independence and critical academic role.

14.5.4 Societal Impact

As can be seen from the above examples, during the relatively short period of the research project, the research team has been drawn in different directions, invited to take different roles and to create different sociomaterial relations with various stakeholders. These different invitations and roles change depending on the contextual circumstance as well as the political context at particular points in time. For instance, at the outset of the research project, the prime minister announced parliamentary elections in Denmark. This meant that the research team did not have as much time as they initially assumed and they were rushed into the field. During this election, one of the vendors demonstrated their e-voting machines. Thus, although the research team was cautious and avoided introducing any technology at that point in time, the vendors have already moved ahead and demonstrated their e-voting machines. Not too long after, a letter was written by several municipalities and was quickly submitted to the ministry requesting to change the law. The municipalities have already attempted to change the law a few years ago but with no luck. The newly elected government seemed initially more welcoming; however, the situation changed and the government turned down the second request to change the law. These are some of the changes in the local conditions that influenced the research agenda and activities.

It is worth noting that the pressure initiated by the municipalities to change the law was partially influenced by the fact that Norway had initiated a new pilot project testing Internet voting. The context surrounding the DemTech project has been continuously and rapidly changing, influencing the opportunities and types of roles and interventions that the research team received at different moments in time. What is critical here is that at no time was it relevant for the researchers to contribute by identifying requirement specifications or evaluating the technology. Instead, the main contribution from the researchers has been in the form of shaping the discourse and practice which makes "technology for democracy" while at all times keeping track of this dynamic entity by binding together new and bracketing out other sociomaterial relations.

14.6 Socially Embedded Technologies

Studying technologies in practice while acknowledging that we cannot make a separation between the social and the technical brings particular research agendas to the table and changes the focus for what the researchers have to do when engaging with practice. We propose the concept of bounding practices to describe the work the researchers do when studying technologies in practice as sociomaterial dynamic entities.

We presented examples from the DemTech project to illustrate how different boundings of technology are created and changed over time. The example of the ministry workshop to which bloggers, hackers, and activists were invited illustrates very clearly the bounding practices, which took form during the research project. That is, the relations toward the requirement specification were cut, while new relations were created, for instance, by inviting activists and technology critics. This illustrates how the role of ethnography for design has to expand when we study such dynamic and multiple entities. We are no longer simply identifying requirements or evaluating technology use; instead we are part of creating the technology and conceptualizing the sociomaterial relations that make the technology. While this role is not limited to ethnographers, it includes all the different kinds of research practices engaging in projects similar to DemTech. What this finding points to is that funding for ICT research has a clear tendency toward a particular type of research, namely, technological deterministic research, where the center of attention is the creation of a technological artifact. It can be said that it is not entirely a coincidence that the original agenda in the DemTech research proposal pays great attention to the technical artifact. Reviewing funding calls for ICT research in, for example, the European Horizon 2020, the types of projects which can be funded are typically centered on the construction of a technological artifact, which is expected to improve practices. Even though we ICT researchers are well aware that the technical artifact does not automatically lead to improved and successful new practices and that research opening up and critically examining such technologies serve a valid and important ICT research topic, we still find ourselves in situations where we

have to adopt the technologically deterministic rhetoric of the funding agencies when writing research proposals. The rhetoric of research proposals obviously does not imply a complete adherence to the actual research practice. As we saw in the DemTech project, the researchers took upon themselves the role of participation and letting the empirical field guide what made the entity "technologies for democracy." This investigation includes political, technological, and commercial environments and all important information infrastructures constituting the practice of democracy.

What is important to note here is that in most cases, the ostensible purpose of ethnography in strategic technology project grant applications is formulated as providing requirement specifications for the future design of a technology. ICT funding is directed toward the design of technical artifacts, and the role of other disciplinary engagements in design is often seen as supportive. The sequential order between first studying practice and then designing technologies remains dominating in the nature of ICT funding structures, a sequential ordering which does not take into account the complex sociomaterial practices which shapes technology in a modern society. Technologies are not stable singular objects; instead they only come into being when enacted in the practices by which they are part.

"Democratic technologies" were enacted in multiple different ways along the DemTech project, and these became different things at different points in time. What made the "democratic technologies" in the interactions with vendors and commercial interests was different than what made the "democratic technologies" when the researchers interacted with technology critics. But rather than referring to these differences in terms of different perspectives, we argue that the unit of analysis—"democratic technologies"—was made in different ways, and thus the boundaries for what makes this unit were dynamic and constantly changing. The entity "democratic technologies" is both a commercial interest and a possible engine for trust in democracy. This entity is bounded continually and over time it takes multiple forms. If we are to design "technologies for democracies," we have to take a diverse set of boundings into considerations, which only appears to us if we pay analytical attention and expand our notions for what makes the boundaries of technology design.

In this chapter we propose that socially embedded technology research is a promising opportunity for dismissing the current technological deterministic perspectives on ICT research, and we propose that one possible replacement is the sociomaterial-design approach (Bjørn and Østerlund, in progress), where we attempt to design technical artifact without predetermined boundaries. This approach suggests that researchers should pay critical attention while participating actively in the bounding practices making the technology.

14.7 Final Remarks

We argue that the sequential order of first conducting ethnography and then designing technology no longer holds because technology today is dynamic and ever changing, and by the time we complete our ethnography, both practice

and technology are already evolving, sometimes dramatically so. Therefore, we recommend rethinking the role of research in such situations, and, in particular, we suggest thinking about the researchers' role as creating and managing the boundaries for what makes the technology. The boundaries for what makes the technology are no longer simply predefined; instead they are created and recreated when people enact technology, and they are continuously changing and being bound in different ways.

We cannot study the technology without the social, and as such the social becomes constitutive part of what makes the technology. Socially embedded technologies form an overall umbrella of different approaches for ICT research. In this chapter we have proposed a way to conceptualize the practices of SET research, namely, in terms of designing technological artifact without predetermined boundaries by investigating, experimenting, and participating in the bounding practices which make the technology. Our role as researchers is thus to engage with relevant groups and communities with invested interests in the ICT topic and to study how technology becomes bounded in practice. This includes identifying relations in a hyphenated structure as well as [bracketing] the entity by distinguishing what makes the boundaries for the black box of technology.

Acknowledgment We highly appreciate the discussions we have had on our work with the great researchers within the EUSSET community including Dave Randall, Myriam Lewkowicz, Volker Wulf, and Kjeld Schmidt as well as many others. We would also like to acknowledge Carsten Schürmann, the principle investigator of the DemTech project, for his comments on the final draft of this chapter. This work was supported in part by grant 10-092309 from the Danish Council for Strategic Research, Programme Commission on Strategic Growth Technologies.

References

Andersen, T., Bjørn, P., et al. (2010). Designing for collaborative interpretation in telemonitoring: Re-introducing patients as diagnostic agents. *International Journal of Medical Informatics, 80*(8), e112. doi:10.1016/j.ijmedinf.2010.09.010.

Balka, E., Bjørn, P., et al. (2008). Steps towards a typology for health informatics. In *Computer supported cooperative work (CSCW)*. San Diego: ACM.

Barad, K. (1996). Meeting the universe halfway: Realism and social constructivism without contradiction. In *Feminism, science, and the philosophy of science* (pp. 161–194). Dordrecht: Kluwer.

Bardram, J., & Bossen, C. (2005). *A web of coordinative artefacts: Collaborative work in a hospital ward*. Sanible Island: ACM Group.

Bentley, R., Hughes, J., et al. (1992). Ethnographically-informed system design for air traffic control. In *Computer supported cooperative work (CSCW)*. New York: ACM Press.

Bjørn, P. (2012). Bounding practice: How people act in sociomaterial practices. *Scandinavian Journal of Information Systems, 24*(2), 97–104.

Bjørn, P., & Balka, E. (2007). Health care categories have politics too: Unpacking the managerial agendas of electronic triage systems. In *ECSCW 2007: Proceedings of the tenth European conference on computer supported cooperative work*. Limerick: Springer.

Bjørn, P., & Boulus, N. (2011). Dissenting in reflective conversations: Critical components of doing action research. *Action Research Journal, 9*(3), 282–302.

Bjørn, P., & Hertzum, M. (2011). Artefactual multiplicity: A study of emergency-department whiteboards. *Computer Supported Cooperative Work (CSCW): An International Journal, 20*(1), 93.

Bjørn, P., & Østerlund, C. (2014). *Sociomaterial-design: Bounding technologies in practice*. Cham: Springer.

Bjørn, P., Burgoyne, S., et al. (2009). Boundary factors and contextual contingencies: Configuring electronic templates for health care professionals. *European Journal of Information Systems, 18*, 428–441.

Blomberg, J., Giacomi, J., et al. (1993). Ethnographic field methods and their relation to design. In D. Schuler & A. Namioka (Eds.), *Participatory design: Principles and practices* (pp. 123–155). London: Lawrence Erlbaum Associates Publisher.

Boulus, N. (2004). *Managing the gradual transition from paper to electronic patient records (EPR)*. Master, University of Oslo.

Boulus, N. (2009). Sociotechnical changes brought about by electronic medical record. In *Americas conference on information systems*, San Francisco, CA, USA.

Boulus, N. (2010). *A journey into the hidden lives of electronic medical records (EMRs): Action research in the making*. Vancouver: School of Communication, Simon Fraser University.

Boulus, N., & Bjørn, P. (2007). Constructing technology-in-use practices: EPR-adaptation in Canada and Norway. In *Third international conference information technology in health care: Socio-technical approaches*. Sidney: IOS Press.

Boulus, N., & Bjørn, P. (2008). A cross-case analysis of technology-in-use practices: EPR-adaptation in Canada and Norway. *International Journal of Medical Informatics, 79*(6), 97–108.

Boulus-Rødje, N. (2012). Action research as a network: Collective production of roles and interventions. In *Proceedings of the 20th European conference on information systems (ECIS)*. Barcelona: ESADE.

Dourish, P. (2006). Implications for design. In *Computer human interaction (CHI)* (pp. 541–550). Montreal: ACM.

Dourish, P., & Bly, S. (1992). Portholes: Supporting awareness in a distributed work group. In *Computer human interaction (CHI)* (pp. 541–547). New York: ACM Press.

Grudin, J., & Grinter, R. (1995). Ethnography and design. *Computer Supported Cooperative Work (CSCW): An International Journal, 3*, 55–59.

Grudin, J. (2004). *Crossing the divide. ACM transactions on human-computer interaction*. New York: ACM Press.

Gutwin, C., & Greenberg, S. (2002). A descriptive framework of workspace awareness for real-time groupware. *Computer Supported Cooperative Work (CSCW): An International Journal, 11*, 411–446.

Haraway, D. (1987). *Donna Haraway reads "the national geographic" on primates*. youTube video. http://www.youtube.com/watch?v=eLN2ToEIlwM

Haraway, D. (1991). *Simians, cyborgs and women: The reinvention of nature*. London: Free Associations Books.

Hartswood, M., Proctor, R., et al. (2003). Making a case in medical work: Implications for electronic medical record. *Computer Supported Cooperative Work (CSCW): An International Journal, 12*(3), 241–266.

Hughes, J., Randall, D., et al. (1992). Faltering from ethnography to design. In *Computer supported cooperative work (CSCW)* (pp. 115–122). New York: ACM Press.

Hughes, J., King, V., et al. (1995). The role of ethnography in interactive system design. *Interactions, 2*(2), 57–65.

Jones, M. (2013). A matter of life and death: Exploring conceptualizations of sociomateriality in the context of critical care. *MIS Quarterly Special Issue on Sociomateriality, 38*(3), 895–925.

Latour, B. (2005). *Reassembling the social: An introduction to actor-network-theory*. Oxford: Oxford University Press.

Law, J. (2004). *After method: Mess is social science research*. London/New York: Routledge.

Leonardi, P., Nardi, B., et al. (2012). *Materiality and organizing: Social interaction in a technological world*. Oxford: Oxford University Press.

Luff, P., Hindmarch, J., et al. (Eds.). (2000). *Workplace studies: Recovering work practice and informing system design*. Cambridge: Cambridge University Press.

Mol, A. (2002). *The body multiple: Ontology in medical practice*. London: Duke University Press.

Møller, N. H., & Bjørn, P. (2011). Layers in sorting practices: Sorting out patients with potential cancer. *Computer Supported Cooperative Work (CSCW): An International Journal, 20*, 123–153.

Orlikowski, W. (1992). Learning from notes: Organizational issues in groupware implementation. In *Conference on computer supported cooperative work*. New York: ACM.

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

Pipek, V., & Wulf, V. (2009). Infrastructuring: Toward an integrated perspective on the design and use of information technology. *Journal of the Association for Information Systems, 10*(Special Issue), 447–473.

Randall, D., Harper, R., et al. (2007). *Fieldwork for design: Theory and practice*. London: Springer.

Schmidt, K. (1998). The critical role of workplace studies in CSCW. In C. Heath, J. Hindmarsh, & P. Luff (Eds.), *Workplace studies: Recovering work practice and informing design*. Cambridge: Cambridge University Press.

Schmidt, K. (2009). *Divided by a common acronym: On the fragmentation of CSCW* (European conference on computer supported cooperative work (ECSCW)). Vienna: Springer.

Schmidt, K., & Bannon, L. (1992). Taking CSCW seriously: Supporting articulation work. *Computer Supported Cooperative Work (CSCW): An International Journal, 1*(1–2), 7–40.

Suchman, L. (1994). Do categories have politics? The language/action perspective reconsidered. *Computer Supported Cooperative Work (CSCW): An International Journal, 2*, 177–190.

Svensson, M. S., Heath, C., et al. (2007). Instrumental action: The timely exchange of implements during surgical operation. In *European conference on computer-supported cooperative work (ECSCW)*. Limerick: Springer.

Winograd, T. (1994). Categories, disciplines, and social coordination. *Computer Supported Cooperative Work (CSCW): An International Journal, 2*, 191–197.

Wulf, V., Rohde, M., et al. (2011). Engaging with practices: Design case studies as a research framework in CSCW. In *Computer supported cooperative work CSCW* (pp. 505–512). Hangzhou: ACM.

Yamashita, N., Hirata, K., et al. (2008). Impact of seating positions on group video communication. In *Computer supported cooperative work (CSCW) conference* (pp. 177–186). San Diego: ACM.