ROUTLEDGE STUDIES IN INNOVATION, ORGANIZATION AND TECHNOLOGY

The New Production of Users

Changing Innovation Collectives and Involvement Strategies

Edited by
Sampsa Hyysalo, Torben Elgaard Jensen and Nelly Oudshoorn

ROUTLEDGE

The New Production of Users

"A welcome addition to the reading list for any aspiring student of innovation and technology management who has a thirst for understanding how users, like technology, are pervading services, products and business models."

—Brendan Galbraith, Ulster University, Ireland

Behind the steady stream of new products, technologies, systems and services in our modern societies, there is a prolonged and complicated battle around the role of users. How should designers get to know the users' interests and needs? Who should speak for the users? How can designers collaborate with users, and in what ways can users take innovation into their own hands?

The New Production of Users offers a rare overview of these issues. It traces the history of designer–user relations from the era of mass production to the present day. Its focus lies in elaborating the currently emerging strategies and approaches to user involvement in business and citizen contexts. It analyzes the challenges in the practical collaborations between designers and users, and it investigates a number of cases, where groups of users collectively took charge of innovation.

In addition to a number of new case studies, the book provides a thorough account of theories of user involvement as well, and offers further developments to these theories. As a part of this, the book relates to the wide spectrum of fields currently associated with user involvement, such as user-centered design, participatory design, user innovation, open source software, co-creation and peer production.

Exploring the nexus between users and designers, between efforts to democratize innovation and to mobilize users for commercial purposes, this multi-disciplinary book will be of great interest to academics, policy makers and practitioners in fields such as innovation studies, innovation policy, science and technology studies, cultural studies, consumption studies, marketing, e-commerce and media studies as well as design research.

Sampsa Hyysalo is an Associate Professor in co-design at the Aalto School of, Art, Design and Architecture, Finland.

Torben Elgaard Jensen is a Professor in Techno-Anthropology and Science and Technology Studies at Aalborg University in Copenhagen, Denmark.

Nelly Oudshoorn is a Professor Emeritus of Technology Dynamics and Health Care at the University of Twente, the Netherlands.

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About the Editors

Sampsa Hyysalo is an Associate Professor in Co-Design at the Aalto University School of Art, Design and Architecture in Helsinki, Finland. His research focus is on longitudinal studies of designer-user relations in technology projects. He has published 50 peer-reviewed articles and book chapters on user-developer relations. He is the author of *Health Technology Development and Use: From practice-bound Imagination to evolving Impacts* (Routledge, 2010). Sampsa received his PhD in behavioral sciences from the University of Helsinki and holds docenture in information systems, specializing in user-centered design.

Torben Elgaard Jensen is a Professor at Aalborg University in Copenhagen, where he heads the Techno-Anthropology Research Group. He is the co-editor of *Identity in the Age of the New Economy* (Edward Elgar 2004), and the co-author of *Bruno Latour: Hybrid Thoughts in a Hybrid World* (Routledge 2011). His research focuses on technical and social innovation practices. He has conducted qualitative field studies of innovation by following innovation projects that attempted to enhance innovation through management interventions, organizational design, deployment of innovation methods and user involvement. His work is broadly inspired by science and technology studies and the sociologies of innovation and organization.

Nelly Oudshoorn is a Professor Emeritus of Technology Dynamics and Health Care at the University of Twente in the Netherlands. Her research focuses on user-technology relationships in information and communication technologies and medical technologies. She is the author of *Beyond the Natural Body. An Archeology of Sex Hormones* (Routledge 1994), *The Male Pill. A Biography of a Technology in the Making* (Duke University Press 2003) and *Telecare Technologies and the Transformation of Health Care* (Palgrave 2011), and is the co-editor of *Bodies of Technology. Women's Involvement with Reproductive Medicine* (Ohio State University Press 2000) and *How Users Matter. The Co-construction of Users and Technology* (MIT Press 2003).

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About the Contributors

Luciana D'Adderio is a Reader in Management at Strathclyde Business School (UK) and an Innovation Fellow with the Advanced Institute of Management (AIM) Research. Her ESRC/EPSRC-sponsored AIM project, entitled "Making Innovation Dependable", examined the challenges to innovation in the context of global high-technology production. Before joining Strathclyde, Luciana worked at Edinburgh University, where she was involved in a number of high-profile interdisciplinary projects, including the EPSRC Interdisciplinary Research Collaboration on "Dependable Computing" and the ESRC study of The Biography and Evolution of Standardised Software Packages, with Williams, Pollock and Procter. Luciana's scholarly publications include research articles in leading organisational, innovation and information systems journals as well as a monograph with Elgar (2004) titled *Inside the Virtual Product*.

Mikael Johnson is a software engineer and PhD with a deep interest in science and technology studies. His research themes are strategic user involvement, social media and changing patterns of energy use. He is a post-doctoral researcher at Aalto University School of Art, Design and Architecture in the Department of Design. Mikael received his Doctor of Science from Aalto University's Department of Computer Science and Engineering. His doctoral thesis focused on how social media changes user-centred design. He has also worked as a software engineer, interaction designer and IT consultant on various projects.

Eric von Hippel is a Professor of Technological Innovation at the MIT Sloan School of Management, and is also a professor in MIT's engineering systems division in the US. He specializes in research related to the nature and economics of distributed and open innovation. He is also involved in developing and teaching about practical methods that individuals, open user communities and firms can apply to improve their product and service development processes. He is the author of *The Sources of Innovation* (Oxford University Press 1988) and *Democratizing Innovation* (MIT Press 2005).

Line Melby works as a Researcher at the University of Oslo and SINTEF Technology and Society, Norway. Her research interests revolve around health service research, in particular how information and communication technologies (ICT) reshape the health care sector, health care work and the interaction between patients and providers. She is also interested in the relationship between developers and users, and how they co-produce technologies. She is the co-editor of the Norwegian book *Collaboration for health* [Samhandling for helse] (Gyldendal Akademisk 2013), and has been published in journals like the *International Journal of Medical Informatics* and the *International Journal of Integrated Care*. Her current research focuses on how ICT supports (or not) collaboration across the Norwegian health care sector.

Hajar Mozaffar is a Research Fellow at the Center for Population Health Sciences at the University of Edinburgh. Her research focuses on technology user innovation and the multi-faceted user-technology relationships in enterprise information systems and medical applications. She has recently published several papers on the role of user communities in complex technnologies. With both academic and professional backgrounds in software engineering and her current research focus on social sciences, she has a multi-disciplinary approach in conducting her research. Hajar's present research concentrates on understanding the role of user communities on technology when it concerns organizational applications that are interlinked but at the same time distributed across the firm. She currently has a particular focus on evolutions of hospital information systems in the UK.

Kristian H. Nielsen is an Associate Professor at Aarhus University's Centre for Science Studies. His research interests cover many aspects of the history of science and technology in the twentieth century. He has published in journals such as *Public Understanding of Science*, the *British Journal for the History of Science*, *Science Communication*, *Annals of Science*, *Engineering Studies*, and *Centaurus*. His recent publications include work on the transformation of Greenland in the early part of the Cold War (*New Global Studies*, 2013) and on Camp Century, the nuclear-powered army base under the inland ice in Greenland (*Science as Culture*, 2014).

Ellen van Oost is an Associate Professor in the Sociology of Technology and Innovation at the University of Twente. She has a master's degree in mathematical engineering and did a PhD in the field of gender and technology. Together with a colleague, she wrote a Dutch textbook on technology dynamics and assessment. Her research and publications include history of ICT, the co-construction of users and technology, gender and technology. Currently, her research interests concern the dynamics and the (self)-governance of grassroots innovations, in relation to a more normative question of advancing responsible innovation.

Morten Krogh Petersen is an Assistant Professor in the Department of Learning and Philosophy at Aalborg University in Copenhagen. His research explores how contemporary design and innovation projects explore, utilize knowledge of and create intricate links to everyday and work life, drawing on material-semiotic methods of analysis. His current research focuses on the notion and practices of design thinking and follows these through various connected sites. He co-edited a special issue of *Science Studies* on cultural analysis as intervention (2012), and recently contributed to a volume on the new field of techno-anthropology with the chapter "Contributions from Techno-Anthropological Ethnography to Innovation and Design Projects" (Aalborg University Press 2013).

Trevor Pinch is the Goldwyn Smith Professor of Science and Technology Studies and a Professor of Sociology at Cornell University. He holds degrees in physics and sociology. He has authored many books and numerous articles on aspects of the sociology of science, the sociology of technology, the sociology of economics and sound studies. His books include *Analog Days: The Invention and Impact of the Moog Synthesizer* (Harvard University Press 2002). He is co-editor of the *Oxford Handbook of Sound Studies* (Oxford University Press, 2012). He is also performing musician with the Electric Golem.

Neil Pollock is a Professor of Innovation and Social Informatics at the University of Edinburgh Business School, where he is also the head of the Entrepreneurship and Innovation Group. He has published widely on the sociology of information systems and has co-authored three books: *Putting the University Online* (with James Cornford) and *Software and Organizations* and *How Industry Analysts Shape the Digital Future*, Oxford, University Press (both with Robin Williams). He is currently working on a third, provisionally entitled *The Sociology of Business Knowledge*.

Johan Söderberg is an Associate Professor in the Department of Philosophy, Linguistics and Theory of Science, Göteborg University. His research focuses on the regulation of open innovation. He is the author of *Hacking Capitalism* (Routledge, 2007), founding editor of the *Journal of Peer Production*, and a member of the editorial board of *Triple-C* and *Science as Culture*. His latest research is about open source 3D printing and home-brewed psychedelic drugs.

Lucy Suchman is a Professor at the Center for Science Studies and the Center for Gender and Women's Studies at Lancaster University in the UK. She came to Lancaster University after twenty years as a researcher at Xerox's Palo Alto Research Center in the US. Her research interests are focused on technological imaginaries and the material practices of technology design, particularly developments at the interface of bodies and machines. Her current research extends her long-standing critical engagement with the field of human-computer interaction to contemporary war fighting, including the figurations that inform immersive simulations, and problems of "situational awareness" in remotely controlled weapon systems.

She is concerned with the question of whose bodies are incorporated into these systems, how and with what consequences for social justice and the possibility of a less violent world. She is the author of *Plans and Situated Actions: the problem of human-machine communication* (Cambridge University Press 1987) and *Human-Machine Reconfigurations: plans and situated actions expanded edition* (Cambridge University Press 2007).

Andrew W. Torrance is a Professor of Law at the School of Law at the University of Kansas in the US. His research interests include intellectual property, patent law, innovation law, biotechnology, biolaw, food and drug law, biodiversity law, climate change law and international environmental law. He is well known as the author of the Google TechTalk (2010) "The Patent Game: Experiments in the Cathedral of Law."

Pieter Toussaint is a Professor of Health Informatics at the Norwegian University of Science and Technology in Trondheim, Norway. His research focuses on two themes: the integration of information systems in clinical work, and computer-mediated communication in health care. His work has been published in the fields of health informatics, information systems research and Computer Supported Collaborative Work research. Currently, he is involved in research on patient-nurse communication and the application of information technology in supporting collaboration between different actors in health care.

Stefan Verhaegh is the Founder of Buro Vector, a commercial research and consulting company located in Amsterdam, the Netherlands. In his current work, he effectively translates between worlds and words, with a specific focus on information and communication technologies and everyday life. In his PhD thesis ("How community innovation works", University of Twente, 2010), he analysed user-initiated innovation and the different types of work involved in creating and maintaining novel socio-material networks. His current interests revolve around innovative use practices, hacker/maker cultures, technologically mediated identity projects, the sociology of maintenance and repair, the digital post-Snowden panopticon and the performativity of words and metaphors.

Kate Weiner is a Research Fellow in the Department of Sociological Studies at the University of Sheffield. Her work is situated at the intersection of medical sociology and science and technology studies. She is interested in lay and professional knowledge, user-technology relations and the distributions of responsibilities for maintaining health, and has undertaken research in the areas of genetics and heart disease, pharmaceuticals and functional foods. She is currently developing work on the uses and non-uses of consumer technologies for monitoring and tracking health that are acquired independently of health care providers.

Catherine Will is a Senior Lecturer in the School of Law, Politics and Sociology at the University of Sussex. Her research interests lie in the organisation and interpretation of randomised controlled trials in health care, the practice and policy of treating heart disease and lay and professional responses to medical interventions that have preventive aims. With Tiago Moreira, she published a book on trials, *Medical Proofs, Social Experiments: Clinical Trials in Shifting Contexts* (Ashgate, 2010). Her more recent work includes a collaboration with Kate Weiner on lay responses to drugs and functional foods for cardiovascular risk reduction and their development and regulation, as well as issues around self-monitoring and the ways in which people navigate markets in consumer health products and services and contact with statutory providers of care.

Robin Williams is a Professor of Social Research on Technology in the School of Social and Political Sciences and the Director of the Institute for the Study of Science, Technology and Innovation at the University of Edinburgh. Building on research into the "social shaping" of enterprise systems and various other information technology applications, he is developing, with co-authors, the Biography of Artefacts perspective to address the design and implementation of information infrastructures. His recent books include *Social Learning in Technological Innovation: Experimenting with Information and Communication Technologies*, (Edward Elgar: 2005) with James Stewart and Roger Slack, and *Software and Organisations: The Biography of the Enterprise-Wide System—Or how SAP Conquered the World* (Routledge: 2009), and *How Industry Analysts Shape the Digital Future* (Oxford University Press 2016), both with Neil Pollock.

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1 Introduction to the New Production of Users

Sampsa Hyysalo, Torben Elgaard Jensen and Nelly Oudshoorn

Several years before Facebook, at the turn of millennium, in the early days of social media and online recreational games, a remarkably successful project saw the light of day in Helsinki. Two young media developers began building "Habbo Hotel", a free-to-play online virtual world where people could chat and hang out. The web service featured retro pixel graphics and gained revenue from micropayments on virtual furniture that the visitors could use to decorate their own hotel rooms. It was a friendly, noncompetitive environment, and soon became popular among people in their twenties as well as among teenagers.

In the years that followed, teens crowded the place, and the user base expanded. What was being done at the hotel and with its virtual furniture expanded too. Literally thousands of new uses, new configurations of the furniture, tweaks and hacks emerged. Hundreds of external websites dedicated themselves to Habbo. Much of the user-generated content was embraced by the designers and incorporated into their rapidly evolving virtual world. At the same time, the designers worked hard to keep the basic functionalities of the platform running. At the back end, they confronted and solved scalability issues, and at the front end, they continually updated crucial components such as entry, login, payments and furniture selection. The growth of the hotel was remarkable: with eleven language versions, customers in 150 countries and over 15 million visitors per month, Habbo was the world's largest teenage virtual world for over a decade.

The developers' ability to service these creative users was no coincidence. During the earliest phases, they drew from their own rich understanding of being users in the hotel. Informal evaluation practices, abundant email feedback, fan-authored Habbo-themed websites and discussion forums outside the hotel gave further ideas. When the number of users reached too many to keep track of, the developers turned to typical usages: logging in, learning to navigate in Habbo, connecting with others, creating a room, etc. As the hotel matured, the arrays of methods for knowing and working with the users grew, including usability and playability testing, market surveys, automated web analytics, persona methods and focus groups; in all, close to thirty different main ways emerged. In part, these were responses to new *knowledge needs, in part attempts to deal with the diversification of the user base, but they were also a means of managing contact with the hordes of users in a viable way—one could not have rich interactions with millions of people.*

Habbo managed to grow for ten years in a row before competition from other social media began to squeeze in on it. Its downturn was accelerated by a public scandal: the British broadcaster Channel 4 uncovered that Habbo's online moderation was unable to prevent sexual harassment and keep the site safe. The Channel 4 program struck an Achilles' heel: moderation had been a challenge for cost-effective growth all along. It had been shifted from the company to volunteers and then back to the company, aided by algorithm-powered chat surveillance. It had been shifted within the company from hotel country offices to one centralized office with less diversity in language and culture skills. Eventually, parts of the moderation were automated and handed over to bots, complemented by 225 employed moderators. But none of this prevented the scandal. Habbo, whose success was built on content produced by users and clever developer responses, also turned out to be vulnerable to the unwanted actions of some of its users.

The interest of this book is in the *new production of users*. Our starting point is the commonplace observation that the productive role of users is under constant development. Users in the twenty-first century will play different roles in innovation, production and consumption than they did previously. Users will develop new forms of innovative collectives that enable their engagement with products and technologies, and users will be faced with equally creative managers, designers and producers who will develop new strategies for involving and analyzing users. The new production of users therefore means both the new production by users and the new efforts to produce active users.

As we see in the Habbo case, there is a simultaneous production of "matter" and "form." The matter is the incessant stream of opinions, ideas and technical solutions that are generated by users and that may or may not be welcomed by the designers. The forms are the organized ways in which users become productive—ranging from the users' independent fan homepages to the strictly controlled usability tests developed by the designers. The new production of users in the Habbo case, as well as in all the other cases in this book, is thus about user creativity *and* about changing involvement strategies that produce creative users. The aim of the book is to provide a rich, updated account of the matters and forms of the new production of users, and to guide the reader through the contemporary landscape of user involvement.

In the course of this introduction, we will provide some background to the current production of users by going back to the first part of the twentieth century and recounting some key events that produced users and allowed users to produce in particular ways in the past. We will also review a number of more recent contributions, from the 1970s and onwards, that have directly laid the groundwork for the current production of users. But before we go into these matters, we will take another look at Habbo Hotel to draw out some of the noteworthy features of the contemporary landscape of user involvement.[1]

The first thing that strikes us about Habbo is the extremely active role that users play. In some traditional understandings of business, it is commonplace to ask how the users will respond to the latest product from the company. In the case of Habbo, the reverse question is the order of the day: how will the designers respond to the latest practices and designs created by the users? Both users and designers at Habbo maneuver in a landscape where *it has become a "fact of life" that users have significant productive capabilities*. Not only do the users respond and appropriate the services of Habbo, they also envision and sketch out new features and new ways to render the service valuable. They do so within the platform, but they also carry out some of the action elsewhere by means of the hundreds of homepages that are associated with Habbo.

The uniqueness of Habbo is not that users and designers collaborate or co-produce. This has taken place before and in other arenas. But the difference to the past is the apparent ease and the degree to which users are now able to produce and innovate—even the preteens do this in Habbo.

The second thing to note is that *user involvement has become a key object of industrial strategizing*. Throughout the fast-growing and fast-changing Habbo project, the managers made a series of strategic choices about how to involve users, how to assess the results of this involvement and how to shift to new modes of user involvement. The move from designing a game for oneself and one's peers to the sophisticated tracking and catering for user preferences was not a planned sequence. But it was clearly the result of managerial efforts to monitor, deploy and adjust user involvement, just as the management team would attempt to control other key operations of the business.

We should point out again that the uniqueness of Habbo is a matter of degree rather than of kind. Companies have always acted strategically towards their customers and markets. They have always attempted to produce or configure their users (Woolgar 1991; Akrich 1992). The novelty of Habbo is the degree to which user involvement has moved to become a central and normalized part of the business; Habbo rose and declined with its ability to manage the engagement of users. The strategizing around users was thus not merely an addition or enhancement of the core business, as was still the case a decade ago in most crowdsourcing, microtasking, open innovation communities and idea competition projects by companies. Now, these user involvement activities are no longer something extraordinary.

The active users and actively strategizing managers are highly visible figures in the Habbo case. But there is also a third facet that we wish to emphasize, namely, the resources, methods and tools that are available to users and managers. It is evident from the case that managers draw on a number of previously developed ways of engaging users, such as usability testing, market surveys, persona methods and focus groups. Many of these (social) techniques were invented decades before Habbo and are now widely available to managers who wish to study or engage with users in various ways. Recently, they have been complemented by a growing array of digital methods for keeping track of users. So, if the Habbo designers wondered if a new possible feature would be appreciated by users, they did not have to rely on guesswork. Instead, they could hire a usability expert to investigate the matter or they could quickly test-market the feature on selected users and make design decisions based on digital tracking of the users' behavior. The methods for studying and engaging users are one crucial aspect of the landscape in which users and designers operate. Another crucial resource is the flood of online tools and platforms that allow users to share, discuss and exchange. These are more or less readily available means that can be deployed by contemporary users and designers. The conclusion, then, is that *active users and strategizing managers operate and produce in a landscape where the methods and resources for engagement are widely available*. In the contemporary situation, user involvement methods do not need to be invented; they are there to be selected and deployed. However, this does not mean that user involvement is easy. On the contrary, the Habbo case clearly suggests that involving the users is like riding wild horses. The managers had to try, deploy, combine and shift between a flood of different methods, and despite all this, the users remained quite unpredictable.

What we suggest then, from our brief examination of the Habbo case, is that the game is open in a new way. The methods and resources for user engagement are now more widely available than ever. The innovative capability of users has become a recognized fact of life, and managers have made user involvement a key part of their strategizing. These, we suggest, are the emerging, crucial characteristics of the new production of users.

The case of Habbo is only one indication that user creativity is a force to be acknowledged. There is currently an abundance of stories about business successes that draw heavily on creative and unpaid work from users. Some companies, for example, Lego and Ducati, encourage users to propose specific design ideas. Other companies, for example, eBay and Microsoft, create forums where users help other users figure out how to use the product. Users have even been bestowed with prestigious public recognition: in 2006, TIME magazine selected *citizens* to be the "Person of the Year" because of their creative, unpaid work in innovating the World Wide Web.

The contemporary examples of "open user innovation" or "crowdsourcing" are striking and undoubtedly important. It would, however, be quite misleading to see them as signs that users have now *for the first time* come to play an important productive role, as if users somehow came out of the woodwork around the time of the development of the Internet. To get a proper sense of the productive roles that users have played in the past and will come to play in the future, we should go back at least a century. In the following, we provide an account of attempts to produce a role for users at the beginning of the era of mass production. As we shall see, these gave rise to the numerous resources and methods for user engagement that are widely available today.

USER ENGAGEMENT IN THE EARLY DECADES OF MASS PRODUCTION: WEAVER'S PROBLEM AND THE RISE OF THE LIAISON DISCIPLINES

We begin our historical sketch with a quandary or predicament, which we shall call a *Weaver's problem*. Henry G. Weaver was the director of consumer research at the American car manufacturer General Motors in the 1930s. In 1932, he produced a series of diagrams (Figure 1.1) that he used to make the case for the emerging discipline of consumer research (Marchand 1998; Pantzar and Ainamo 2000). As some sort of baseline, Weaver suggested that "a hundred years ago," in other words, in 1832, there was an intimate link between users and producers, since most goods were produced in one-man shops. This intimacy was broken, however, with the rise of "modern industry," where an increasing number of links had become inserted between the consumer and the producer; in the industrial setup, the engineering department links to the production department, which then links to the sales department, which would link to numerous dealers, who would finally link to the consumers.

In painting this portrait of a widening distance between engineers and consumers, Weaver was clearly speaking of some hot contemporary issues around mass production—an industrial strategy that successfully drove down production costs, but at the expense of making standardized goods that were poorly tailored to the individual needs of customers. The prime example in Weaver's mind and in the minds of his readers was undoubtedly the Ford Motor Company, which was also the main competitor of General Motors. Henry Ford was famous for his efficient mass production apparatus, but also for his impatience with individual demand. As he famously termed it, "any customer can have a car painted any colour that he wants so long as it is black" (Ford, 2007).

Weaver, however, had a different vision, which he indicated in the last part of his diagram titled "General Motors." In this depiction, Weaver inserts a link called "consumer research" between engineers and consumers. As he explains in the accompanying text, the link would provide "some kind of liaison which would serve as a substitute for the close personal contact, which existed automatically in the days of the small shop." Weaver's problem, as we playfully call it, is precisely this: how to reconnect, or weave together, the designers and the users, who have been separated by the forces of mass production? When contemplating Weaver's diagrams, it strikes us

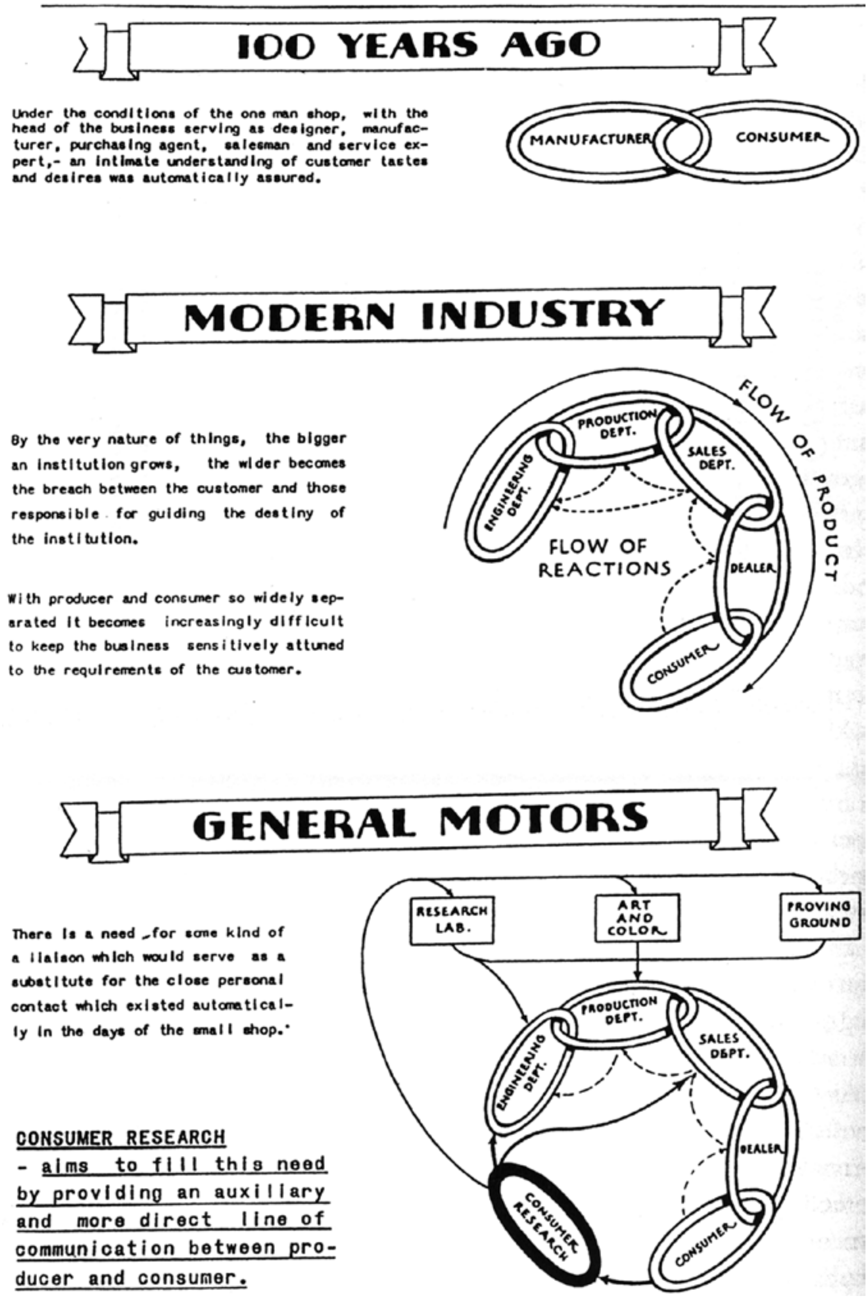

Figure 1.1 Weaver's problem: how to establish a liaison between designers and consumers, separated by the forces of mass production (Image: Henry G. Weaver to O. J. Hunt, Detroit 1932 folder, Charles F. Kettering Papers, GMI Alumni historical collection, Flint, Mich. GM media archives).

that he is not merely depicting a technical fix to a communication problem. His diagrams imply a vision that is subtly communicated by the graphics. The ends of the chain bend towards each other and are almost connected by "consumer research." It is as if the closing of a circle is within reach, that a healing of sorts will happen and that a happy homecoming of consumers will take place, even in the age of modern production. This vision, as we shall see later, is still alive today.

The first attempt to reconnect producers and consumers was marketing research, of which Weaver was among the pioneers. The key approach was to develop a series of methods to study consumers. As early as the 1920s, polling was carried out on the streets to examine the degree to which people read and remembered different kinds of car advertisements in newspapers. This information could immediately be used to target the advertisements more precisely (Starch 1923). From the 1930s, polling became phone-based and large-scale, and it was supported by sophisticated statistical analysis. In the 1950s, psychological and sociological methods, such as focus group interviews, were developed to understand people's reasons for choosing particular products and brands over others (Lezaun 2007). The history of marketing and consumer research also features the collection of a large amount of behavioral and demographic data with the aim of predicting consumer behavior (Poon 2009; Cukier and Meyer-Schoenberger 2013), and the quest for an in-depth understanding of consumers has even extended into measuring the brain, as in the recent development of neuromarketing (Schneider and Woolgar 2012).

The history of consumer and marketing research is much richer than what we can convey here, but the point should be clear. Great efforts and a broad collection of scientific methods were deployed to gain knowledge about users' preferences and willingness to buy. Marketing research thus emerged as an early liaison discipline that attempted to weave the connecting threads between designers and users, who had been torn apart by the forces of mass production.

Systematic efforts to weave connections between users and designers also took place on other fronts. Industrial design emerged during the first decade of the twentieth century to improve the aesthetic quality of industrially manufactured goods. Artists had been used previously to copy the looks of handcrafted items over to industrial products, but the new breed of industrial designers forged new aesthetics suited to "modern life," valorizing industrial capabilities for the pursuit of the good life of the increasing urban consumer base (Benton, 2000). In doing so, industrial designers came to mediate the advancing production capabilities and ever-changing wants of consumers. This liaison position bestowed designers with significance and visibility, from the styling of product lines (along with corporate logos) to seeking principles with which to ensure that the goods produced would appeal to the consumer. A key part of the appeal lay in how the products could be used. Cumbersome instruments and awkward controls were common, and the significance of effective machine operation was fronted in both world wars, where swathes of men were needed to operate increasingly complex new weapon systems (McRuer and Krendel 1959). Therefore, industrial designers and engineers began to *study how people used products* and to design products that were fitted to the physical and cognitive properties of the users. The principles developed in work process optimization (Taylor 1911) were taken further. Universal measures of man's proportions were developed (e.g. Dreyfuss 2003 [1955], 2002 [1960]) and design heuristics for particular circumstances. These efforts were joined by those of industrial engineers and gave rise to the field that is now known as human factors and ergonomics (Meister 1999).

The new liaison disciplines—marketing research, consumer research, industrial design and ergonomics—were responses to Weaver's problem. They deployed many resources and a broad spectrum of methods in their vigorous attempts to reconnect producers and users. All these first liaison disciplines were also responses of a particular kind; they were, first and foremost, the *producers'* responses. Producers hired new kinds of experts in order to investigate, predict and manipulate consumers, and they used this knowledge to develop products that were increasingly better fitted for use and better fitted to users' willingness to buy. Just as importantly, these first liaison disciplines were responses from a particular production paradigm; getting to the right design (and getting that design right) became a concern of vastly greater proportions under production runs of tens of thousands than the concern it was in small or handcrafted production.

Meanwhile, the consumers and users also developed *their* set of responses to the new world of mass production. Most importantly, the emerging mass of consumers learned to buy and replace rather than make and mend. Nonetheless, it should be borne in mind that throughout the first half of the twentieth century, it was still very common for people to be engaged in all sorts of productive activities in their free time and work time, such as repairing, mending, building and crafting. Craft production and craft skills were widespread in the countryside, but also among the working classes of cities. Users' productive activities also shaped many industrial products in important ways. Rural cars were used for almost anything at the farm through add-ons and hacks, ranging from a generator to a conveyor belt, a mixer to a tractor. The extent was such that there was a publication about the rural reuses of a T-Ford (Kline & Pinch 1996, 2003). Telephony was first envisioned for important business calls, but was soon reappropriated for the use of social chatter, particularly in rural areas separated by distance. The change in function created many-to-many "gossip lines," as well as an array of phone-based services, such as weather reports over the phone (Martin 1991; Fisher 1992). Amateur radio operators discovered new uses for radios, which commercial operators then followed (Douglas 1989). In industry, it was common for customer companies to develop their own instrumentations and reveal their development efforts to spur collective innovation, a pattern found in steam engines (Nuvolari 2004), blast furnaces (Allen 1983) and Bessemer steel plants in the late nineteenth century, and in mainframe computing in 1950s and 1960s (Knight 1963; Akera 2001). Users also invented new technologies, such as the airplane, and then systematically improved their characteristics (Gardiner and Rothwell 1985).

Yet, by the 1960s, "mass everything" had become a pervasive condition in large parts of the Western world. Goods, public services, city planning and media were to a large extent delivered by big, uniform, centralized systems. Crafts had waned to such a degree that longing for the old days of handicraft services appeared as romantic escapism or mere elitism (Engeström 1987). Industry had become able to develop effective marketing campaigns and to monitor peoples' brand loyalty. The means were also available for avoiding gross ergonomic or design misfits. However, one could hardly say that a happy reunion of designers and users had been achieved between mass production and a new generation of consumers. New product classes were not necessarily more usable, and the cultural critique of the era portrayed industrialization and mass consumption as alienating forces that turned people into passive "cultural dupes" (Miller & Slater 2007). Weaver's problem was still around, perhaps more accentuated than ever before. The search was still on for ways to connect designers and users.

A NEW WAVE OF USER PRODUCTION: ACTIVATING AND ADVOCATING THE USERS

From the 1970s and onwards, a new wave of possible solutions to Weaver's problem emerged. The early liaison disciplines had already generated a significant amount of knowledge about humans as consumers and users; what generic physical and cognitive characteristics needed to be addressed in design and whether or not new products might be received well by users. They were, however, blind to users' situated use of technologies and products and the resultant roles they could play in design and innovation. This new emphasis on knowledge residing in users themselves entailed an important shift in the production and productive roles of users. In broad terms, the shift could be described as a move from seeing users as *objects* that producers should know better, to seeing users as *subjects* that producers should find ways to learn from and collaborate with. In the words of Bannon (1991), attention was shifting from "from human factors to human actors."

Next, we will discuss this new wave through five key areas of development. First, we will recount the emergence and development of two broad types of design strategies: collaborative design and human-centered design (HCD). Then, we will move to three areas of study, namely consumption studies, innovation studies, and science and technology studies (STS). These three areas of study have been central in foregrounding the increasingly active user roles performed by citizens, activists, entrepreneurs and industry actors. However, a perfectly sharp boundary between design strategies and studies, or between practical and theoretical contributions to user involvement, cannot be drawn. This is because there has been considerable mutual inspiration and exchange between practical and theoretical efforts, but also because these participants, to some extent, have been inspired by the increased emphasis on users that followed from broader events, such as the rise of anti-authoritarian social movements.

The contemporary landscape of user involvement, we argue, is strongly influenced by these five key areas through their methods, analyses and conceptualizations, affording specific types of connections between users and designers. In the following, we emphasize (along with recounting some of the key findings) how each of these areas has tried to understand and modify the socio-cultural landscape in which users and user collectives become productive in new ways.

Collaborative Design: Users as Design Participants

It was probably unimaginable to car manufacturers in the 1920s that ordinary people could play an active role in the work of engineers and designers. By the 1970s, however, user-designer collaboration had begun to emerge as a possible design strategy.

An important forerunner was the socio-technical approach, which was developed by the Tavistock Institute of Human Relations in London soon after World War II. Working with von Bertalanffy's theory of general systems, the institute engaged in action research projects aimed at changing the technical, as well as the social, systems of workplaces. Projects in heavy industries, such as metal production, coal mining and cotton weaving, brought home the point that such enterprises could be understood to be intricately linked "task systems" and "sentiment" systems. The socio-technical approach thus implied and became an impetus for collaborating with workers and other participants when considering new technical and organizational arrangements (Törpel et al. 2009).

An even stronger impetus for a collaborative approach began to emerge in Scandinavia in the late 1970s. Trade unionists at that time were faced with the challenge that industrial companies were implementing new production technologies that threatened to make workers redundant or transform their jobs into simpler, "deskilled" and potentially lesser-paid tasks. Collective bargaining, the traditional approach of the unions, had turned out to be an unsuccessful tool for influencing this process. The unions therefore began envisioning engagement with specific design and implementation projects in companies (Asaro 2000, 267). A number of projects were launched with the purpose of designing technical systems with the workers' skills and interests in mind (Greenbaum and Kyng 1991, 11). In these projects, there was considerable development of workshop formats and prototypes that would facilitate workers' direct contributions to design. Over time, the Scandinavian approach to participatory design has established itself as a significant locus for experimentation on how to make design processes collaborative. Participation has expanded from factory-floor workers to broader scopes of users, in particular, the users of ICT systems (Schuler and Namioka 1993; Kensing and Blomberg 1998). In some projects, participants have also expanded to a broader range of stakeholders, including "potential" stakeholders, such as the possible types of users of new ICT systems (Bødker et al. 2004). Participatory design has thus moved from an effort to empower workers and trade unions to a broader and less labor-conflict oriented effort to engage users in design.

The contributions of collaborative design to the twenty-first century are particularly visible in three areas. First, collaborative design has demonstrated that all people possess viable knowledge of their own work and conditions, which can be usefully brought to design if facilitated properly (Bjerkness et al. 1987; Greenbaum and Kyng 1991; Joshi and Bratteteig 2015). A significant amount of agency in the design process can thus be placed in the hands of the net benefactors of the systems, even when they are not professional designers.

Second, to serve this aim, hundreds of collaboration setups, techniques and methods have been developed and used to date (Kuhn and Muller 1993; Bødker et al. 2004). Many of these techniques have been adopted in mainstream IT development and industrial and service design practices. This has taken place both through direct uptake as well as through being first adopted in Human-Centered Design (see the next section). So, although participatory design failed in its original mission to control technological change through collective bargaining, all the efforts of collaborative design clearly succeeded in offering the means for thinking and working through conflicting interests in design projects.

Third, collaborative design has played an important role as a critical and political endeavor. It has been a forerunner in emphasizing design as a force that shapes our society and hence emphasizing that democratic societies should not leave design processes to narrow managerial and technical elites. This political vision was closely affiliated with a broader stream of anti-authoritarian social movements that came to prominence in the 1970s. Collaborative design projects could concretize what the vision of democratized technology could mean in practice, how people could take technological development into their own hands or at least ensure it served their purposes. This has remained a source of inspiration for many subsequent attempts to gain democratic control over science and technology.[2]

Human-Centered Design: Investigating Users for Human-Computer Interactions

Whereas physical products and mass media had restricted sets of functions and user responses, the computing of the 1970s expanded both the functions and interactions that were possible with digital machines. The generic ergonomic measures, be they physical or cognitive, became difficult to establish for the myriad *specific interactions* that could take place between a user and a program. The multidisciplinary field of human-computer interaction (HCI) emerged, emphasizing the dialogic nature of the new interactions (Card et al. 1983). Having over 100,000 publications, HCI is arguably the largest body of research that relates production and use.

The emergence of the scientific HCI program was soon followed by the rapid proliferation of desktop computing and graphical user interfaces. The range of specific interactions and specific problems that specific users and designers could now find by themselves exploded. As systematic research struggled to keep pace, two important responses emerged. Firstly, the rough and stripped testing of interaction with products—usability testing—emerged as an academic and industry practice for ascertaining sufficient ease of use; the test user thus turned from an object to be studied into a subject through which the interface was examined and improved. Secondly, the approach of user-centered systems design emerged to replace previous requirements-capture techniques that elicited requirements from organizations by way of surveys or occasionally by interviewing key users (Royce 1970; Robertson and Robertson 2006). The key informants for requirement engineers would be the clients' managers and IT staff, whereas the end users were predominantly conceived as human factors whose work, role and interactions with technology and others were limited (Friedman and Cornford 1989; Bannon 1991). User-centered design (later HCD) (Norman and Draper 1986; ISO 9241-210; ISO/TR16982) proposed that the context of use should be thoroughly investigated prior to other design activities, followed by an equally contextual evaluation of the proposed system. Various ways to model and understand the context of use (Preece et al. 2002; Dix et al. 2004), mostly derived from cognitive psychology, were accompanied by detailed enquiries into their use "in the wild," drawing on ethnography, ethnomethodology and distributed cognition (Suchman 1987; Hutchins 1995; Szymanski and Whalen 2011).

The key contribution of usability research and HCD to the twenty-first century has been to normalize the view that new information technologies need to be worked into contexts of use before and during their wider uptake. It was established that this quest requires both research into users' contexts and practices, and system evaluation prior to and after launch, as well as new interaction design principles suited to the new technology and its user.

Equally important, HCI and HCD have contributed significantly to the current landscape of user involvement through its development of methods. They have churned out hundreds of methods and method variations for task, role, context and work analysis, requirements determination, prototyping, usability evaluation and user data organizing. Within this abundance of work on methods, particular salience should currently be given to the ethnographic observation of real-life settings, as well as digital observation methods. These types of observation have now become common practice in mediating between design and use. At the level of mainstream, everyday R&D projects, some efforts have even been made to institutionalize and install the process principles of HCD (e.g. ISO 9241–210).

HCI and HCD have also become mainstream avenues in shaping all interactive products. The earliest HCI and HCD engagements took place with office machines, information systems and desktop computing in the early 1980s, while groupware systems became central by the turn of the 1990s and mobile devices by the mid-1990s. In turn, Internet applications and information appliances took center stage around the turn of the millennium, ubiquitous computing and social technologies by 2005, and the Internet of Things by the 2010s.

Whenever one of these new systems moved beyond the initial technical visions and into its first applications, it became evident that new systems invariably entailed new interaction patterns between users, groups of users and various parts of the systems. Therefore, new interfaces and interaction conventions had to be improved or redesigned, which then created demand for in-depth knowledge of users' behavior through HCD. Tens of thousands of professionals have been trained in HCI over the years (CHI: Paper acceptance statistics 2014) and further influence is evident in more modest modes of engagement, for instance, the fact that some form of usability testing, or at least heuristic usability evaluation, has become an integral part of most companies' R&D processes.

The Cultural and Social Studies of Consumption: Users' Active Construction of Meaning

The first of the three areas of study we wish to elaborate on is that of consumption studies, which has reversed the image of the consumer since the 1980s. While consumption had been raised as a core social dynamic in modern society, the patterns of consumption were treated as being stratified through consumers' economic and cultural positions (Bourdieu 1984). Even if one's social identity was seen expressed through consumption, as an activity, consumption was treated as a (habitual) response, conditioned by the availability of material and the cultural resources to acquire consumables. On the other hand, it was also seen as conditioned by the availability of mass-produced goods, images proffered by mass media and mass advertisements. If active meaning-making and the adjustment of products happen during consumption, then the place to look for them would be within various countercultures (Shove and Warde 2002; Miller and Slater 2007).

Gradually, however, more attention was given to consumers' active engagements with consumption objects in their everyday lives (de Certeau 1984; Miller and Slater 2007). Consumption began to be seen to be an effortful accomplishment, underdetermined by the properties of the product and varying from person to person (Holt 1995). Consumption was thus redefined as an active cultural process that involved the symbolic incorporation of objects into selves and identities (Gell 1986, 112; Belk and Costa 1998; Strathern 1992, viii). Correspondingly, the 1990s saw a flux of studies on how people appropriated consumption objects through shared rituals, traditions, authentication and symbols (Sherry 1990; Wallendorf and Arnould 1991; Belk and Costa 1998). An important line of study examined the process by which new technology became “domesticated” by the moral economy of the household, thus highlighting the *processes* of the active shaping of technology (Silverstone et al. 1992, 15–32; Lie and Sorensen 1996; Berger et al. 2005). Since their initial focus on the home, these studies have extended the study of consumption processes to, for instance, the learning that takes place during domestication (Sorensen 2002), the gradual shaping of the form of novel technology through feedback to developers (Pantzar 1996, 2000) and crossover domestication pathways from one technology to another (Juntunen 2014).

This change in the academic view of consumption interestingly coincides with the changing nature of products and changing production systems. By the 1980s, industry production lines had become considerably more flexible and the market segmentations and product differentiations more nimble than those found in the heyday of mass manufacturing. Interactive digital products were increasingly common. The active consumer was constituted through industry practice too. Today, many companies can engage in flexible and incessant change processes, such as those illustrated by Habbo Hotel; they can rapidly twist and tweak peripheral aspects of their products, while their consumer insights also prepare them for the occasional, more structural change of their products. Consumers have been enrolled into peer content creation and into being active carriers of marketing campaigns and other types of brand value creation. Many business models have evolved into n-sided platforms where users are served for free in order to solicit their creative capacities, while the revenue is obtained through selling the visibility so generated to other parties, such as advertisers (Tapscot and Williams 2008). This has also changed how the audience is commodified: instead of selling the passive TV viewer or reader in a mass to advertisers, the audiences of interactive sites are now tracked, their interactions stored and controlled to predictable degree. Also, the audience is analyzed and algorithmically matched to potential advert sellers (Aaltonen 2011; Johnson 2013). The active consumption, identity creation and peer interactions (etc.), once headlined by consumption studies as novel, have become omnipresent features of what it means to use our contemporary products and services.

To sum up, cultural and social studies of consumption have contributed to a new conceptual and practical configuration of users: the analyses of the active consumption process have supplanted the passive view of the consumer and have called attention to a series of cultural meaning-making practices that designers may try to play into with their increasingly flexible production platforms.

Innovation Studies: Uncovering the Forces of Innovation by Users

That users innovate is no news today. But similar to consumption studies' slow awakening to active forms of consumption, innovation studies have been slow to admit the extent to which users innovate for themselves and by themselves. Studies in an increasing range of fields, however, show that in some areas, most of the innovation comes from users in all stages of the innovation process. Enquiries into scientific instruments (von Hippel 1976), circuit boards (von Hippel 1988), medical instruments (Shaw 1985), chemistry analyzers (Riggs and von Hippel 1994), early computer systems (Knight 1963), library information systems (Morrison et al. 2000), application software (Voss 1985), early mainframes (Akera 2001) and the aerospace industry (Tierney and Foxall 1984) gradually established that a substantial amount of innovation in many industrial sectors emerged from individuals and companies who invented primarily for their own needs.

The early work on user innovation established that innovation was concentrated within a few individuals, so-called lead users, who faced a given need before the rest of the market and held high expectations of the benefits from a solution (Franke et al. 2006). Identifying and working with lead users for commercial product development became the first application area of the user innovation findings (von Hippel 1986, 1988).[3]

During the course of the 1990s, the findings around innovating users grew into a basic framework that rested on information transfer, and the attainable benefits and costs of innovating (von Hippel 2005). User innovators were found to introduce functionally novel solutions, while producer solutions typically improved some dimension of merit of a functionality known to be in demand (Knight 1963; Riggs and von Hippel 1994). This difference was founded on the knowledge that these parties held. Users held rich information on the needs and context of use within a specific domain, while producers tended to hold rich general solution information and production process information. Both types of knowledge were needed for a successful solution, but both were "sticky"—costly and laborious to transfer. For this reason, users and producers tended to base their innovation on the knowledge they already had (von Hippel 1994; von Hippel and Tyre 1995). Analyzing innovation activities through "information assets" also explained why some innovations were easy for some individual users and manufacturers to accomplish but not easy for others.

At the more aggregate level, similar findings were made of complementary competences and thus of the mutual benefits of interactive learning between developers and users (Lundvall 1985; Lundvall and Johanson 1994). "Organized markets" were observed: instead of investing in attracting and acting in an open market, suppliers concentrated their sales on a few close customers with whom they worked interactively to improve their products (Håkanson and Johansson 1988; Lundvall 1988). This allowed companies to save on marketing costs, to avoid the risks involved in developing new markets and to access information without the challenges involved in merging vertically into the same organization (Lundvall 1988; Powell 2003).

The turn of the millennium marked a key change in the user innovation research agenda. Open-source software communities demonstrated that users could effectively pool their individual information assets and achieve products and services that greatly exceeded the scope of what any individual user could build (von Hippel and von Grogh 2003). This liberated users from having to go through a producer in order to get a more professionally built, upgraded and extended solution (Baldwin and von Hippel 2011), and turned them into producers themselves (Tierney and Foxall 1984; Shah and Tripsas 2007).

Research on user communities also gained impetus from studies on innovating *consumers* in emerging sports, such as mountain biking, kiteboarding and kayaking (Franke and Shah 2003; Luthje et al. 2005; Baldwin et al. 2006). In these studies, the benefits that users could achieve through collaboration were used to explain the free and selective revealing of solutions and organized cooperation, as well as more informal peer assistance. It was argued that cooperation in networks and communities, rather than secrecy and competition, helped design, test and diffuse innovation more effectively among differently endowed users, as well as between users and producers (von Hippel 2005; Baldwin and von Hippel 2011). In country surveys, 3.7% to 6% of consumers reported having modified some equipment they use (von Hippel et al. 2011, 2012; de Jong et al. 2014), and have invested annually, on average, $1,400 to $1,800 in these activities. When compared to national R&D expenditures on consumer products, the total consumer investment ranges from 13% in Japan to 144% in the UK (for more detail see Torrance and von Hippel, Chapter 2 of this volume). The pervasive importance of user innovation is further underscored by their appearance in less "hot spot" sites, such as renewable home heating technologies (Rohracher and Ornetzeder 2006; Hyysalo et al. 2013a, b).

The key contribution of innovation research has been to *normalize* the view that users are not just active in the consumption process, but are a significant source of innovation, product modification and repurposing across different sectors. This happens in business and professional contexts as well as in consumer goods. It happens in conjunction with producer ecologies as well as independently of them. User innovation research has also established innovation by users as an economically rational activity rather than one based only on ideology, hobbies, interests or sociality. In so doing, it has outlined a framework consisting of information transfer, information assets, benefits and costs to explain why and how users innovate. Drawing on this framework, it has even been argued that users' ability to innovate is likely to *increase* in the future relative to that of manufacturers. The reason given for this additional advance of user innovativeness is that online tools for collaborating and sharing are now more widely available than ever before

(Baldwin and von Hippel 2011). Users have thus been shown to constitute a formidable force of innovation for and by themselves.

Science and Technology Studies: Opening and Connecting the Black Boxes of Innovation

If the *active consumer* was articulated by consumer studies and the *innovative user* was articulated by innovation studies, then the key contribution of STS has been to expand on these insights and to build a conceptualization of how *the innovation process* unfolds across a multitude of actors, materialities and time spaces, and how the moments of innovation, technology development and user activities interrelate.

As a field, STS is broadly concerned with theorizing and investigating the relations between science, technology and society. It originated in anthropological and historical studies of science and has expanded to cover a range of other processes of knowledge production and technology development (MacKenzie and Wajcman 1999). The analytical project of STS has often been described as "opening the black box"—by which STS scholars mean paying careful, often ethnographic, attention to the workings of key sites of science and technology, such as research laboratories, R&D departments and engaged citizen movements (Latour and Woolgar 1979; Bucciarelli 1994; Hess 2007).

STS has had productive engagements with all the other user-advocating disciplines that we have mentioned thus far (collaborative design, HCD, consumption studies and innovation studies). In the following, we will emphasize the work in STS that has "connected the dots" between these disciplines conceptually and empirically. Particular attention is given to findings on processes of innovation, the roles played by users and the construction of markets.

The first set of STS contributions emerged in the 1980s as a reaction to the widely held beliefs in the "technological imperative," suggesting that technology would have certain necessary and determinate impacts on society (Williams and Edge 1996, 868). STS scholars challenged this technological determinism by conducting in-depth case studies of how particular technologies had evolved. Through these studies, it was shown that the process of technological innovation is full of choices; innovation was described as "a garden of forking paths" rather than a process following a predetermined trajectory (Williams and Edge 1996). A range of social, institutional, economic and cultural factors were shown to influence both decisions about design and the outcomes of technological change (Bijker et al. 1987; Law and Bijker 1992; Sorensen and Williams 2002).

Several conceptual frameworks were developed to support such inquiry and to communicate its findings. *The social construction of technology* (Bijker and Pinch 1984; Bijker 1995; Kline and Pinch 1996) developed the notion that a number of different relevant social groups would constitute a social force field in which an emerging technology would be constructed. Each relevant social group would have different interpretations of the emerging technology and hence a different preferred version of it. Various types of struggles between the groups would occasionally lead to a process of closure around one particular version of the technology (Bijker 1995; Oudshoorn and Pinch 2003). The *actor–network theory*, a material-semiotic approach, described technologies as hard won and often unstable alliances of human and non-human actors. Achieving these alliances was analyzed as resulting from "heterogeneous engineering," in which a variety of actors was mobilized and committed to playing particular roles in the actor network (Callon 1986; Law 1986; Latour 1987; Akrich et al. 1988). *Symbolic interactionist studies of technology* (Clarke and Star 2003) and *the social shaping of technology* (Williams and Edge 1996; Russell and Williams 2002a, b) both forefronted the mundane work, the orchestration between different actors and the managing of organizational exigencies that created the winding journeys of innovation through which new technologies came into being. In sum, all of these lines of research of technological innovation were contemporaneous, arrived at many of the same conclusions and effectively orchestrated a conceptual and empirical opposition to the prevailing beliefs in the technological imperative (Russell and Williams 2002a, b).[4]

The many contingent choices in the innovation process drew attention to people who played a role in shaping the implications of technology (Bowker and Star 1999; Oudshoorn 2003). Users were such people *par excellence* and the process of use was found to be intricately entangled with the evolving local situations, infrastructures and technologies at hand (e.g. Suchman 1987; Collins 1992; Cambrosio and Keating 1995; Strauss and Star 1999). A good example is Suchman's (1987) work on photocopy machines, which demonstrated how users responded to the states and actions of machines with the help of social, cognitive and material resources that were specific to the situation. The process of use, or situated action, was thus shown to be *constitutive* of technology, and not merely an event that took place after the technology had been developed.[5]

The focus on the mutually constitutive relations between development and use was carried into several research avenues in STS in the 1990s. The material-semiotic analyses examined how assumptions about the user were hardwired into the material characteristics in design practice (Johnson 1988; Woolgar 1991; Akrich 1992). Furthermore, the analyses traced how these "inscriptions" or "configurations" later became subject to "description" (Akrich 1992), reconfiguration (Mackay et al. 2000) or co-configuration (Hyysalo 2004, 2009a).[6]

Parallel to analyses that traced the development and use of particular technologies, STS also begun to uncover the wider patterns of interaction between developer and user practices. Part of this work was done through collections that charted different key sites and moments where users shaped new technologies (Phaffenberger 1992; Sorensen and Williams 2002; Oudshoorn and Pinch 2003; Rohracher 2005; Williams et al. 2005; Baraldi et al. 2009; Voss 2009). A more integrated method was pursued within the *biography of artifacts and practices* approach. Taking its cue from examinations of the whole "circuit of technology" in cultural studies (Kopytoff 1986; du Gay et al. 1997), these studies have deployed in-depth historical and ethnographic research to longitudinally capture the complex and evolving relationships between users, designers and product development in particular fields—typically covering several cycles of design and use (Oudshoorn 2003; Pollock and Williams 2008; Hyysalo 2010).

Yet another extension of scholars' STS on innovation is a recent surge of interest in the anthropological studies of markets, market devices and calculability (Callon 1998; Callon and Muniesa 2005; Callon et al. 2007). In this stream of work, STS scholars have "denaturalized" one more essential element of the technological imperative, namely the assumption that "the market" acts like a universal, ubiquitous force. On the contrary, these authors have shown how markets and market actors crucially depend on material devices, such as scales, equations, economic theories and marketplaces. The crucial economic aspects of innovation processes have thereby also been opened up to a broader set of inquiries.

The key overall contribution of STS has been to examine in detail user contributions to innovation and to connect these into a *deep understanding of the contingent and interactive innovation processes*. STS has shown how *user contributions* are not limited to just the innovations by users, just the information they may provide for producers, just the design ideas they can help generate or just the new uses, meaning-making and efforts to integrate technologies in their everyday consumption. These are all-important moments wherein users shape innovation. But users also interact with innovation by expressing their demand through markets, by advancing their own systems of valorization and by building their own communities of practice, both directly and indirectly related to technology. The view forcefully promoted by STS is thus that innovation is never an insulated, autonomous process that develops according to its own logic. On the contrary, there is interactivity with users and society at large at every step of the way.

An important corollary to this conceptual development has been the engaged program within STS seeking to use these insights to achieve more democratic and sound technology. These efforts have often taken the form of articulating the knowledge and interest that pertain to a technology but have become suppressed or ignored by narrow technical or scientific decision-making (Wynne 1992; Suchman et al. 1999; Suchman & Bishop, 2001; Hess 2007). Their forms have also included organized interventions to connect stakeholders for common concerns (Rip et al. 1995; Miettinen and Hasu 2002; Hyysalo 2010), scholars stepping into bridging roles (Elgaard Jensen 2012; Jespersen et al. 2012), siding with social movements (Hess 2007), critical design engagements (Flanagan and Nissenbaum 2007;

Flanagan 2009; Ratto 2011) and the mapping of controversies and matters of concern (Marres 2007; Venturini 2010).

The conceptual apparatus of STS has hence not only challenged beliefs in technological determinism, but has also given considerable impetus to efforts to connect designers and users. So, like the other studies and design strategies that we have reviewed, the interactive understanding of innovation has become a part of the theoretical and methodological toolbox that is available for contemporary encounters between designers and consumers, companies and social movements, user communities and R&D practitioners.

ARRIVING AT THE CONTEMPORARY SCENE OF USER PRODUCTION: NEW MEETING GROUNDS AND AMBIVALENCES

Users have always been productive, but the matters and forms of user production keep changing. To develop a sense of these changes, and hence to attain an image of the new production of users, we have juxtaposed the situation of marketing researcher Henry G. Weaver in the early days of mass production with the situation of Habbo—an Internet-based recreational game company—some seventy years later.

Weaver operated in a world where producers had to invent ways to figure out how their mass-produced goods could be sold. Users at that time were seen as relatively passive consumers that the manufacturers would need to target with the proper type of advertising.

The Habbo case unfolds at a time when companies are increasingly aware of users' productive capabilities and in which companies attempt to harness these capabilities by means of a broad range of widely available user involvement methods.

Between the days of Weaver and the days of the Web, an enormous and vastly distributed amount of effort has been put into creating connections between designers and users. In our review of these developments, we have attempted to highlight merely the most important contributions to the new production of users.

Our account of user production history, in the shortest possible formulation, is as follows: a first wave of liaison disciplines responded to Weaver's problem by professionalizing the gathering of market and consumer information. A second wave of liaison disciplines professionalized the analysis of situated-use practices and the active collaboration with users. Concurrent with the second wave, empirical and theoretical efforts were made to articulate the active consumption process, the innovative capabilities of users, and the users' crucial roles in the interactive processes that generate innovation. This all happened in a time frame of broader cultural-political changes in which social movements tried to democratize technology.

We now turn our attention to the contemporary scene of user involvement. The question we would like to contemplate is where these developments have taken us. What can be said about the *new* production of users? What kinds of efforts, games and controversies evolve under the present conditions?

These questions are not so much about *how* user involvement can be done, but rather about *what kind* of activity user involvement is considered to be. As a sort of baseline, one might imagine the idea of user involvement to be an entirely pragmatic question about improving the fit between a product and a user. In one way or another, this way of thinking informs all of the efforts that we have covered. But the "fitting" perspective is particularly evident and unambivalent in some of the first liaison disciplines that emerged. Ergonomics "just fitted" the products to the users body; marketing research "just fitted" the advertisement campaigns to the users' willingness to buy.

The early liaison disciplines were doing their jobs successfully, but they were not unchallenged. In fact, some commentators were fiercely critical of the dominating trends of technological development. Mumford (1964), for instance, argued that cheap mass production is a prime example of "authoritarian technics," a type of technology that is system centered, large scale, mechanically organized and under centralized command. It is a systemic monster that creates and feeds its own needs. The distinctly opposite type, which he dubbed "democratic technics," is based on craft production organized in local and autonomous small communities, centered on the needs of people and flexibly adjusting to nature. The contrast between a social critic like Mumford and the self-identity of the first liaison disciplines is stark, to say the least. The liaison disciplines would probably describe their work as creating a better fit for the benefit of the people. Mumford would most likely describe the liaison disciplines as cogwheels in the machinery of totalitarian development. We thus have two radically opposed ideas of what user involvement is about.

The collaborative design movement takes a position that is partially similar to Mumford's: it argues that detrimental consequences will follow from the "natural" inclinations of capitalists and technology developers. But collaborative design is also hopeful in the sense of believing that the proper involvement of users will lead to human benefits. Collaborative design is thus moving the battle *inside* particular projects. It is not a question about being for or against new technologies *en bloc*, but a question of gaining influence. Critical proximity, rather than critical distance, is the aim (cf. Latour 2005). From this perspective, user involvement is not "just fitting" and it is also not just being skeptical: it is an act of active partisan advocacy.

The active advocacy of users spurred, as we know, decades of broadscale experimentation with methods and approaches that would enable users to contribute to the design process. Further additions to the burgeoning stock of methods have come from HCD efforts as well as from consumer research. The existence of all these methods is now a fact on the ground that users as well as companies must reckon with. From countless projects, we now know *how* to involve users in productive roles. But we also know *what* happens when users become involved. And here comes the next twist to the story: what began with the "democratic" hope that users could draw technological development into a direction suited for their needs has now turned into something far more complicated. The widespread experience is that user involvement is *not* a certain and safe path to "good" technologies, good outcomes and democratic control. This point has been made repeatedly by authors within collaborative design who reflect on decades of projects (Markussen 1996; Asaro 2000). We can learn the same point from the Habbo case: despite all the efforts to generate the best possible platform by involving users, the project was scandalized by the actions of some of their users and by the company's inability to control the process. In a more systematic fashion, the point has also been brought home by the biographies of artifacts and practices approach: longitudinal studies have shown that the incorporation of user contributions varies greatly; at times they are solicited, at times discouraged; the preferred methods and modes of engagement vary and the choice of preferred partners changes. Participation as productive force remains today the management motivation to engage with users as it did already in the 1980s (Williams and Cressey, 1990). Similarly its potentially conflicting relation to participation as democratic force remains a key tension. Yet participation has changed increasingly from a management–employee relation to one between an outside technology producer and client organisations' employees, or, designers and consumers. This has lead to complex value creation processes characterized by "multi-level games" for all parties (e.g. Pollock, Williams & d'Adderio, Chapter 7 of this volume; Hyysalo 2010; Johnson 2010; Johnson et al. 2014; Hyysalo et al. 2015).

What has emerged is a situation where users, more than ever, get noticed, tracked or studied. Occasionally, users also gain a strong influence on design or take things into their own hands and create an innovation or a community (von Hippel, 2005; van Oost et al. 2009). But simultaneously, we are in a situation where the increased visibility of users, in itself, has become an object of negotiation and strategizing.

The hope that involving users and making their practices visible will inevitably lead to good results has thus turned into a form of ambivalence. When users and designers meet in specific projects, one typically finds a variety of hopes and fears: small hopes of achieving a better-fitted technology, democratic hopes of gaining influence and the fear of exploitation on smaller or greater scales.

The current state of ambivalence is well articulated in some of the contemporary commentary on technological development. One example is the human geographer Thrift (2006), who like Mumford in his day, writes with more than a little dystopian flavor. Thrift depicts contemporary "creative capitalism" as an intensification of market exchanges in which organizations strategically move their innovation beyond the organization by tapping into the commodity involvement of consumers. In this way, it becomes possible to understand and manipulate the consumers' affective responses and to "squeeze every last drop of value out of the system" (Thrift 2006, 281). At the same time, however, companies become increasingly dependent on customers. "Customer passions do not just run to fan websites. They also run to ethical consumption [. . .] to websites and blogs that are openly and even savagely critical of their object" (Thrift 2006, 301). The situation is described by Thrift as an *uncomfortable status quo* for customers as well as for producers (Thrift 2006, 301). The ambivalence of the entire situation comes even more strongly to the fore in Thrift's reflection on the possible role for social scientists. Thrift harbors no Mumfordian dreams of an entirely different technological development, nor does he advocate a clear partisan approach. He merely raises the point that companies increasingly use theory as a resource for constructing the world. Social scientists must therefore realize that every theoretical concept will eventually move out of their hands and become deployed for new purposes. Academics must therefore come to terms with participating without being able to control matters. They are partisans without a solid sense of either their own party or the opposing one.

If this is the landscape that users, designers, managers, producers and academics operate in, then there is good reason to take our bearings carefully. We cannot assume that just fitting products to consumers is an innocent and uncontested activity. We can also not assume that making users and their practices visible will inevitably lead to good results. What we can assume, however, is that the new production of users emerges from a richly equipped and ever-changing game, where the hopes of democratized technology will encounter creative capitalism on many different meeting grounds. Our contention is that to maneuver in this space, we need to recognize past efforts, as they have equipped the current scene of user involvement. We need to understand the main contours of how the current situation has changed. This has been the primary purpose of this introduction. We also need to get a sense of the different types of sites or meeting grounds between designers and users wherein the new production of users comes into being. That will be the purpose of the remainder of the book. In combination, we hope the book will provide readers with historical background, theoretical guideposts and an up-to-date account of the contemporary production of users.

THE STRUCTURE OF THE BOOK

The book is divided into four sections, each of which explores a particular aspect of the new production of users.

Section 1 reviews and extends the theories of users and user production in innovation. Section 2 explores various user-producer engagements in the tension zone between the hopes of democratized technology and industry strategizing. Section 3 investigates innovation communities driven by users and how these link to wider, often corporate, networks. Section 4 examines how innovation is shaped by non-use and unwanted innovation. In the following, we will introduce the sections and the chapters in more detail.

The first section, **Rethinking and Extending Theoretical Approaches to the Production of Users in Innovation,** consists of Chapters 2–4. As we have reviewed above, there are several theoretical approaches to understanding the roles that users play in socio-technical change. Most of the currently prominent theories and concepts emerged between the late 1970s to the early 1990s and have since enjoyed varying further development. The three chapters in the section address how either the theoretical positions or their implications require reassessment so as to keep pace with the growing importance and recognition of users in innovation.

Innovation studies are perhaps the most systematically built and upgraded of the current approaches to users in innovation. There are still, however, a number of issues to be discussed with respect to the implications of user innovation. In Chapter 2, *Protecting the Right to Innovate: Our Innovation "Wetlands*," Andrew Torrance and Eric von Hippel examine one such issue, namely the legislative position of innovating citizens. They argue that the recognition given to the amount and quality of innovation carried out by users begs for a sea change in assessing the importance of the conditions offered for user innovation also. The shift finds an allegory from seeing wetlands as "malarial swamps" to seeing them as vital settings for flora and fauna. Similar to wetlands, the "innovation wetlands," the trials and experiments by users, must not, by default, be bulldozed over by a range of legislations that affect them without due (preferably mandatory) assessment.

Use is, however, not limited to the actions of users. Design activities, by necessity, represent users. Early emphasis on designers' potentially incorrect values resonated with the rise of HCD and participatory design (Agre 1995; Akrich 1995; Stewart and Williams 2005), and has since been standardly used for differentiating design with due accountability from design that is less accountable. Yet, many studies since have cumulated a considerable stock of findings about represented users and how they relate to users' eventual situated use. Chapter 3, *User Representation: A Journey Towards Conceptual Maturation*, by Sampsa Hyysalo and Mikael Johnson, makes an analytical review of forms of "user representation" in design organizations and of how these relate to eventual situated use. The conceptual repertoire they outline presents an important tool for navigating the contemporary landscape of industrial strategizing with respect to the users.

Chapter 4, by Kristian Hvidtfeldt Nielsen, is titled *How User Assemblage Matters: Constructing Learning-by-Using in the Case of Wind Turbine Technology in Denmark 1973–1990*. The chapter engages the widely used theoretical position that the introduction of new technology, and the first difficult phase of use, will be followed by cumulative improvements in efficiency. The improvements in skills and procedures have been conceptualized as learning by doing (Arrow 1962), and the improvements to the makeup of technology have been conceptualized as learning by using (Rosenberg 1979). Over the years, both concepts have become taken for granted in innovation studies and innovation policy: a string of improved design characteristics will follow after the initial introduction of technology. Learning by using has been empirically shown in some studies—such as the DC-3 design improvement study by Gardiner and Rothwell (1985)—but its adequacy has also been questioned. Von Hippel and Tyre (1995) insisted that quite little was in fact known about the micromechanisms by which learning by doing (and implicitly also learning by using) was taking place. Other detailed studies of post-launch learning have equally confirmed the importance of the phenomenon, but also confirmed that the learning processes at stake are far more complex than the "learning-by" concepts portray (Fleck 1994; Hasu 2000; Hyysalo 2006; Hyysalo 2009b). This chapter by Nielsen joins a line of studies that question the portrayal of learning by using as an "automatic effect" that by default leads to improved design characteristics. Examining Danish wind turbine development, he elaborates on how the effects of learning by using are dependent on the arduous work of aggregating, translating and disseminating knowledge about technologies in use and constructing "user assemblages." He thus argues that learning by using on its own is too glossy as an analytical construct unless its workings are duly exposed to reflect the work that users and intermediary actors perform in innovation.

The second section, **User-Producer Engagements Between Democratized Technology and Industrial Strategizing**, consists of Chapters 5–7. As we have argued in this introduction, a "happy homecoming" of users has never been fully realized. Products and technologies remain contested despite the efforts to fit products to consumers and despite the efforts to actively engage users in design activities. Since the 1970s, users have become increasingly visible and active, but this very activity and visibility has also increasingly become an object of industrial strategizing. So, rather than being on a path that will safely and inevitably lead to the democratization of technology, the current situation is one of ambivalence. The chapters in Section 2 explore these tensions on the ground; from various empirical vantage points, the three chapters trace encounters between users and producers, and between industrial strategizing and attempts to democratize technology.

The section begins with Chapter 5, *Making Work Visible*, which is a republication of an article by Lucy Suchman (1995). Suchman has worked on numerous technology projects since the mid-1980s and has been a key contributor to the fields of HCD, participatory design and STS (e.g. Suchman 1987, 2007; Suchman et al. 1999). Suchman's extensive experience is the background against which she, in the chapter, reflects and comments on one of her colleagues' projects. Although the specific project is dated, we include Suchman's article as an early and particularly clear articulation of the ambivalences that follow from the increasingly systematic and professionalized application of user study methods. The chapter explores a range of issues and concerns that arise when designers make work visible, including the opportunities to engage users in design and the risks of turning users into objects of manipulation. Suchman argues that representations of work must be viewed as maps or craftwork, constructed from particular social occasions and with specific forms of practice and interests. The chapter emphasizes the inherent dilemmas and intimate links between work, representations and the politics of organizations.

Chapter 6, *Straddling, Betting and Passing: The Configuration of User Involvement in Cross-Sectorial Innovation Projects*, by Torben Elgaard Jensen and Morten Krogh Petersen, continues the investigation of dilemmas and tensions within user-involving projects. Similar to the arguments made in this introduction, the chapter begins with the observation that the growing commitment to user involvement in innovation and design also comes with a growing concern about the unintended effects of these activities. The authors argue that commentators now express deep fears of user exploitation as well as high hopes of democratization. The question about the meaning and value of user involvement is thus an open one, but arguably also a question that would benefit from being treated in context. The chapter explores how the question of meaning was handled in a number of cross-sectorial user involvement projects sponsored by a Danish innovation program. By looking closer into the pragmatics of running these projects, the authors argue that user involvement organized as projects implies a specific series of tasks, which are different from the challenges generated by other organizational arrangements (e.g. user involvement as community innovation or user involvement as a routine R&D activity). The chapter proposes a model of the specific tasks of user-involving projects and discusses the implications of considering the meaning and value of user involvement from the perspective of project pragmatics.

This final chapter in the section complements the two earlier chapters by offering a direct focus on industrial strategizing with respect to users. Chapter 7, *Generification as a Strategy: How Software Producers Configure Products, Manage User Communities and Segment Markets*, is authored by Neil Pollock, Robin Williams and Luciana D'Adderio. The chapter is a case study of how the strategizing around user involvement achieves the seemingly implausible project of developing "generic" packaged solutions that can bridge not only the wide range of activities within organizations, but also the enormous differences between organizations within and between sectors. By comparing the design and evolution of two software packages, the authors examine how they are built to work across a diverse range of organizational contexts. The authors describe a set of revealed strategies through which suppliers produce software that embodies characteristics that are common across many users. This is accomplished through what they term "generification work." This process of generification involves configuring users within "managed communities," "smoothing" the contents of the package and, at times, reverting to "social authority." The authors' argument is that generic systems do exist, but that they are brought into being through an intricately managed process, involving the broader extension of a particularized software application and, at the same time, the management of the user community attached to that solution.

The third section, **Innovation Practices and User Communities**, consisting of Chapters 8 and 9, addresses the innovative work of users. Describing users as the co-producers of innovation raises the question of who is doing this innovative work. For a long time, most studies on the role of users in innovation focused on individuals, such as lead users (von Hippel 1988). The rise of the Internet and open-source communities indicates that user-driven innovation is not restricted to individuals, but includes the creative work of user collectives as well. More recent research in the field of innovation studies therefore addresses the innovative work of user communities, although the primary focus of this research is on the economic value of these communities (von Hippel 2005). Because many of these user collectives try to contribute to democratizing technology—think of "access for all" and the free sharing of knowledge and expertise—it is important to extend the study of these collectives to understanding how they try to realize socio-technical change.

In this respect, user collectives provide an excellent case for investigating the new production of users and the inherent tensions and dilemmas. Collective innovation by users may involve different kinds of dynamics and incentives than other innovation processes in industry. Studies of wireless network communities, for example, illustrate that shared political and ethical views are crucial for collective innovation processes (Söderberg 2011). Innovation by user collectives not only results in new technologies but also new communities, which are closely intertwined with the technology in the making (van Oost et al. 2009).

A highly successful case of user community innovation is explored in Chapter 8, *Innovation in Civil Society: The Socio-material Dynamics of a Community Innovation*, authored by Stefan Verhaegh, Ellen van Oost and Nelly Oudshoorn. Drawing on insights from both innovation studies and STS, the chapter addresses the question of how the dynamics of innovations developed and sustained by user collectives can be understood. Based on a qualitative in-depth analysis of one exemplary case, a new, innovative, city-wide wireless backbone infrastructure—Wireless Leiden—developed in the Netherlands, the authors analyze the dynamics of this successful innovation. The chapter introduces a new vocabulary with which to capture the specific characteristics of community innovation in order to specify what sets community innovation apart from other types of innovation. The concepts found to be central in the understanding of community innovation include diversity, reciprocity and communification, warm users, and fluid and open technology.

But user collectivities in innovation are not limited to user-only innovation communities. The boundary between autonomous user collectives and firm-hosted communities is often blurred. Firms sponsor, host and launch open-source development projects (West and Gallagher 2006; West and O'Mahony 2008), the use of user groups in development activities is a common measure (Holmström and Henfridsson 2006; Johnson et al. 2014; Pollock and Hyysalo 2014) and user-run online forums can generate independent community knowledge and development efforts in domains where most technology comes from producers (Hyysalo et al. 2013b). Even users in company innovation platforms can form semi-independent innovation collectives and wield power (Jeppesen and Molin 2003; Jeppesen and Fredriksen 2006; Heiskanen et al. 2010; Elgaard Jensen 2013).

In Chapter 9, *User Communities as Multifunctional Spaces: Innovation, Collective Voice, Demand Articulation, Peer Informing and Professional Identity (and More)*, Hajar Mozaffar offers a close-up account of user communities operating in the blurred field between company-sponsored activities and independent user collaboration. The focus of the chapter is the multifaceted roles played by user groups, in other words, on the heterogeneous communities of customers that share an interest in the vendor's solutions. Mozaffar argues that despite the importance of user groups in both economics and STS literature, studies of such groups tend to focus on the outputs of such communities in the form of user innovations. This view has led to a partial understanding of these groups. The chapter examines the fine-grain details of user communities attached to enterprise systems and explains the multifaceted role of user groups as a joining point not only between the technical and social, but also as a linkage between meeting present demands and the shaping of future technologies. Drawing from an ethnographic study of several user groups functioning around the organization-wide packaged software products of a large global vendor (Oracle), the author traces the functions and tensions as they are framed and explained by participants. The chapter demonstrates how community members with diverse interests and conflicting perspectives collectively perform specific functions in innovations.

The chapters in this section on "innovation practices and user communities" engage with both independently organized user groups and company-organized user groups. From these different vantage points, the chapters raise and begin to answer a series of new questions about current innovation practices: what kinds of conceptualizations of innovation are needed to capture the dynamics of innovation by user communities? In what way do network technologies facilitate collective innovation? How do user collectives shape socio-technical innovation? What are the challenges for democratizing technology when it concerns HCD practices in which groups of citizens are involved?

Section 4, **Unwanted Innovation and Non-Users**, consists of Chapters 10–12. The chapters in this section shift attention from the users and innovations that are embraced by producers towards both users that create unwanted innovations and "users" that prefer the role of being non-users. We include this section because we want to avoid the risk of adopting a "pro-innovation bias"—the view that new technologies *should* be adopted by everybody (Rogers 1995; Wyatt 2003). We also want to avoid the assumption that user production *necessarily* entails collaboration and agreement with technology producers. Therefore, it is important to include non-users and ask questions such as: what are the relations between non-use and innovation? How do people who are reluctant to use or reject new technologies shape innovation? Although one of the most-cited historical examples of resistance to technological innovation—the Luddites' revolts in the early nineteenth century in Britain—seems to indicate that resistance to technologies is merely a destructive force, historians and sociologists of technology have argued that resistance should be considered as transformative rather than destructive because it is a common feature of socio-technical change (Kline 2000; Hyysalo 2010).

In Chapter 10, Line Melby and Pieter Toussaint examine the unsuccessful implementation of a hospital information system by studying the non-users of the system. Titled *We Walk Straight Past the Screens: The Power of the Non-Users of a Hospital Information System*, their chapter departs from the different strategies for involving users that have been proposed and applied in recent years. The authors, however, point out the need to also examine users that turn their back on the system and ask how they influence an information system's success. Melby and Touissant categorize non-users based on the way they enact their resistance, leading to four types: the activist, the saboteur, the avoider and the skeptic. This reconceptualization of resistance enables us to study resistance as part of the ongoing negotiations between producers, users and mediators that underlie socio-technical change. Melby and Touissant continue a line of research of STS scholars who have criticized dominant conceptualizations of non-users for only including negative views of non-users such as "have-nots," "laggards" or "drop-outs"—terminology frequently used in policy discourses that portray non-use as a deficiency and an involuntary act. To counterbalance these negative approaches to non-use, STS scholars have introduced categorizations of different types of non-users, including both voluntary and involuntary aspects of non-use (Henwood et al. 2003; Wyatt 2003).

Although it is important to study these reconceptualizations of non-users and non-use, more recent scholarship encourages us to reflect on the very notions of use and non-use (Baumer et al. 2013; Derthick 2014; Loder 2014). This dualistic perspective does not allow for nuances in the ways in which people engage in interacting with technologies, which may alternate between use and non-use in different social contexts, daily life routines and phases of life. Concepts such as "negotiated use" (Loder 2014) and "selective use" (Hyysalo 2007; Oudshoorn 2011) exemplify this more dynamic approach to studying how people relate to technologies.

Chapter 11, by Kate Weiner and Catherine Will, *Users, Non-Users and "Resistance" to Pharmaceuticals,* builds on this legacy and examines the uses and non-uses of a particular class of pharmaceuticals—statins, which lower cholesterol. In medical sociology, the non-use of medicines has been described through the lens of "resistance" as a counter to medical concerns with adherence; yet, these discussions have not referred to STS ideas about the uses/non-uses of technologies. The authors examine points of articulation and difference between these frameworks. In particular, they consider the value of Wyatt's (2003) taxonomy of non-users for this case. The analysis draws attention to the potential transience of use and non-use over time and the practices and social relations through which this might be mediated. The chapter concludes by suggesting an analytical shift from individual users and non-users to a focus on the variety of actors, processes and practices involved in use and non-use.

The new vocabulary and dynamic approach to non-use raises important questions for understanding the challenges and tensions of the new production of users. How does non-use in its various forms and practices shape the development and implementation of new technologies? How important are social relations in shaping use and non-use over time? A related and equally important question emerges when we shift the attention to innovation that is not wanted by major stakeholders. What kind of work is involved when users and social groups are engaged in innovation practices that contest existing regulatory regimes of the state? This topic is explored in Chapter 12, *DIY Research in the Psychonaut Subculture: A Case of Unwanted User Innovation*, by Johan Söderberg. The chapter is a case study of the ambivalences that arise when users take matters into their own hands in an unexpected way. The author begins by noting that the trend towards the increased involvement of users and amateurs in scientific research and product development is applauded by company executives and policymakers alike. Some benefits expected from this trend are greater legitimacy for scientific research, goods that better approximate consumer needs and the lowering of in-house costs. Missing from this picture are cases where user innovation is emphatically unwanted, to the point that law enforcement agencies try to curb it. In order to shed light on this aspect of research and innovation, the chapter investigates a subculture dedicated to psychedelic and controlled substances. At the center of the inquiry is the state and its role in directing user innovation. It can be seen in two, partly contradictory, ways. First, the users of controlled substances innovate in response to the presence of the state in the form of criminal law. Second, innovations from users are driven by the absence of the state in the form of safety and consumer regulations. The case is extreme, but the implications that can be drawn from it are likely to grow increasingly important. The more that firms and policymakers push a model where research and innovation are let out to users, the better the latter can mobilize those practices for unforeseen and potentially contentious ends.

The chapters in this fourth section thus move from non-users and user resistance to unwanted innovation, conveying the range of user practices that affect technology development through alternative, additive and agonistic engagements. All in all, they close the circle of how users become productive in new ways and how users themselves become produced in the process.

AFTERWORD

The book ends with an afterword by Trevor Pinch, reflecting on how he sees the last decade of development (which the current volume documents) since the publication of *How Users Matter*, a book he produced with Nelly Oudshoorn for The MIT Press in 2003.

NOTES

1. In describing the development and use of Habbo, we have drawn from an exceptionally deep, decade-long documentation of this service by Johnson (e.g. Johnson 2007, 2010, 2013; Johnson et al. 2010, 2013).
2. These attempts span a range of technological domains and types of users: from local user communities developing electronic devices (e.g Verhaegh et al., Chapter 8, this volume), over nationwide associations constructing wind turbines (Karnøe and Jørgensen 1996; Nielsen, Chapter 4, this volume) to patient groups struggling to assert their expertise on the design of biomedical research (Epstein 1996; Callon and Rabehariso, 2003).
3. The commercial interest in "tapping into" the innovative users has since lead to the development of user innovation toolkits (von Hippel and Katz 2002), the building of user innovation communities to support corporate R&D (Jeppesen and Molin 2003), open innovation contests and broadcasting (Jeppesen and Lakhani 2010) and to various mass customization platforms and variations in how to motivate users therein (Franke and Pille 2003).
4. It should be noted that in-depth innovation process studies within innovation studies reached the same results, on a par with STS, and departed radically from the mainstream innovation research, later siding with the STS conceptualizations of the innovation process (Garud and Gehman 2012; Van de Ven and Poole 2005; Van de Ven et al. 1999).
5. Such ethnographic attention to micro-interactions was informed by the adoption of ethnography in PD and UCD and became foundational for the study of Computer-Supported Collaborative Work, a field that investigates the distribution and possible redistribution of interactional features and capacities within socio-technical assemblages of interacting humans and computers (Kensing and Blomberg 1998; Voss et al. 2009). These findings and conceptions have had further influence in the years that followed, for instance, the concept of "sticky information" within user innovation research, which is an economic expression of situated and instrument-tied knowledge.
6. These lines of study had interchanges with studies of domestication (Lie and Sorensen 1996; Sorensen and Williams 2002) and in bringing materiality into theories of social practice in consumption studies in the 2000s (Shove 2003; Shove et al. 2012).

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Part I

Rethinking and Extending Theoretical Approaches to the Production of Users in Innovation

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2 Protecting the Right to Innovate

Our Innovation "Wetlands"

Andrew W. Torrance and Eric von Hippel

INTRODUCTION

Many millions of individuals around the world spend many billions of dollars every year to create new products and services for their own use. This innovation activity is of great benefit to the individuals involved, and to national economies as well. Individuals create products and services they personally need, and also learn from and enjoy engaging in the innovation process. Also known as user, consumer or citizen innovation, this phenomenon involves individuals who, either alone or collaborating with others, engage in noncommercial innovation to satisfy their own needs. The practice of innovation by individuals prominently involves factors important to "human flourishing," such as exercise of competence, meaningful engagement and self-expression (Fisher 2009). In addition, the innovations individuals create often diffuse to peers, who gain value from them, to firms that may adopt them as the basis for valuable commercial products offered on the market, or to both (ibid.).

Individuals innovate on their own and also collaboratively (Baldwin and von Hippel 2011). To innovate on their own, individuals need the right both to develop and to use their innovations for themselves. To innovate collaboratively, individual developers also need the right to share their detailed designs with others, who then, in turn, must have the right to copy, test and use these innovations, to add improvements and to share with others what they have learned. Impediments to individual and collaborative innovation harm social welfare by reducing the amount, rate and dissemination of innovation.

The law robustly protects the rights of citizens to engage in noncommercial innovation and the dissemination of information about their innovations, both individually and collaboratively. In the United States, fundamental constitutional, statutory and common law rights, such as the right of privacy, protect individuals' rights to develop innovations for their own use without undue government interference. Furthermore, fundamental legal rights to share and disseminate innovation-related information, such as freedom of speech, foster the spread of innovations. What, then, are the threats to this valuable personal and societal resource? Most individuals cannot afford to spend a great deal of money on their innovation projects. Anything that raises their innovation costs can therefore have a major deterrent effect. As we will show, legislation and regulation at multiple governmental levels—generally aimed at goals unrelated to individual innovation—can and do sometimes increase individual innovation costs to prohibitive levels. A particularly potent impediment to user, open and collaborative innovation involves agency regulation. Regulation can directly harm individual innovators by raising their costs of innovating. Regulation can also act in a manner analogous to government grants of intellectual property. Just as the threat of infringing existing patent and copyright protections can chill subsequent innovation, especially where cost-sensitive individual innovators are targeted, agency regulation can chill innovation by effectively granting to market incumbents powerful "regulatory property" rights. Large commercial firms are more likely to be able to afford substantial regulatory compliance costs. In fact, these firms may even lobby governments to increase regulation to increase barriers to market entry to prospective new market entrants. Even if not primarily aimed at individual innovators, regulatory property, like intellectual property, can have very harmful effects on the innovation wetlands. In effect, heedless government actions currently have significant impacts upon the fragile innovation wetlands environment within which individual innovators operate.

In this chapter, we will argue that it is important for society better to protect the innovation wetlands. We think this can be done with greater awareness of the *existing* legal protections for innovation coupled with more careful and innovation-conscious regulatory design. At least in the United States, a mechanism is already in place at the federal level that can be used to insist on such awareness: cost-benefit analyses are required for all federal regulations, and the requirements specifically cite the impacts that regulation can have on innovation as an important motivation and caveat. Many U.S. states also have similar cost-benefit analysis requirements.

We begin Part I of this chapter by briefly developing our innovation wetlands metaphor. We then summarize the evidence for the great extent and value of innovation by individual users of consumer products and services in Part II. Next, in Part III, we explain how a bulwark of existing legal principles, some longstanding and fundamental, are already available in the United States to protect individuals' rights both to innovate and to freely diffuse their innovations noncommercially. In Part IV, we then explore how governmental actions can impact users' rights to innovate and diffuse their innovations. Finally, in Part V, we offer some practical guidelines to individual innovators regarding their innovation wetlands rights. We also suggest approaches for improving the protection of the innovation wetlands, a goal we consider very important to social welfare. The right to innovate should be recognized, respected and protected to ensure that individuals and society enjoy more fully the myriad benefits of innovation.

PART I: THE INNOVATION WETLANDS METAPHOR

Until recently, marshy ecosystems were generally regarded as, at best, resources ripe for conversion into more beneficial uses. At worst, they were considered noxious sources of pestilence and disease, as exemplified by the disparaging phrase "malarial swamp" (Sagoff 1997). Accordingly, for many decades, governments promoted the filling in or draining of wetlands "through a variety of legislative and policy instruments" (Dahl and Allord 1997). For instance, "the Watershed Protection and Flood Prevention Act (1954)[1] directly and indirectly increased the drainage of wetlands near flood-control projects" (Dahl and Allord 1997, 9). Perversely, "[t]ile and open-ditch drainage were considered conservation practices under the Agriculture Conservation Program. . . ." (ibid: 10). These and other misinformed "policies caused wetland losses averaging 550,000 acres each year from the mid-1950s to the mid-1970s" (ibid.).

Beginning in the 1950s, a paradigm shift in the biological understanding of wetland ecology drove the recognition that, far from being dangerous or waste areas, wetlands are actually among the most productive and diverse of ecosystems on earth, providing great benefits, such as a vital habitat for biodiversity, flood control and water purification. Diffusion of information on these benefits changed the perception of wetlands by citizens, and the posture of governments also gradually changed. "Noxious swamps" increasingly came to be viewed as "valuable wetlands" (see Ornes and Hogan 2014). Regulatory approaches underwent a remarkable *volte-face*, resulting in a new emphasis on the protection, preservation and even rehabilitation of degraded wetlands. This new legal approach was crystallized in the U.S. Clean Water Act of 1972, which provided a strong legal basis for discouraging further elimination or degradation of wetlands.[2] The Ramsar Convention on the Conservation of Wetlands of International Importance also elevated the value of wetlands at the international level when it came into force in 1975.[3] Whereas governments had once targeted wetlands for destruction, many now focus on preserving and fostering them (United States Environmental Protection Agency 2003).

We define the innovation wetlands as the rights and conditions that enable innovation by individuals to flourish. Just as in the case of environmental wetlands, the nature and extent of the innovation wetlands must be understood, and the value of the considerable innovation activity that takes place therein must be better appreciated. Recall that innovation by individuals, although of proven economic and social value, is fragile in the sense that it is developed by individuals who generally have small resources, and who expect only small-scale personal rewards for their efforts.

Legislative bodies and governmental agencies whose legal actions raise consumer innovation costs can greatly damage this economically important and individually valued activity. In fact, for many individuals, the mere worry that their innovative activities might trigger governmental (e.g., agency) scrutiny or penalties is sufficient to chill, or even end, those activities. For citizen innovators, actually being subject to an enforcement action can be financially ruinous, whether such enforcement is justified or not, and even if the citizen innovator targeted by enforcement ultimately prevails. This stems from a fundamental imbalance: individuals' monetary, legal and temporal resources are almost invariably insignificant compared to those effectively infinite resources available to governments and their regulatory agencies. By contrast, this imbalance is less pertinent to commercial firms, which often have access to the money, attorneys and personnel sufficient to weather governmental action. It is important that the present and potential negative impacts imposed by governmental legislative and regulatory actions be recognized and understood in the larger context of an innovation wetlands to ensure better stewardship of important sources of innovation.

PART II: INNOVATION DEVELOPMENT AND DIFFUSION BY INDIVIDUALS

In order to understand the value that protection of the innovation wetlands can potentially provide, we must understand the nature and value of innovations developed by individuals. Many consumers develop product and service innovations for their own use. Such innovations can range from new or modified vehicles they wish to use, to medical innovations intended to address their own health issues, to software code that improves data exchange, to sporting innovations developed to use in the sporting activities in which they personally engage.

The large scale and scope of activities among individual users to create and improve products for their own use has been documented to date by three national surveys of representative samples of citizens over age eighteen. With respect to scale, as can be seen in Table 2.1, these surveys found that millions of individuals in the UK, the United States and Japan individually spend between \$1,000 and \$2,000 per year in time and money developing new consumer products for their own use.[4] Collectively, they spend billions of dollars annually on this type of innovation. In aggregate, the scale of this development activity by individuals rivals the scale of product development by all consumer product firms in those three countries (von Hippel et al. 2011; Ogawa and Pongtanalert 2011; von Hippel et al. 2012).[5]

As can be seen in Table 2.2, the subject matter of user innovations documented in these three surveys covers a very wide scope, mirroring the wide range of product types used by consumers.

Table 2.1 Extent of Innovation by Consumers in Three Countries

	UK	U.S.	Japan
Sample Size	1,173	1,992	2,000
Percentage of population aged eighteen and over that creates or modifies products for their own use	6.1%	5.2%	3.7%
Annual expenditures by average individual consumer innovator (time plus out-of-pocket money per year)	$1,801	$1,725	$1,479
Estimated total expenditures by consumer innovators on consumer products per year	$5.2 billion	$20.2 billion	$5.8 billion

Table 2.2 Types of Innovation Developed by Users

Categories	Japan	U.S.	UK
Craft and shop tools	8.4%	12.3%	23.0%
Sports and hobby	7.2%	14.9%	20.0%
Dwelling-related	45.8%	25.4%	16.0%
Gardening-related	6.0%	4.4%	11.0%
Child-related	6.0%	6.1%	10.0%
Vehicle-related	9.6%	7.0%	8.0%
Pet-related	2.4%	7.0%	3.0%
Medical	2.4%	7.9%	2.0%

Individuals will innovate if and as their expected benefits exceed their expected costs, up to the level of resources they have available. It is reasonable that the average innovating individual will expect benefits per project that are, although a matter of personal importance, of a relatively small scale. One consequence is that regulatory costs and risks that are easily borne by commercial firms, for which innovation-related regulations are generally designed, can be prohibitively costly for individual users. For example, a requirement to crash test an automobile enhanced by a modification before receiving regulatory approval to use an auto having that modification on public roads would be an acceptable business expense for an automobile producing firm—but would be literally prohibitive for all but a tiny, wealthy minority of car modifiers. Or, putting it in terms of the metaphor used in this chapter, the innovation wetlands can be expected to be quite fragile: legislative or regulatory actions that increase the costs of individual user innovators can be expected to have a significant negative impact on the amount of innovation activity taking place. Overregulation drains vitality from the innovation wetlands, depriving society of valuable benefits.

PART III: LEGAL RIGHTS TO INNOVATE AND DIFFUSE INFORMATION

Individual innovators in the United States have strong, and sometimes even fundamental, legal rights to innovate, to use what they create for themselves and to diffuse information to others about what they have done. These rights are *de jure*, or formally derived from the law, and are distinct from *de facto* factors, such as the practical difficulty of regulating innovative activities by individuals that are likely to escape detection, or are so common or popular with the public as to render enforcement impractical or impolitic. Though underappreciated and often unrecognized, these "innovation rights" offer robust protection to the innovation wetlands. In this part, we explore the sources of individuals' broad rights to engage in innovation-related activities without unreasonable governmental interference. As we will see, these rights often have long been embedded in the common law, the U.S. Constitution, or both. We focus on common law and constitutional innovation rights because of the powerful and durable principles they represent. Although legislatures and agencies can also confer valuable innovation rights by statute and regulation, respectively, these rights tend to be less reflective of deeper and more permanent innovation rights.

Rights at Common Law

The common law is a body of legal principles that has continuously evolved from customary practices and the decisions of courts. Having originated largely within the British legal system, the common law subsequently spread throughout the British Empire to countries such as Canada, Australia, New Zealand, India and what became the United States. An influential early legal theorist, Sir Edward Coke (1623), emphasized the importance of the common law as "the most generall and ancient law of the realme," and described its basis as "nothing else but reason . . . gotten by long study, observation, and experience." Many common law principles support innovation rights and afford robust protection to the innovation wetlands. We highlight several notable principles, though there are many others.

Bounded Liberty

It is a fundamental default principle of U.S. law that, absent specified and legitimate prohibitions, people are generally free to act however they choose. This venerable liberty protects individuals from unreasonable limitations imposed upon them either by other people or by governments, and has deep roots in Western philosophy. As John Locke (1690) suggested more than three centuries ago:

> *Freedom of people under government is to be under no restraint apart from standing rules to live by that are common to everyone in the society and made by the lawmaking power established in it. . . . Persons*

> *have a right or liberty to [(1)] follow their own will in all things that the law has not prohibited and [(2)] not be subject to the inconstant, uncertain, unknown, and arbitrary wills of others.*
>
> (Locke 1690, published by Industrial Systems Research, 2013, viii)[6]

In the context of the United States, President Thomas Jefferson (1819) asserted that "rightful liberty is unobstructed action according to our will, within the limits drawn around us by the equal rights of others" (published in Appleby and Ball 2004, 224). More recently, philosopher Isaiah Berlin (1958) described "[p]olitical liberty [as] . . . simply the area within which a man can act unobstructed by others" (republished in 1971, 118, 122). The law affords the innovation wetlands a generous zone of freedom within which individual innovation can both survive and thrive.

This liberty is, however, subject to some limits. In general, one is free to take actions that do not materially harm others. Zechariah Chafee (1919) offered a vivid and visceral metaphor to describe the limits of liberty to act, suggesting that "[the] right to swing your arms ends just where the other man's nose begins." This "bounded" liberty confers upon individuals a right to engage in innovation without requiring permission from other people or governments, provided that the actions engaged in while innovating do not violate specific, legitimate and preexisting legal prohibitions (*mala prohibita*) or are not inherently wrongful or unreasonably dangerous to other people (*mala in se*). Beyond these limitations, individuals tend to be free to engage in a wide range of innovative activities. Indeed, the burden of proving that innovative activities do violate specific, existing legal prohibitions, or unreasonably endanger or harm others, generally lies with those who oppose these innovative activities. Furthermore, in the spirit of the rule of lenity, ambiguity as to whether an innovative activity is or is not illegal will tend to benefit an innovator wishing to engage in that activity (USLegal 2015).

Castle Doctrine

Domiciles are accorded special protections under the common law. Their owners possess robust rights to deny entry to others, even official agents of the government. This principle is commonly expressed in the maxim "a man's house is his castle." This maxim is likely derived from a quote by biblical commentator Matthew Henry (1761), who wrote that "[a] man's house is his castle, and God's law as well as man's, sets a guard upon it; he that assaults it, it is at his peril." Later, in his influential treatise, *Commentaries on the Laws of England*, William Blackstone (1769) emphasized the strong justification that the law gives the owner of a domicile to keep others, including the government, from impinging upon that domicile:

> *And the law of England has so particular and tender a regard to the immunity of a man's house, that it stiles it his castle, and will never*

> *suffer it to be violated with impunity: agreeing herein with the sentiments of ancient Rome, as expressed in the words of [Marcus Tullius Cicero]; 'quid enim sanctius, quid omni religione munitius, quam domus uniuscujusque civium?' [what more sacred, what more strongly guarded by every holy feeling, than a man's own home?] For this reason no doors can in general be broken open to execute any civil process.*
>
> (Blackstone 1769)

Exemplified by the iconic garage inventor, individuals quite often engage in innovation at home, where the law provides them with considerable protection from scrutiny, intrusion and interference. Without well-founded grounds for invading this sanctum of the home, those lacking permission from an individual innovator can be legitimately excluded from invading the innovator's home and property. The legal repose this affords robustly fosters and protects innovation by individuals within the innovation wetlands.

Bodily Autonomy

A corollary of Zechariah Chafee's (1919) rule, that "[the] right to swing [my fist] ends just where the other man's nose begins," is that noses, and the rest of the bodies attached to them, possess legal protection from interference by others. This principle of bodily autonomy affords individual innovators considerable scope for innovation affecting only their own persons, most notably medical treatments involving medical procedures, drugs or medical devices. Physical interference with the body of another person constitutes battery; even the mere threat of physical interference can constitute assault. Forcefully preventing an individual from engaging in an act of innovation generally constitutes an illegal invasion of bodily autonomy. However, unless the actions of an individual innovator unreasonably threaten or harm the safety of another person, that innovator may usually interfere with her own body, even if such interference is unwise or dangerous to that individual. Medical innovation involving one's own body, such as the off-label use of pharmaceutical drugs to treat disease or discomfort, is generally protected by the principle of bodily autonomy. For example, medical patient contributors to the website of the firm PatientsLikeMe routinely engage in experimental medical treatments of their own maladies and report their findings on the firm website: www.patientslikeme.com (last visited April 12, 2015). Not only do members of PatientsLikeMe innovate with respect to their own health care, they also often share their results on the organization's website, allowing visitors to the website to learn from the successes and failures of myriad others.[7] Although not without limits, legal protection for bodily autonomy allows individual innovators considerable liberty to innovate on their own health and bodies.

Constitutional Rights

In addition to rights arising within the common law, constitutional rights offer substantial protections to the innovation wetlands. We focus primarily on the highest U.S. legal authority, the U.S. Constitution, because most of the relevant innovation rights derive from the Bill of Rights, and thus apply to all levels of government by incorporation through the Fourteenth Amendment.

The Constitution provides individual innovators with several powerful and formal legal rights, including strong protections for thoughts, beliefs and speech[8] and homes,[9] as well as protections against unreasonable searches and seizures of persons and their property,[10] and self-incrimination and compelled release of personal information.[11] Together, these protections afford individual innovators with broad rights to conceive innovations, to engage in innovative activities in the privacy of their own homes, to use their innovations on and for themselves, to collaborate with other innovators and to disseminate to others information about their innovations, all without unreasonable interference from governments. However, the Constitution is a two-edged sword, because the copyright and patent protection it offers to authors and inventors can also discourage subsequent individual creation, experimentation and tinkering, consequently inflicting harm on the innovation wetlands.[12]

Right to Liberty

In oft-cited language, the second paragraph of the 1776 United States Declaration of Independence recognized that all people possess "unalienable Rights [that include] Life, Liberty and the pursuit of Happiness."[13] Later, the Bill of Rights enshrined a number of fundamental liberties, including freedom of thought, association and movement.[14] As the American Civil Liberties Union has suggested, the Bill of Rights "guarantees individuals the right to personal autonomy, which means that a person's decisions regarding his or her personal life are none of the government's business."[15] Like the common law principles of bounded liberty, castle doctrine and bodily autonomy, the constitutional right to liberty provides considerable legal protection to individual innovators by preventing governments, including their regulatory agencies, from arbitrarily interfering with, or prohibiting, the activities of individual innovators. In addition, individuals have strong rights to associate with other individuals with whom they may engage in collaborative innovation. In other words, the constitutional right to liberty provides individual innovators several robust default rights to innovate, both alone and collaboratively.

Right to Privacy

Consider that the right to be left alone is a fundamental precondition of liberty. Although this right is not absolute, and, indeed, is limited in myriad ways by both law and the necessities of social interaction, its inner core allows an intimate zone of privacy surrounding each individual that can only be legitimately invaded, either by other individuals or governments, in rare and well-justified circumstances. In his classic 1879 textbook on tort law, Judge Thomas Cooley provided an early description of a right of personal autonomy: "The right to one's person may be said to be a right of complete immunity: to be let alone." (Cooley 1888) However, it was Samuel Warren and Louis Brandeis (1890) who formally proposed the existence of a constitutional right to privacy in an influential article they published in the *Harvard Law Review*. In its landmark decision *Roe v. Wade*, the U.S. Supreme Court itself noted that it "has recognized that a right of personal privacy, or a guarantee of certain areas or zones of privacy, does exist . . . in the concept of liberty guaranteed by the first section of the Fourteenth Amendment."[16] In addition, state courts have recognized privacy as a fundamental legal right.[17]

The right to privacy is a highly valuable innovation right, providing formidable protection against government intrusion into even illegal innovative behavior. For example, in *Stanley v. Georgia*, the Supreme Court held that the right to privacy even shields an individual who possesses pornographic materials so obscene that they would be completely illegal for vendors to sell.[18] In *Ravin v. State*, the Alaska Supreme Court went even further, ruling that the Alaskan Constitution confers upon individuals a right to privacy so powerful that it allows the personal possession and use of small quantities of illegal marijuana.[19] More recently, after overturning a statute criminalizing same-sex sexual intercourse in *Lawrence v. Texas*, the U.S. Supreme Court emphasized that " '[i]t is a promise of the Constitution that there is a realm of personal liberty which the government may not enter.' "[20] The right to privacy provides individuals with substantial autonomy of choice, including the ability to decide whether or not to perform controversial acts or undergo novel experiences, as well as the ability to control access to information about their private lives. It encourages individual innovators to take chances, question assumptions, challenge prevailing *mores* and push back intellectual frontiers.

This right to privacy is vital for fostering individual innovation. It affords individuals a zone of freedom inside which they may engage in activities largely beyond the scrutiny and interference of others—especially governments. This is important for at least two reasons. Individual innovators may experiment, tinker and create without feeling constrained by worries that their activities or ideas might be considered by others to be unorthodox, foolish, unethical or immoral. An innovator may also use her inventions to satisfy her own needs, especially if such use takes place in a location, such as a home, in which she has a reasonable expectation of privacy.

Decisions regarding one's body and health can illustrate how the right to privacy can foster individual innovation. This category of decisions occupies the core of the right to privacy.[21] Individuals are generally permitted to accept or reject medical care from physicians.[22] Alternatively, they may choose to engage in medical treatment of themselves. In fact, they may decide to modify aspects of their own bodies, either benignly, in the case of tattoos or ear piercings, or negatively, as in the case of dangerously extreme dieting or bodybuilding.[23] User creation or modification of medical treatments may, in some cases, turn out to be dangerous, but such practices can also lead to new insights into human health or even successful new medical treatments (Habicht et al. 2012). As long as one avoids carrying out such practices on other people (which may, among other violations, violate state law prohibiting the unlicensed practice of medicine, or even constitute battery), this behavior is generally legally permissible, as long as it does not reach a level so extreme as to attract the scrutiny of mental health authorities. Even the most extreme act of personal autonomy—suicide—is illegal at neither the state nor the federal level.

Naturally, innovators must usually still obey specific, legitimate legal rules, such as criminal prohibitions against the possession or production of controlled narcotic drugs or dangerously radioactive substances. However, they are otherwise free to act for themselves as they wish, providing they do not harm others. Even actions ancillary to innovation, such as purchasing required parts or equipment, are accorded considerable protection under the right to privacy (and liberty), though the level of protection for an activity does tend to decline the further that activity strays outside a location or context usually associated with privacy. For example, innovative activities conducted inside one's own home are more strongly protected by the right to privacy than are activities conducted in a public park.

Finally, the right to privacy may even shield individuals somewhat from liability for infringing on the intellectual property rights of others to the extent that there is significant governmental involvement. Like the protection it affords personal possession and use of an illegal drug in Alaska,[24] the right to privacy might be invoked to challenge allegations of infringement arising from the personal making or using of others' patented inventions in contexts redolent of privacy. Moreover, individual noncommercial use of patented inventions rarely results in litigation, due to the limited prospects for collecting damages (Eisenberg 2008).

First Amendment Rights to Free Speech, Press and Association

Crucial to individuals' rights to diffuse information about an innovation through speech or publications, and to collaborate on innovation, are rights guaranteed by the First Amendment to the U.S. Constitution. This provision states, in relevant part, that "Congress shall make no law . . . abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble,"[25] which, through incorporation by the Fourteenth Amendment, also prohibits state governments from creating similar laws.[26]

First Amendment rights robustly limit the ability of governments to restrain speech, communication and the sharing of thoughts, thus allowing innovators not only to conceive of new inventions, but also to broadcast or share information about their new inventions with others, either directly or through general publication. These rights also allow innovators to meet and collaborate with one another.

Individual rights to diffuse information tend to be robust even when they protect behavior with potentially harmful consequences. For example, in *Caronia v. United States*, a 2012 decision by the Second Circuit Court of Appeals, the court held that a salesperson who promoted unapproved off-label—yet scientifically justified—uses of a drug (in this case, the anti-narcolepsy drug Xyrem®) could not be held liable for violating the Food, Drug, and Cosmetic Act (FDCA) because the particular FDCA restrictions imposed on such speech—even commercial speech, which the Constitution tends to accord lesser protection[27]—violated the First Amendment.[28] If such commercial speech is protected by the First Amendment, then *a fortiori* is similar noncommercial speech about the off-label or unapproved use of drugs and medical devices.

The rights conferred upon individual innovators by the First Amendment should act as powerful protections against government actions that attempt to abridge the innovation process, from conception to publication to collaboration.

The Fourth Amendment

The Fourth Amendment to the U.S. Constitution can also be a powerful counterweight against governmental interference with individual innovation. It states that

> *[t]he right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no Warrants shall issue, but upon probable cause, supported by Oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.*[29]

Although usually associated with criminal prosecutions, the rights this constitutional provision protects complement both the common law castle doctrine and the right to privacy by acting as legal bulwarks protecting individual innovators from unreasonable governmental intrusion into their homes, writings and personal property. The Supreme Court has interpreted the Fourth Amendment as granting considerable protection from governmental intrusion into individuals' homes, home lives and possessions. For example, in *Kyllo v. United States*, the Supreme Court overturned a homeowner's criminal conviction for growing marijuana at home on the grounds that the Fourth Amendment protected the homeowner from the warrantless use by the government of a thermal imaging device to detect heat radiation emanating from the home grow-op.[30] Although most citizen innovation is benign and uncontroversial, the Fourth Amendment provides innovators, even when engaged in activities society considers unsavory or the law otherwise prohibits, with considerable protection at home, even from government monitoring carried out at a distance. Along with the castle doctrine and the right to privacy, this provides individual innovators with considerable repose when innovating at home. It also makes the home an ideal place to innovate undisturbed.

Rights Reserved to the People

Finally, we note that the Ninth and Tenth Amendments to the U.S. Constitution not only allocate governmental power between the federal and state governments, but also retain and reserve all powers not specifically granted to these two levels of government by and for "the people."[31] The legal implications for the innovation wetlands are profound. No government can claim a right to legislate or regulate unless it can ground its power to do so in the law. In the absence of such a specific legal grant, the people are sovereign, and their liberty to act, and to innovate, is considerable.

What does this mean for the innovation wetlands? Governments can legitimately legislate and regulate in many fields of human endeavor. Notable among these fields at the federal level are commerce, national defense, foreign relations, patent and copyright and general police powers to maintain public safety.[32] However, the activities of individuals, when they fail to implicate interests legitimately within governmental jurisdiction, are largely beyond the remit of government. This is especially true of innovation that is noncommercial in nature, carried out by individuals on themselves or for their own benefit, conducted on private property or in one's home, of a nature that does not materially risk public safety or whose details are shared with others either privately or publicly. Much of the innovation carried out by individual citizens, independently or collaboratively, within the innovation wetlands falls into this realm of powers reserved to the people.

PART IV: HOW GOVERNMENTS CAN IMPACT THE INNOVATION WETLANDS

Given the array of legal rights described in Part III of this chapter, one might ask why individuals' rights to innovate, to collaborate, and to diffuse information about what they have created are not secure. Again, recall Zechariah Chafee's (1919, 957) rule: "Your right to swing your arms ends just where the other man's nose begins." As possible sources of harm to public or private interests may exist, related to the development and use of innovations by individuals, a reasonable basis in law and policy exists to correspondingly constrain users' liberty of action with respect to many potential innovations. In the United States, three major levels of government can play roles in protecting or damaging the innovation wetlands: federal, state and local. Each can constrain consumer freedoms to innovate via statutes or regulations intended to promote or protect public safety, welfare or property rights, among other motivations, to benefit the public interest. In addition, governments, or their agents, may sometimes act due to improper or harmful motivations, such as agency capture whereby corporate interests influence agencies to regulate on behalf of protecting those corporate interests over the interests of the public (Stigler 1971). While the examples we use to illustrate the effects of legislation and regulation on the innovation wetlands predominantly involve the federal level of government, we use this focus for simplicity. Legislation and regulation by state and local governments (which may conceptually be subsumed within the state level because local governments tend to derive their legal authority from their states) can also have strong effects on the innovation wetlands, and we also provide some examples drawn from these levels.

Regulating Access to Public Resources

Consider that federal, state and local governments regulate and control access to many *public* resources. This can importantly affect the innovation wetlands because, more often than one might suppose, the development and practice of innovations requires the use of public resources. Thus, one can build almost any type of car one likes, but to test or use it on a public road, one needs to meet detailed regulatory constraints intended to protect the safety of the driver and others. Similarly, one can build a radio-controlled unmanned aircraft, but to test or use it in the pubic airspace, one must adhere to detailed regulations promulgated and enforced by the Federal Aviation Administration (FAA). One can build a new wireless transmitter, but to test or use it in the public radio spectrum, one must adhere to regulations and constraints imposed by the Federal Communications Commission (FCC). And, one can also use and test one's innovations in public waters, but only in certain prescribed areas and under prescribed constraints, such as the avoidance of polluting effects. Where others may be affected by an innovation, the argument for government regulation is stronger, but where the innovation affects only the innovator, this potential justification for regulatory action would be much slimmer. For example, in the case of an automotive innovation that a user makes and practices away from others—driving the innovative auto only on his or her private land, and only at his or her own risk, for example—arguments favoring strong regulation to protect the public are much weaker.

As we will consider in our discussion section (Part V), there can be ways both to protect the public *and* to provide access to public resources for user innovators. However, if legislators and regulators are not aware of the prevalence and value of user innovation, they can grievously and unnecessarily damage the innovation wetlands while pursuing other objectives. As an example, consider a pending European Union (EU) directive that will, if passed, in effect prohibit users from modifying their personal vehicles in functional ways, in the name of increasing road safety.[33] This proposed EU regulation, if enacted, will have just that result by mandating that cars will only be allowed on public roads if periodic inspections by authorized inspectors reveal that they have only standard producer parts installed, even if a nonstandard user modification *enhances* safety.[34]

Road safety is certainly a worthy social goal, and as we have seen, governments have the right to regulate access to public resources, like roads, in order to reduce actual or potential public harm. However, no serious comparison of costs and benefits has been done in the case of this pending EU regulation because, we presume, there is no awareness among EU regulators that there is in fact a cost to offset against the intended benefit upon which they are focused. In the written background justification of this regulation, there is only one empirical study of automotive accident rates in standard and modified cars, and that study finds that modified cars are *less* frequently involved in accidents than nonmodified cars.

The extent of economic disruption to individual user innovation caused by this single proposed EU regulation can be approximately measured by reference to the national surveys discussed earlier. Recall from Table 2.2 that 8% of all consumer innovations in the UK were related to vehicles. If we assume that each innovation in that sample had the same cost independent of subject matter, we see that in the UK alone, consumer innovators spent $416 million dollars in vehicle-related innovations annually. Effectively, all of this innovation expenditure and related benefits are threatened by this single, shortsighted regulation.

Regulations with damaging impacts on the innovation wetlands can be promulgated by all levels of government. For example, codes regarding acceptable homebuilding practices in the United States are generally left to state and local governments. Building codes that are drawn up without awareness of the potential of user innovation in this realm can prohibit novel—including safer or more efficient—building techniques (Harris 2012). Interestingly, unlike the auto-regulation case just described, where a new regulation threatens to close down a thriving and very visible ecosystem of vehicle-related innovations, opportunities for innovations that are deterred by regulations long in place can be effectively invisible because these innovations simply do not happen. This can make it difficult to document the benefits to be derived from the easing of those regulations. Phantom innovation prevented from ever occurring, due to misguided regulation, denies society considerable potential benefits.

Regulating Commerce

Federal regulatory agencies can generally regulate the *commercial* manufacture and practice of, and the *commercial* advertising and distribution of, innovations via the Commerce Clause in Article 1, § 8 of the U.S. Constitution.[35] This clause grants Congress the power "[t]o regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes."[36] The Supreme Court has construed the Commerce Clause as permitting Congress to pass statutes regulating broad swathes of the economy, and reaching commercial activity that implicates interstate commerce both directly and indirectly.[37] However, Supreme Court decisions have consistently agreed that the Commerce Clause does not allow federal agencies to regulate truly noncommercial activities.[38] The Supreme Court reaffirmed this principle in 2012, when it decided *National Federation of Independent Business v. Sebelius*, a case contesting the constitutionality of the federal Affordable Care Act of 2010.[39] There, the Court clarified that "[t]he power to *regulate* commerce presupposes the existence of commercial activity to be regulated."[40]

In other words, innovative activity by individuals that is commercial in nature can be within the legitimate reach of the federal government, whose authority to regulate is often derived from the Commerce Clause. In turn, federal regulatory agencies derive their legal authority to regulate commercial activity both from the Commerce Clause and, more particularly, from the "organic statutes" that govern their activities and specify the limits of their authority. Organic statutes typically limit agency authority to regulate more restrictively than the full scope of the Commerce Clause would allow. Thus, agency regulation tends to be best justified when it concerns clearly commercial activities. For example, individuals who develop and *sell* novel medical treatments are subject to Food and Drug Administration (FDA) regulatory oversight. More specifically, when innovators or others begin to advertise or sell drugs or devices, or services entailing their use, the Commerce Clause is triggered, and the FDA, Federal Trade Commission (FTC) and other relevant agencies are empowered to regulate such behavior.

However, as discussed above, when individuals develop their own medical drugs and treatments, they can personally make and use them as they see fit, provided that they do not use materials, such as opioids, specifically (and legitimately) proscribed by law, pose unreasonable harm to others or infringe on existing patent rights. These citizen innovators are also free to distribute information about their innovations, including design details and the effects of use they have experienced, to others without permission from, or constraint by, the FDA or the FTC, as long as they do not engage in commerce or incite others to break the law or infringe patents or copyrights belonging to others. In practice, innovative activity that avoids the indicia of commerciality (e.g., advertising, offering or holding for sale or actually selling) lies at the margins of what tends to attract regulatory agency attention, and beyond what regulatory actions courts will tend to uphold as justified by the Commerce Clause or the agency's organic statute. Individual innovators who innovate to satisfy their own individual needs, and who do so noncommercially, will tend to be beyond legitimate federal agency regulation. This is the heart of the innovation wetlands.

Defining and Regulating Intellectual Property Rights

Patent and copyright laws are based in the U.S. Constitution. Article I, § 8, Paragraph 8 (the "Intellectual Property Clause") states that Congress shall have the power "[t]o promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries."[41] Congress derives its authority to legislate patent and copyright policy directly from the Intellectual Property Clause, rather than via the Commerce Clause discussed in Section IV.B above. Consequently, with respect to patents and copyrights, Congress may regulate *noncommercial* behavior, such as that carried out by myriad individual user innovators.

For example, without permission of the patent owner, one may not make, use, sell, offer to sell or import a claimed invention, either directly or indirectly.[42] This can pose dangers to the innovation wetlands, because even individual users who are *not* engaging in commerce are prohibited from making or using patented inventions, such as incorporating them into their designs. In fact, due to the unforgiving "strict liability" principles of patent law, even inadvertent or unknowing use of patented inventions may trigger infringement liability, monetary damages and injunctive relief. This can create a forbidding cost and risk problem for individuals active in the innovation wetlands because it is often prohibitively expensive to identify all relevant patents and their true owners, to understand what activities all relevant patent claims prohibit, to calculate accurately the risks of infringement and litigation and to predict the specific likely monetary and injunctive penalties.

Copyright law also poses hazards to the innovation wetlands, especially in the restrictions it places on software code and the making of digital copies. Consider the Digital Millennium Copyright Act of 1998 (DMCA).[43] This U.S. legislation was intended to prevent the free digital copying—"piracy"—of commercially sold information products, such as software and music. However, the DMCA has created severe collateral damage to users' abilities to innovate with respect to products subject to DMCA restrictions, even where such products have been legally purchased. Specifically, the DMCA made it a crime to circumvent anti-piracy measures built into most commercial software. The intent of the law was to reduce "piracy" by using the threat of criminal sanctions to prevent copying of software or digital media.

However, access to software code in products is also needed by user innovators to understand, modify and improve the products they purchase, and innovators must circumvent anti-piracy measures to gain access to the software code. As a result, the DMCA legislation raises the costs of this type of user innovation significantly, thereby damaging this portion of the innovation wetlands. The damage done is invisible—no one has totaled up the value of phantom innovative projects not embarked upon—but it may be of significant scale. Recall that in the UK, 14% of consumer innovation involved the development and modification of software. If, in the United States, the same fraction of innovation is devoted to software (this fraction was not measured in the U.S. survey), a total of $2.8 billion worth of annual of user innovation activity in the United States alone will have been put at some level of risk by the DMCA.

In the legislative history of the U.S. bill, there is little evidence that the drafters were even aware of the damage the legislation they were developing would inflict on the innovation wetlands.[44] And what evidence was presented failed to soften the draconian effect that the DMCA has had on curbing user innovation reliant on digital text, images, videos, recordings and software code. Worst of all, uses of digital media by user innovators that were formerly sheltered under the venerable copyright fair use defense were walled off from user innovators by the anti-circumvention provisions of the DMCA. Like a stream providing water to an ecological wetland that is dammed or diverted, access to the flow of digital resources that provides a feedstock to creativity within the innovation wetlands has been damaged by the DMCA legislation. Although some countervailing legal rights (e.g., castle doctrine, the right to privacy) may lessen the chilling impact that intellectual property rights may have on individual innovation, the indiscriminate application of intellectual property rights to the activities of individual innovators risks doing substantial harm to the innovation wetlands.

PART V: DISCUSSION

We have proposed that a first and very important step in the preservation and strengthening of the innovation wetlands is to frame that integrating concept and explain its value. In a similar way, the unifying concept of wetlands was used by environmentalists to draw together diverse features ranging from inland bogs to seacoast marshes under a single heading, so that their collective properties and value could be better evaluated and protected. Here, with the same goal in mind, we seek to draw together diverse innovation contexts, rights, statutes and regulations, ranging from those applicable to the reverse engineering of software, the hacking of continuous glucose monitors to extend their capabilities and experimental airplane design and usage, under the encompassing heading of the innovation wetlands. The important features that we view as common among all these diverse settings is the innovation activity of, and value provided by, individuals participating in the innovation wetlands, and the net levels of freedom or restriction that they encounter with respect to their ability to innovate freely and freely diffuse their innovations as they choose. In short, we believe the law affords individuals a robust right to innovate.

Beyond this basic contribution, there are additional, more detailed considerations that we explore next. Analysis shows that economies that include open user innovation in addition to closed producer innovation improve social welfare (Henkel and von Hippel 2005; von Hippel and Raasch 2012). Therefore, if areas of governmental discrimination against the former type of innovation can be found, a "leveling of the playing field" or even positive support from government can be justifiable.

Include Innovation Wetlands in Cost-Benefit Analyses

The way to good practice with respect to innovation wetlands protections is, first, to measure the impacts of present or proposed governmental actions on the innovation wetlands. Such evidence-based policy making has become a hallmark of modern regulatory analysis, and is often formally referred to as "regulatory impact analysis."[45] This can be done by following the pattern pioneered by environmental protection acts around the world. "Environmental impact statements" are now required in the case of proposed changes that might inflict environmental damage.[46] Within such an impact statement, evidence is provided to enable officials and citizens to weigh the likely costs and benefits the proposed change would create so that a rational, evidence-based decision can be made.

Cost-benefit analysis has long played a role in regulation in the United States. It was first enshrined in statutory form in the Flood Control Act of 1939, which mandated a straightforward confirmation of net benefits: in any federal flood control project, the overall benefits were required to exceed the estimated costs of implementing the project.[47] On a wider scale, the National Environmental Policy Act of 1969 (NEPA) introduced a requirement that cost-benefit analysis be conducted for any proposed federal regulation that implicated environmental quality. Although NEPA did not mandate that the results of a cost-benefit analysis be determinative on governmental decisions, actions carried out in the face of net costs naturally invite scrutiny.

Perhaps the most far-reaching application of cost-benefit analysis has resulted from executive orders issued by presidents, beginning with Ronald Reagan. Over the past three decades, these executive orders, aimed at regulatory agencies, have markedly expanded the use of these analyses in evaluating the desirability of any new federal regulatory program. The Reagan administration was the first to make cost-benefit analysis a requirement for all federal regulatory agencies. On February 17, 1981, Reagan promulgated Executive Order 12,291,[48] which mandated cost-benefit analysis when triggered by a variety of factors, most of them economic in nature. Among these triggers was any rule "likely to result in . . . [s]ignificant adverse effects on . . . innovation."[49] Succeeding presidents George H.W. Bush, Bill Clinton and George W. Bush largely maintained this approach to detecting and minimizing the adverse economic effects of federal regulation. Most recently, on January 18, 2011, President Barack Obama issued Executive Order 13,563, which reaffirmed Executive Order 12,866 (itself a reaffirmation of Executive Order 12,291), issued by President Bill Clinton, on September 30, 1993, and requires cost-benefit analysis of federal regulations.[50] Among the requirements of Executive Order 13,563, "[e]ach agency shall . . . seek to identify, as appropriate, means to achieve regulatory goals that are designed to promote innovation,"[51] "each agency shall ensure the objectivity of any scientific and technological information and processes used to support the agency's regulatory actions"[52] and the formerly prospective scope of cost-benefit analysis for regulations is to be made retrospective as well.[53] A related procedure, called "regulatory impact assessment," or "regulatory impact analysis," is required in many jurisdictions before the passage of new regulations. Given the growing recognition of the importance of user, open and collaborative innovation, the addition of these forms of innovation to the cost-benefit analysis calculus should help to shift the balance away from regulations harmful to the innovation wetlands.

To recognize more formally the role it should play in sound policy making, some have suggested that the cost-benefit analysis approach for evaluating regulations should be elevated into the more durable form of a generally applicable federal statute (Graham 2011). So influential has this form of analysis become in federal regulation that the United States is sometimes referred to as the "cost-benefit state" (Sunstein 1996).

One of the primary benefits of using cost-benefit analysis to protect the innovation wetlands is that it is already a requirement of federal law with strong bipartisan support. Rigorous application of such analyses to the federal regulatory scheme could help free all sources of innovation from unwarranted restrictions imposed by agencies. However, innovation by individual and collaborating users would benefit disproportionately. Because of the small scale of individual innovators' resources relative to those commanded by firms, it is reasonable that increases in regulatory costs would affect the innovation and diffusion activities of citizen innovators more severely.

It is also the case that application of cost-benefit analysis to possible impacts on individual users is becoming more practical with measurements of the types and levels of user innovation activity that are now being carried out via representative national surveys such as those referred to earlier. These can, and should, be used as inputs to cost-benefit analyses. (Earlier, we illustrated this value in our Part IV case examples by roughly quantifying how much innovation wetlands activity was present in the two fields of motor vehicles and software.) Recognition of this new category of potential damage—contributing to the cost side of the ledger—should tend to result in the approval or survival of fewer regulations harmful to the innovation wetlands.

Design Regulations That Individuals Can Comply With at Very Low Costs

Governmental actions appropriate to repair or offset specific damage to the innovation wetlands will, to some extent, be project specific. However, some promising general pathways can also be identified.

One can add flexibility to the currently rigid regulations to allow local adjustments that can open the door more widely to individual user innovation. For example, § 104.11 of the Utah building code provides county building inspectors with some flexibility in approving the use of unconventional, but innovative, building materials.[54] Instead of being restricted to specified materials, inspectors may approve any material as long as they are satisfied that it meets the functional requirements of safety and reliability. Such a regulation has notable advantages. It allows for innovation in building materials, which may lead to improved materials, but it also maintains sound public policy by ensuring that these materials work as intended (Harris 2012). Similar flexible treatment of individual innovators can be found in regulations applied to experimental airplanes and experimental vehicles.[55]

As a second generic approach, agencies can elect to free segments of a public resource for unlicensed use and experimentation by innovation wetlanders. For example, the FCC reserves some segments of the radio spectrum as "white space," where individuals or groups can explore and exploit novel uses without having to obtain a license.[56] At the same time, regulations reserve other parts of the spectrum for exclusive use by specific, regulated entities with specified purposes, such as on-air TV station channels.[57] As a second example, the FAA allows the use of *some* airspace—for example, space far from airports and up to a height of 400 feet—for unlicensed use by hobbyist makers and users of small radio-controlled airplanes, including drones.[58] Other altitudes and areas are reserved for the use of pilots of licensed aircraft, or are completely off-limits to use by any aircraft.[59]

Finally, Congress possesses the discretion not to use its constitutional powers to support patent or copyright laws to intrude upon the innovation wetlands. It could amend the patent and copyright statutes to end liability for experimental, research or noncommercial uses. Congress, the courts, and the United States Patent and Trademark Office (USPTO) could even insist that no patent or copyright be granted or maintained unless it complied with the language of the Constitution that these rights be granted "[t]o promote the Progress of Science and useful Arts."[60] Neither Congress, the courts nor the USPTO have yet taken such steps. However, this would constitute good public policy for protecting the innovation wetlands and, if done judiciously, would have a negligible effect on any current patent or copyright incentives to innovate.[61]

Improved Wetlands Affordances Beyond Regulation

Beyond direct regulation, there are many business practices that are restrictive to citizen innovators because producers fear potential liability from serving these innovators. Innovation activities by individuals often build upon services, components and equipment that are sold commercially. Costs for wetlanders are increased if businesses refuse to provide commercial materials or services to those they identify as wetlanders, due to fear of legal risks arising from their interaction with the innovation wetlands. For this reason, we suggest that laws should be changed to weaken users' rights to sue producers for damages incurred as a result of user modification of producer products and services, or use of them in ways not intended by producers.

It may also be valuable to consider the wisdom of freeing producers from legal liability if they support innovating users (which they may wish to do when users are working in areas of interest to the firm) without oversight or control of what users create. Ensuring a supply of products and services on or with which users may innovate also helps provide producers with user improvements that producers can then incorporate into better products or services they may then sell on the market. For example, boating firms interested in spurring innovation in boat hull design could then support individual or collaborating boating innovators with materials, tool kits, education or even financial support without incurring legal risk. Such support for the innovation wetlands could result in a diversity of new and improved boat hull designs even if the supporting firm itself lacked its own internal research and design capability. The resulting innovations would benefit not only their creators, but would generally be disseminated freely to anyone, including the supporting firm, interested in using them. In many cases, supporting the innovation wetlands will tend be a less expensive and more efficient strategy for finding useful innovations than the traditional routes of relying on internal efforts or hiring outside consultants. We consider it a fair tradeoff to lessen threats of liability to suppliers in return for improved access to tools, supplies and services that spur activity in the innovation wetlands.

With respect to patents and copyrights, the fear of liability individuals currently feel should be eliminated by the pathway noted earlier.[62] Congress should provide personal noncommercial use exemptions to make, use and modify (and diffuse information regarding) innovation designs that are partially or fully covered by patents or copyrights. This could take the form of experimental, research or fair use exemptions or defenses. This option exists in other countries, but not in the United States. The functional equivalent in the United States could perhaps be conveniently accomplished by incorporating a broad research exemption into existing U.S. patent law and by expanding the applicability of the fair use defense both for conventional copyright and for the anti-circumvention provisions of the DMCA. Ideal for the innovation wetlands would be an exemption for personal noncommercial use, which would eliminate the high burden, and resulting chill, of detecting and avoiding potential patent and copyright infringements for innovating users.

Finally, governments offer extensive financial support to producers in the form of such things as research and development (R&D) grants and subsidies, and R&D tax credits. Neutrality with respect to the provision of public resources to support valuable innovation would suggest the devising of supports of appropriate value to wetlands innovators that reflect the considerable level of their contributions, freely given, to social welfare. These might take the form of government investments to support research in methods of open innovation collaboration and diffusion. Neutrality can also include support for the development of an infrastructure appropriate to cheap distributed innovation development and diffusion. Government subsidies have already played an important role in Internet development, and policy has ensured that the Internet is open to those who seek to use it for innovation-related communications. This has greatly widened the range of online innovation opportunities for which innovation development and innovation diffusion in the innovation wetlands is viable (Benkler 2006). Generalizing such support to include activities that occur within the innovation wetlands would help to even the playing field between firm and individual innovators. More, better and more affordable innovation would be the socially beneficial result.

Practical Guidance for Individual Innovators

The essence of our message for individual innovators seeking guidance regarding their legal rights to innovate is that, as a general statement, individuals' rights to innovate are generous and already deeply enshrined in the law. In the United States, protected by both constitutional and common law rights, individuals are free to engage in a broad range of noncommercial innovative activities to satisfy their own curiosity and needs. They may also innovate collaboratively with others, and then disseminate information about their innovations to anyone and everyone. Moreover, they may engage in innovative activities, both wise and unwise, and risk life and limb doing so. Strong legal limits on such activities are triggered when they pose unreasonable risks to others, especially harm to third parties or their property. Thus, the core of the legal protections for the innovation wetlands allow individuals to innovate for their own noncommercial purposes without posing unreasonable risks to others. Both the theory and the empirical evidence we present above suggest that the lifeblood of the innovation wetlands is precisely this category of individual noncommercial innovation that does not unreasonably risk harm to others. As we have shown, misguided or misapplied statutes and regulations can impinge on the innovation wetlands, thereby impeding one of society's most important sources of new innovation, but the right to innovate provides legal protections against these threats. We next provide several illustrative examples of innovative activities that are likely well protected by law.

Individual Medical Experimentation

Like the admonition "Physician, heal thyself," almost everyone has, at some point in her life, engaged in innovative self-medication. Whether improvised bandages, splints, compresses, hangover concoctions, herbal remedies, folk cures for the common cold or words of comfort with placebo effect spoken to a child who feels ill, people routinely engage in the practice of medicine on themselves. In most cases, the malady being treated is mild and temporary. However, many people also develop and implement novel treatments for more serious and chronic medical conditions when frustrated by the limitations, in effectiveness or access, of formal medical care. Many of these patient-developed innovations doubtless are of little value, or possibly even damaging. However, some are extremely valuable. Indeed, many medically important treatments, now adopted widely as standard medical practice, have arisen from experimentation by patients themselves (Habicht et al. 2012). A powerful example involves NightScout, a community of collaborating individual innovators who successfully modified a commercially available continuous glucose monitoring device—a device upon which many patients with type 1 diabetes rely to avoid such catastrophic outcomes as diabetic coma—to greatly improve the well-being of patients who require monitoring by extending the device's capabilities to include remote monitoring of patients' glucose by friends, family or physicians (Linebaugh 2014).

As long as controlled substances or devices are not used, and others are not unreasonably endangered, the law provides strong protection to individual patient innovators to carry out medical treatments or experiments on themselves, to report the results to others and to engage in collaborative innovation and experimentation. The FDA may chafe at such activities, and attempt to regulate them, but it is largely beyond the agency's legal authority to prevent individual patients from engaging in such noncommercial medical treatment on themselves.

Vehicle Customization

Automobiles are legally regulated in many respects. These include minimum fuel efficiency standards, mandatory seatbelts, airbags and other safety equipment, pollution emission standards and wheelbase and width limits. Drivers must adhere to a plethora of operation regulations, such as not exceeding speed limits, obeying traffic lights and signs and signaling turns and lane changes. Despite this maze of regulations, individuals retain tremendous scope for innovation, whether by modifying or constructing cars or by using them in unorthodox ways. High-fidelity stereos and video systems can be installed to transform automobiles into traveling entertainment centers, engines can be modified for high-performance or alternative fuels, shapes, colors, textures and materials of various parts of a car may be customized and many other creative alterations can be made.

Individual innovators can make a nearly infinite number of modifications to their cars while retaining their right to use public roads. In part, this results from a regulatory emphasis by the National Transportation Safety Board and others on function rather than form. For example, as long as one's automobile emits measured pollutants at less than a legally specified level, regulators will tend to tolerate many different designs capable of achieving lower emissions.

On private land, customized automobiles are even freer. Private roads or race tracks can host even car designs that would violate statutes or regulations governing driving on public roads (e.g., monster trucks, drag-racing cars, demolition derby cars), provided, of course, that they do not pose unreasonable risks (e.g., extreme noise, noxious pollution) to third parties. Here, protections are afforded by such legal principles as the castle doctrine and the right to privacy.

In general, individuals are fairly free to innovate on their own vehicles in the United States as long as any resulting innovations comply with safety and pollution regulations and do not pose unreasonable risks or harms to others.

Intellectual Property Laws

Individuals' innovation wetland activities can be constrained by intellectual property rights owned by others. User innovators tend to be affected most by two kinds of intellectual property: patents and copyrights. Patents and copyrights pose a threat to the innovation wetlands that is different in kind from that posed by government legislation and agency regulation because ownership of these intellectual property rights tends to be diffusely spread among private owners. Rather than a small number of identifiable governmental threats, the threat of legal liability posed by tens of millions of patents and copyrights is decentralized among numerous private individual and corporate owners, making it difficult to determine whether or not one is infringing any of these owners' intellectual property rights.

One of the most worrisome aspects of patents and copyrights is the harsh legal standard of strict liability that can be applied to individuals who may, knowingly or unknowingly, violate owners' rights. Strict liability applies as long as a defendant is responsible for an act that causes damage. Liability tends to be triggered based on whether or not infringement occurred, not whether reasonable precautions were taken to avoid infringement or the infringement occurred intentionally. In the case of patents, there are currently no significant fair use, personal use or noncommercial use defenses available to infringers. In the case of copyright infringement, infringer may invoke the fair use defense to escape liability for a narrow set of unauthorized uses of copyrighted works. However, the DMCA, through its anticircumvention provisions, has severely curtailed the fair use defense in the case of digital works, to the strong detriment of citizen innovation.

Rather than the *de jure* protection afforded much activity within the innovation wetlands that may be threatened by government legislation and regulation, in the case of intellectual property law, wetlanders must generally satisfy themselves with the *de facto* protection that accompanies their *de minimus* and noncommercial activities. Especially in the case of patent-rights violations, patent holders whose rights individual innovators knowingly or unknowingly violate by making a copy of a patented invention for personal, noncommercial or experimental use will tend to receive only damages reflecting economic losses resulting from infringement. Since this will likely be a very small amount, it will often be cost ineffective for the patent holder to sue individuals within the innovation wetland.

CONCLUSION

Despite the lack of awareness of, and attention to, the innovation wetlands that we have documented, evidence from surveys shows that innovation wetlanders are very active in many fields. In part, this is due to the reality that individual innovation tends to be small scale and tends to avoid unwelcome attentions from firms and regulators who could have legal bases to take action against them if they so choose. This situation will become progressively less viable as the innovation wetlands continue to grow, and interactions with firms and governmental activities become progressively larger in scale and more visible. For these reasons, we must increase awareness of the innovation wetlands and their great value in order to ensure that statutes, regulations and enforcement practices are better aligned to this increasingly important and beneficial phenomenon. Fortunately, the law already provides a robust right to innovate to individual or collaborating inventors, designers, creators and tinkerers who inhabit the innovation wetlands. The core of this right protects noncommercial innovation for personal use, collaboration with other similar innovators and free dissemination to others of information about innovations that result from these activities.

In this chapter, we have focused upon the legal context for the innovation wetlands in the United States only. The national surveys cited in our chapter, however, indicate that new product and service development by individuals is significant in many nations, and so, appropriate governance measures should be examined quite broadly. Just as actual wetlands were despised until their ecological importance was recognized, and only then subject to strong protections and public support, the importance of the innovation wetlands needs both recognition and robust protection. Individuals and nations will only enjoy the full benefits innovation wetlands can provide once society and its laws consciously and zealously protect this invaluable source of innovation.

NOTES

1. Pub. L. No. 83–566, 68 Stat. 666 (1954).
2. Clean Water Act of 1972, Pub. L. No. 92–500, 86 Stat. 816 (codified as amended at 33 U.S.C. § 1251 (2012)).
3. Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Aug. 21, 1975, 996 U.N.T.S. 245.

4. Unless otherwise specified, all monetary values referred to in this chapter are expressed in U.S. dollars.
5. All figures have been converted into U.S. dollars for comparison.
6. Internal quotation marks omitted.
7. The First Amendment right to disseminate the results of one's innovation is discussed further in Subsection II.B.3.
8. U.S. Constitution amend. I.
9. *Id.* amend. III.
10. *Id.* amend. IV.
11. *Id.* amend. V.
12. *Id.* art. I, § 8, cl. 8.
13. The Declaration of Independence para. 1 (U.S. 1776).
14. U.S. Constitution amend. I.
15. *The Right to Choose: A Fundamental Liberty*, *ACLU Briefing Paper Number 15*, 'Lectric L. Libr., http://www.lectlaw.com/files/con17.htm
16. 410 U.S. 113, 152 (1973).
17. See, e.g., *Ravin v. State*, 537 P.2d 494, 504 (Alaska 1975).
18. 394 U.S. 557, 564, 566 (1969).
19. 537 P.2d at 504.
20. 539 U.S. 558, 578 (2003) (quoting Planned Parenthood of Se. *Pa. v. Casey*, 505 U.S. 833, 847 (1992)).
21. *Cruzan v. Director*, Mo. Dep't of Health, 497 U.S. 261, 269–70 (1990).
22. *Id.* at 278.
23. *Id.* at 269–70.
24. *Ravin*, 537 P.2d at 504.
25. U.S. Constitution amend. I.
26. *Gitlow v. New York*, 268 U.S. 652, 665–66 (1925).
27. 703 F.3d 149, 163 (2d Cir. 2012).
28. *Id.* at 168–69.
29. U.S. Constitution amend. IV.
30. 533 U.S. 27, 40–41 (2001).
31. U.S. Constitution amends. IX, X.
32. *Id.* art. I, § 8.
33. Council Directive 2009/40, 2009 O.J. (L 141/12) (EC).
34. *Id.* art. 13.
35. U.S. Constitution art. I, § 8, cl. 3.
36. *Id.*
37. *Wickard v. Filburn*, 317 U.S. 111, 123–24 (1942).
38. *United States v. Morrison*, 529 U.S. 598, 617 (2000).
39. 132 S. Ct 2566, 2577 (2012).
40. *Id.* at 2586.
41. U.S. Constitution art. I, § 8, cl. 8.
42. 35 U.S.C. § 271(a) (2012).
43. Digital Millennium Copyright Act of 1998, Pub. L. No. 105–304, 112 Stat. 2860.
44. *Digital Millennium Copyright Act*, OpenLaw (Feb. 15, 2000), http://cyber.law.harvard.edu/openlaw/DVD/dmca/.
45. *Regulatory Impact Analysis*, OECD http://www.oecd.org/gov/regulatory-policy/ria.htm
46. National Environmental Policy Act of 1969, Pub. L. No. 91–190, § 102(C)(i), 83 Stat. 852.
47. Pub. L. No. 76–396, 53 Stat. 1414.
48. Exec. Order No. 12,291, 3 C.F.R. 127 (1982).
49. *Id.* at 127–28.

50. Exec. Order No. 13,563, 76 Fed. Reg. 3,821, 3,821 (Jan. 21, 2011).
51. *Id.* at 3,822.
52. *Id.*
53. *Id.*
54. Utah Admin. Code r. 156–56 (2008) (referencing Int'l Bldg. Code § 104.11 (Int'l Code Council ed., 2006)).
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56. *White Space Database Administration*, FCC, http://www.fcc.gov/topic/white-space
57. *FCC Frequency Bandplan*, Colum. Univ. Amateur Radio Club (July 27, 1994)
58. Unmanned Aircraft Operations in the National Airspace System, 72 Fed. Reg. 6689 (Feb. 6, 2007).
59. Commuter Operations and General Certification and Operations Requirements, 60 Fed. Reg. 65832, 65842, 65870 (Dec. 20, 1995).
60. U.S. Constitution art. I, § 8, cl. 8.
61. Other authors have also suggested ways in which intellectual property laws could be interpreted or amended to support, rather than harm, innovation. See, e.g., Pamela Samuelson, *Freedom to Tinker*, Theoretical Inquiries L. (2015), outlining the existence of, and support for, a freedom to tinker that supports legal innovation rights even in the face of others' intellectual property, and additionally suggesting how intellectual property law could be reformed to widen this freedom to tinker; Ariel Katz, *The First Sale Doctrine and the Economics of Post-Sale Restraints*, 2014 BYU L. Rev. 55, explaining how the proper interpretation of the first sale doctrine can support user and open innovation.
62. See Section IV., *Regulating Commerce*

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3 User Representation
A Journey Towards Conceptual Maturation

Sampsa Hyysalo and Mikael Johnson

INTRODUCTION[1]

The envisioning of the user of a technology in the making can predate, even by decades, the first actual people to use it (e.g. Akrich 1995; Oudshoorn 2003; Höyssä and Hyysalo 2009; Hyysalo 2010). Many technologies remain with these envisioned users and never find their way to their (hoped for) flesh and blood counterparts. This does not mean that such envisioned users are irrelevant or illusory. Quite the contrary: envisioned users play an important role in design practices. The users of not-yet-launched technologies are elaborated in product and marketing descriptions. Requirements, specifications and prototypes are adjusted meticulously to their needs. The next product generations often build on these envisioned uses and users. Visions of future products and their usages can further inform the expectations of consumers and other stakeholders, such as regulators and intermediary actors. And even as products find their way to users in the flesh, the objects of the designers' attention will often not be physical human beings per se, but rather the various types of user representations, such as the summarized results of usability studies or rumors from the sales department.

These real consequences of the visions and representations of users inside design is a real-life phenomenon that is worth serious attention, regardless of whether anyone ever uses the product or service that is envisioned. The consequences, as we shall see, depend not only on which users become represented, but also on the sources of user representation, and the types of negotiations and actions that take place with and around these user representations.

Attention to the representations of users within the design processes stands in some contrast to the most widespread ways of thinking about users and what is important about them. We can distinguish three different understandings of the user. In the previous chapter by Torrance and von Hippel, we encountered the common economic understanding of the user. The user is the person or organization that can derive benefits from a good directly, without selling it to others to recoup his/her investment (von Hippel 1988).

The second most common understanding of the user can be found in design, information systems research and human–computer interaction, where the user is commonly associated with real "people out there." The defining feature of user-centered design is to increase the accountability of design by grounding the design decisions in an investigation of the contexts, practices and desires of those who would be affected by it (i.e. the users), rather than grounding it in the designer's own imagination and preferences. However, in contrast to an economic understanding of the user as the net benefactor of goods, the design disciplines consider the user as one of a wide spectrum of people. As the use of most products and services affect wider sets of people, notions such as the secondary user, the implicated user, and social actors and role holders have been suggested as refinements to too narrow and/or vague discussions about users (Norman and Draper 1986; Lamb and Kling 2003; Preece and Rogers 2002; Dix et al. 2004). Nonetheless, it remains that real people in real contexts with real products are commonly regarded as users.

The third understanding of the user can be found in social science oriented work—in consumption studies, science and technology studies (STS), organization studies and information systems. This work stresses that the emergence of the user requires more than "people out there with goods/technologies." When technology adoption is studied in detail, it becomes salient that "usership" is an effortful accomplishment (Kjellberg and Helgesson 2009). At the minimum, becoming a user requires "respondence," the person opening to the characteristics of material goods (Hennion 2007). Commonly, a more extended domestication of a new good into the social, physical and economic order of everyday life takes place (Silverstone 1992; Lie and Sorensen 1996; Pantzar 1996), sometimes accompanied with extensive adoption moves (de Sanctis and Poole 1994) reflecting the fact that most often users do not face goods such as technology naked, but as part of pre-existing sociotechnical assemblage (Nielsen, this volume). Phrased more generally, the adoption of a new technology changes the artifact mediation of human practices, and hence, becoming a user is a property that emerges gradually in interactions between people and technologies (Hartswood et al. 2002; Miettinen and Hasu 2002; Hyysalo 2003; Helgesson and Kjellberg 2009), often requiring mutual adaptation in both the new technology and in users' practices, (their existing instrumentations, their identities and organizational contexts) (e.g. McLaughlin et al. 1999; Botero and Hyysalo 2013; Voss et al. 2009).

Despite the considerable differences in what is held to constitute use and user, all these three positions divorce use and users conceptually from the design activities that precede use. It is justifiable to say that the envisioned user (the "fourth user") and its relationship to the economic user, the affected people and the emergent usership have received far less systematic research attention than they deserve. This is not least because the envisioned uses and users form a fundamental departure point for many who pursue research and design with users in mind.

In the course of this chapter, we seek to outline work on envisioned users and how it has matured over the years. We focus on studies on the topic in

S&TS that examined innovation processes as emergent phenomena, agnostic to the presumed ontological status of objects, subjects, visions, economics, etc. in the seamless web of "technology in the making" (Hughes 1979; Callon 1986; Latour 1999; Oudshoorn 2003).[2] The clearest early expression of this view was Madeleine Akrich's (1995) work on the sociology of *user representations* and its methods and practices. Going into real-life R&D departments and examining how work was carried out, how users were represented and how their actions were preconfigured into products has since grown to a wider area of research, with significant empirical and conceptual progress (Russell and Williams 2002a, b). And since research on the user is about to take a new turn, now is a good moment to take stock of what has been achieved.

APPRECIATING USER REPRESENTATION AS A FORM OF WORK

To understand how research on the users envisioned during design has matured, we need to recount briefly what the early studies in this line of research accomplished. The first studies of users within design practices highlighted how the referent of "the user" was not necessarily any person "out there," but was often derived from the developers' imagination and professional priorities. Concepts such as I-design, ego-design, configuring the user and the "user as scenic feature of design space" were developed to highlight this (Woolgar 1991; Agre 1995; Akrich 1995; Sharrock and Anderson 1994; Cooper and Bowers 1995). Many subsequent studies, in effect siding with participatory and user-centered design critique, have repeated these findings, pointing to the potentially incorrect values and sources for understanding users that designers may have (for a cogent summary and critique, see Stewart and Williams 2005).

The more important legacy of the early studies was, we argue, initiating detailed studies on how user representation happens as part of design work. The research focused on the multiple modalities that a planned use takes: visions, claims, assumptions, ideas, pictures of user-practices, sketches, prototypes, the artifact packaged for sale and the technology entering the hands of users, as well as the transformation processes between these modalities (Hyysalo 2004). These studies no longer *dismissed user representation in design practices as misguided, regressive and unworthy of attention*, as many in user-centered and participatory design did in their proclamations of more enlightened design practices.[3] To gain a sense of what the last twenty years have yielded and how different the sociology of user representation appears now, compared to when ego-design was new, we wish to review the literature in the S&TS field.

The first section deals with the sources of *user representations* in design. The original line of work flagged the dichotomy between explicit and implicit representations, such as designers using themselves as a reference for the user (Akrich 1995; Oudshoorn et al. 2004). Inquiries since have revealed eight major source areas with close to 30 subcategories, and our research suggests that much of this range of significant inputs for designing usage is not a matter of a range of different projects but a matter of variety, even within single projects.

The second section takes a different angle on the same topic; examining *how user representations are put into action*. Development processes tend to feature multiple professional groups with different ways of knowing the user. They also derive their representations of users, systems, products and future contexts from rather different routes and with highly varying ways of materially presenting them (Kotro 2005; Williams, Stewart, and Slack 2005; Konrad 2008; Hyysalo 2010). There are further practices and translations involved in how user representations are embedded in design (Pollock and Williams 2008; Hyysalo 2010; Johnson 2013). We conclude by summing up the empirical and conceptual progress in user representation research through the notion of the user being a relational entity through and through.[4]

Sources of User Representations

For many novel technologies, there is no stable and generous awaiting reality from which the needed user requirements can be readily collected by the means of user research. The users have to be constructed, and this requires the difficult work of finding, weighing and contesting information about potential users and their future engagements with technology. No matter how many surveys (and no matter how cleverly devised they are), focus groups, co-design sessions or planning games developers deploy to probe potential future users, the findings depend on the adequacy with which the users can represent their own contexts, desires and needs regarding a new technology. That people know how to act competently in their everyday practices does not indicate that they are able to reflect deeply on all aspects of technological mediation of their everyday lives, let alone on how new technological possibilities might affect them (Miettinen and Hasu 2002; Hyysalo 2003). Some users, often called lead users, of specific technology have experimented and acquainted themselves extensively with this (future) technology and their own relationship with it (von Hippel 1988). Other people's capacity to represent their future use to themselves can be augmented by various means (Bødker et al. 2004).

Regardless of this, the designing of prospective use tends to be "representation hungry" in that it is hard to cater for all the information required for hypothetical future practices and desires. The Vivago case studied by Hyysalo (2010) is a good example of significant representation of use and users entering the design process from several sources, which we recount as a precursor to a more encompassing review that explains in more depth the categories we use for different sources. In the Vivago project, *investigations* *to elicit user requirements*—ranging from market surveys to a user-centered design study—were conducted during the early years and generated a set of representations about users, usages and preferred functionalities. *Extant systems and solutions* (such as the previous safety phones, available sensors, robot phones and elastic bands) were a major source for representing usage and users throughout the innovation process. *The use of designers' personal experience* as a reference took place from time to time, as in when considering the feel of the device's push-button solution, the width of its wristband and the pressure of the wristband. In design discussions, common sense and folklore about specific groups of people (the elderly and nurses) accompanied (and filled) gaps between explicit requirements. *Cultural maturation* was effectively relied upon in the redesign of control software in 2000 by means of the WIMP user interface paradigm and relying on its organization, as did the framing of the whole device as a new generation of safety phone. Interacting and *collaborating with users* (in various ways) provided the major thrust for many of the second-generation redesigns. Finally, developers' participation in their *professional* traditions gave the major thrust for how usage was designed. Issues such as technical functioning, regulatory demands and the cost of manufacturing heavily influenced which features were seen to be appropriate and desirable, what kind of user interface was sought and what criteria (and points of comparison) for user satisfaction were used. All of these created *de facto* representations of use, representations that concern usage, even though they were only expressed in these terms when their implications became visible in the hands of the users.

The broad scope of sources of user representation in the Vivago case is not somehow exceptional. Reviewing the research to date reveals that even the *dominant sources of user representation*[5] in R&D projects amount to over thirty different sources, which can be categorized under eight distinct source areas (Figure 3.1). The envisioning of users is thus not confined to explicit requirements for gathering techniques or asking the affected people first hand. For this reason, it is also entirely appropriate that the sociology of the sources of user representations has become considerably more encompassing than 1990s notions (such as I-design or configuring the user) suggest. In the following, we will look at what we consider to be the key extensions of the sociology of representation since the 1990s' focus on I-design.

The first source of user representation is that which most R&D, marketing, design and management texts take for granted (users being represented through explicit requirement-gathering techniques, such as market or customer research, focus groups, interviews, expert panels, literature reviews and so on) and which most companies run as a standard part of their R&D processes (Kerr 2002; Johnson 2010; Hrelja and Antonson 2012). These marketing and customer research methods are increasingly complemented by usability, design and user-centered design studies (Righi and James 2007; Neil Pollock and Williams 2008; Heiskanen et al. 2010; Johnson 2013). The form of these user representations varies from customer segments to user categories and to more contextual depictions of users and their identities (Hyysalo 2003; Johnson 2007; Hrelja and Antonson 2012).

Recent years have marked a rise in the second source area for user representations, the direct involvement of users in design and the further development of products and services. Current and prospective users are hired as in-house experts, invited in as participants in consumer panels and user groups, and involved through various crowdsourcing arrangements (Leonard-Barton 1995; Howe 2008; Heiskanen et al. 2010). Users are sometimes keen enough to act as partners in inventing, designing or visioning new products (Bødker et al. 2004; von Hippel 2005), as well as acting as testers of early beta and later pilot versions of the technology (Schrage 2000; von Hippel 2005). As it makes a considerable difference whether people are represented or whether they represent themselves, we see this as a separate area of user representation.

As we have already pointed out, not all representations of use, users and contexts of use come from "people out there." The third source area of user representation is when designers also use their own experience as being representational of the behavior of users. Such implicit user representations were originally labeled as I-methodology or ego-design (Akrich 1995; Hine 2001; Russell and Williams 2002; Oudshoorn et al. 2004). More recent work in this area shows how designers using themselves as a reference is not only potentially negligent behavior, but also notes how designers' in-depth personal experiences of the user activities can be an apt resource for representing users in professional design (Kotro 2005; Ross 2011; Schweisfurth 2012). Personal reference is also not the only personal implicit source by which designers represent users. Designers have also been shown to draw their user representations from generic visions of the future (such as the paperless office, telecommuting), particularly as focusing points and proxies for what the users' context will look like by the time the product is launched (van Lente and Rip 1998; van Lente 2000; Konrad 2006). Some of these visions bundle into sets that form pervasive imaginaries (Suchman and Bishop 2000; Flichy 2007), including unquestioned cultural representations such as cultural stereotypes. This is particularly common in early generic visions of users before they become more articulated in the course of the development work (Schot and de la Bruheze 2003; Höyssä and Hyysalo 2009; Ross 2011).

The sociology of implicit user representations also reveals a fourth source area: user representations that are derived from designers' professional experience and folklore about use-related issues in previous development projects and implementations (Grint and Woolgar 1997; Hyysalo 2006; Johnson 2007; Bobrow & Whalen 2002). As professionals, designers draw user representations from technical visions, engineering traditions and organizational constraints that inform design (van Lente and Rip 1998; Kotro 2005; Johnson 2007; Ross 2011). Design is conducted with limited resources and pressing schedules, and is affected by organizational divisions of labor, rules, career paths and hierarchies of decision-making (Bucciarelli

1994; Van de Ven et al. 1999). Again, not all such representations are intrinsically negligent. For instance, in the development of the Habbo virtual world for teenagers, its developers deployed the notion of the average user as their design target, a seemingly naive gloss category that sent shivers of horror down the spine of a human–computer interaction expert following the project (Johnson 2007, 2010). Yet, the average user turned out to be used as a reflexive category that balanced out the demands of louder and better-articulated groups of users (Johnson 2007).

The fifth analytically distinct area from which user representations have been shown to arise is solutions adopted from previous products and services. The outcomes of design practices and requirements set by earlier products and their users are relied upon to form the launch pad for design efforts (Kerr 2002; Pollock and Williams 2008). Pre-formulated solutions and problem-solving strategies comprise much of the deceptively unimpressive part of design work, and designing use is not the grand exception here (Williams et al. 2005). Developers make use of established tools rather than create new design patterns, code libraries, software architecture frameworks, application programming interfaces and rapid application development tools. These tools are all created for a certain design-use context, and their use imposes characteristics from that context on the current design situation, configuring both designers and users further down the line (Mackay et al.2000; Hine 2001). Tools make certain things easier and other things more difficult for a developer. Hine (2001) further notes that web designers sometimes consider technology as standing in for an audience. For instance, web designers discussed the "correct" ways of placing hyperlinks and marking headers in web texts and, in doing so, referred to specific browser technologies, HTML standards and download speeds. Behind these technological references were specific user representations of potential users for these technologies or in certain technological circumstances. In addition, the designers considered what the intended users would think of the designers and their institutions had they designed the web texts in one way or another.

The sixth key source area for user representations is business operations, which imply some users and uses rather than others (rather than users or customers being considered first and business cases being built on the basis of these considerations). Investment sunk in infrastructure invites the finding of new uses and users for it, such as cable network providers focusing solely on interactive TV applications for private households that have the cable television (Konrad 2008). The potential size of the market can lead to user representations, for example, the above-mentioned Vivago safety phone was built for "plus sixty-five seniors" rather than "plus eighty-five seniors" against evidence that the former do not feel the need to use such a product (Hyysalo 2010). Following a competitor's offers and features has been documented to short-circuit any feedback from customers in rapidly changing areas, such as was the case at the peak of the e-commerce system development around the turn of the millennium (Konrad 2008).

Revenue models are a common source for implied user representations. A good example is the early phases of the online virtual world for teenagers, Habbo Hotel. Its developers first created an SMS-based micro-payment system. They tried it out in an online snowball fighting game, and while experimenting with the revenue model, they invented features such as larger snowballs and shields. As the users found the arms race unjust and uninteresting, the next application was a hotel where SMS payments could be used non-competitively to buy furniture and decorations for rooms in the hotel, which was more successful (Johnson 2013).

Regulatory demands present the seventh source area for user representations that can be found in the research literature. Compliance with medical validations has been shown to result in target group specification and respecification, as well as in inventing new customer segments (Lehenkari 2000; Oudshoorn 2003; Langlais et al. 2004). The need to obtain reliable test results for the capacity of technology can reduce the diversity of user representations considered (Hyysalo 2004; Neven 2011). The prospects of gaining the labels and certificates needed for approaching particular customer segments similarly affect how the users of a technology become represented (Hyysalo 2010). Privacy regulations are a typical area that directly affects representations of acceptable use (Bylund et al. 2010). Moreover, users, their characteristics and contexts are constructed in standards, such as the ISO standards related to different technologies and processes. Most notably this concerns usability, user-centered design and interactive systems, even as empirical research on usability professionals' understanding of users indicates a discrepancy between standards and professional practice (Hertzum et al. 2011).

The eighth and final key source area for representations of the user (identified thus far) is cultural maturation. Technologies build on widespread media and technology genres, which are assumed to be familiar to users (du Gay et al. 1997). Culturally established categories, such as a movie, telephone call or web page, are powerful conventions, bridging design and use (du Gay et al. 1997; Hall 1997; Williams et al. 2005). More restricted digital artifact genres, such as the ATM, an editing program or an instant messaging application are equally recognizable to almost all of us (Löwgren and Stolterman 2004). As a generalized appropriation experience, such conventions, images, "grammars" and narrative structures can be trusted by designers to be decoded in fairly nuanced ways by all those people who have basic competency in a given technological culture. While this cultural stabilization of meanings provides safe ground for variation and experimentation, it also sets up limits as to how certain solutions can be understood (Haddon 2004). Moreover, across (sub)cultures, there may still be surprising variation in how novel versions of product categories become interpreted (Williams et al. 2005).

All in all, these identified sources of user representation yield eight major source areas with subcategories (see Figure 3.1). Such variety in the major

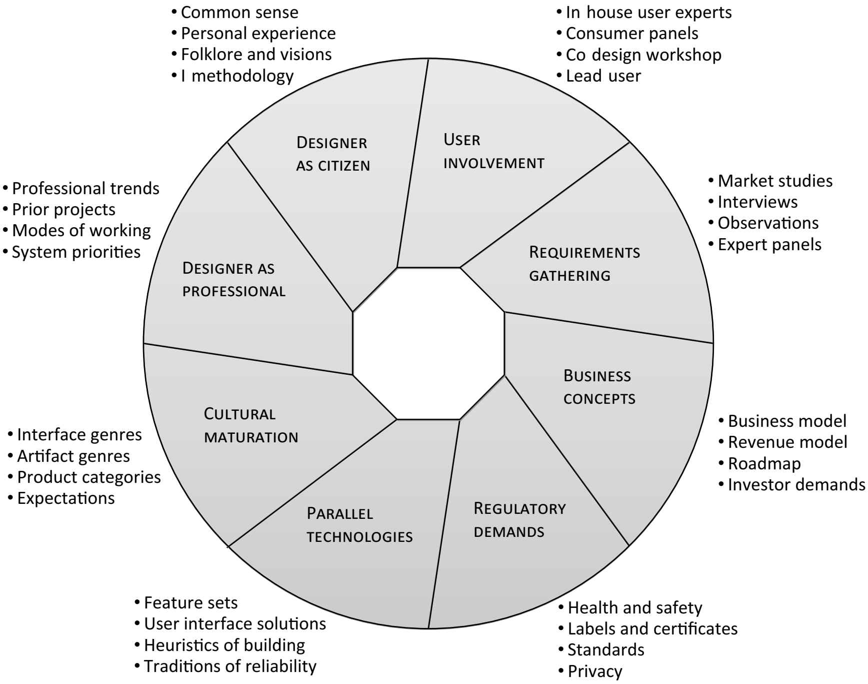

Figure 3.1 The eight major source areas and illustrative subclasses of the sources of the representation of the user in technology design.

sources of user representation provides us with a rather different portrait of how users and usages are arrived at during product design from one that results from any of the traditional scopes of research for requirement gathering, marketing, user-centered design, participatory design or new product development. Indeed, when we give each major source area of user representation an equal area in graphical representation, it suggests that the most studied area of the explicit requirement-gathering techniques has received massive overemphasis. In particular, implicit representations and cultural maturation present areas that are actively used but neglected in terms of research, theory building and research-based advice for developers—in 2015, it makes little sense to only label these areas as bad design practice.

By reviewing the literature, we hope to have conveyed the considerable maturation that has taken place with respect to the understanding of sources of user representation. No less than eight major source areas of user representation have been identified, showing how research has moved quite some distance from implicit/explicit user representation division of the early 1990s. The concepts and analyses from S&TS particularly tell a rather more complicated story than the naturalistic idea of the user as a given entity "out there," waiting to be studied for a more accountable design.

User Representations in Action

We shall now move on to pursue another angle on the same body of research by focusing on how user representations play out in development projects and how they become embedded in products. If the world of design processes was simple, the sources of user representations would be like the pieces of a puzzle that come neatly together in the individual project. But as studies of actual design processes have shown again and again, this is not the case. In the following, we will therefore review what is known about design processes that involve a multitude of actors with non-identical interests and a multitude of only partially compatible sources of user representation.

Different sources of user representation relate to different ways of knowing the user and tend to have different material carriers. Kotro's (2005) research on Suunto wristop computers designed for active amateurs in different sports highlights the topic well. The members of its R&D team who worked in the firm's marketing department built their understanding of markets and users through trade, sports and fashion journals, marketing studies, etc. They materialized these understandings into trend reports and image collections. Meanwhile, engineers on the same team built their understandings of users through following competitors' R&D strategies and development efforts, and by reverse-engineering competing products. Their user in turn was materialized in, for example, requirements specification and the specifications of the available component technologies. The hobbyist understanding of the user, shared by all the R&D team members because of their leisure sport activities, was more weakly materialized in the design team's discussions, but taken seriously because they all had the same common referent in a sport hobbyist lifestyle, allowing them to recognize and appreciate the insights that others had about the hobbies they were designing for. In the end, it was said to be this shared practice background that led to the successful design (Kotro 2005).

These different sources and material carriers related to the different professional skills involved in getting into contact with and understanding user representations, such as the trend analysis of trade journals or reverse engineering competitors' hardware (Kotro 2005). Some of these forms are more elusive than others. Designers' synergistic understanding of users, or the hobbyist knowledge presented in the Suunto case, are typically less tangible and less verifiable as professional practices than, for instance, reports from marketing research or competitor analysis, or other referrals to explicit methods (Finken 2005).

As the wristop computer case suggests, the hardness and verifiability of user representations does not alone determine their relative plausibility in R&D projects. Closeness to "flesh and blood people" appears to be a key issue in how people appear to judge the relative adequacy of user representations. Video recordings of users' work practices, which produce a first-hand witness effect, are notoriously effective, to the extent that they have been noted to skew R&D decisions contrary to other, apparently overwhelming evidence (Nicoll 2000; Williams et al. 2005).

It should come as no surprise that the materiality of user representations is often built purposefully to aid effective use and assessment. Product developers create various explicit user representations to communicate the findings from user research—use cases, user requirements, persona descriptions (Cooper, 1999; 2003; Pruitt and Adlin 2006), scenarios (Carroll 1995), context of use models, workflow/task/artifact models (Beyer and Holtzblatt 1998)—to communicate the results of user research to design and development.

Yet it is not only the characteristics of user representations that matter but, crucially, how they relate to other user representations. It is worth keeping in mind that many actors, consultants and user researchers (for example) make their living as intermediaries that generate and proliferate user representations, and working with these understandings of use, desired functionalities and identities of users is an important part of the work of R&D staff. The representations of current and future users are pitted against each other, and this pitting takes place at various levels of a design organization (Hennion 1989; Stewart and Hyysalo 2008; Hyysalo 2010; Ross 2011). The user can thus be a result of, and an item within, organizational politics—as is the case in Ross's study on how a new media lab meets its audiences, where the producers use future users as a currency to engage partners: they "dangle the user carrot before the partners' donkey" (Ross 2011, 259).

As the previous discussion on the sources of user representations indicates, issues about users appear to be more complexly intertwined into the design organization than, for instance, human-centered design standards would assume it to be. Some user representations are complementary and can have mutually reinforcing relations. Others have more conflicting relations, and yet other representations of use concern such different areas in the product that they tend to remain unconnected. Hence, rather than being a question of the impact or operationalization of user research, a focus on user representations reframes the issue as paying attention to the mutual relations and interactions between the different user representations, people and artifacts that carry them *during design* (Figure 3.2).

Tradeoffs between manifold border conditions, requirements and properties are part of everyday work in design, particularly in systems where qualitative detail (such as look and feel) matter and a very detailed specification and pre-emptive thinking through of all the details is either hard or impractical (Schon 1983; Suchman 1987; Gedenryd 1998). Naturally, design and engineering do not stand helpless in the face of such difficult interdependencies; the separation of concerns (through compartmentalization, modularization, etc.) is one of the principal activities involved, as is the use of target and final specifications (Ulrich and Eppinger 1995; Cross 2000). But how this factually takes place, and how exactly user representations are raised to

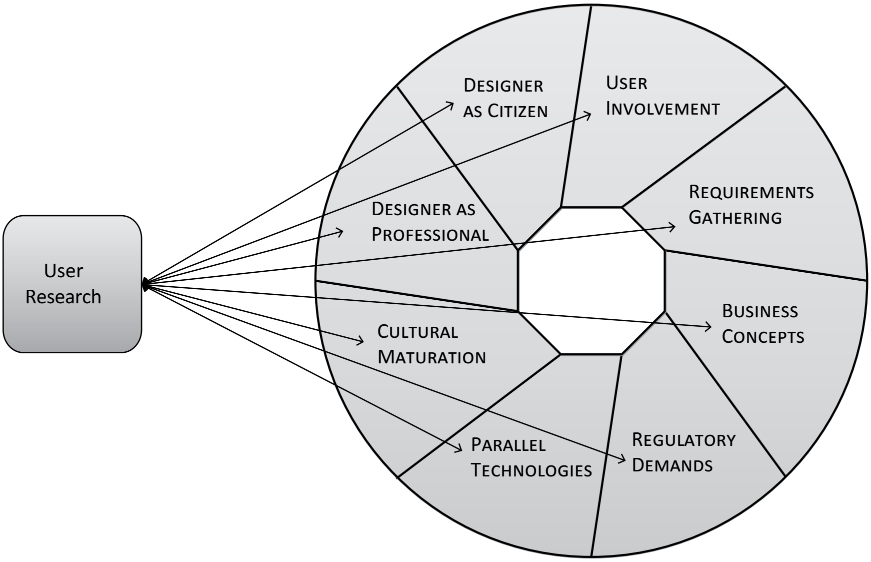

Figure 3.2 User research's impact seen as commission and then driven into the organization (upper image) and as an interaction within the complexly intertwined existing sets of user representation (lower image). Needless to say, "user research" could be unpacked as well.

the fore in situated design action and interactions connected to other situations, still rests on the relatively scant research to date.

The available research suggests relatively complex processes. Hyysalo (2010) examined the trajectories of user representations of the Vivago safety-monitoring device from the initial user research, customer feedback, business plans and the previous product version (used in the characteristics of a new design version). The entry of user representations into the design discussion presented a strongly edited version of the user or usage concerns, in order that these could be directly relevant for the design consideration at hand. Most user representations circling around the R&D projects were simply edited out. These user representations were never brought in to the design process through materials, process detail, resourcing or even talk; they never entered the design, even as the "scenic" or "contextual" features documented by Sharrock and Anderson (1994) and Martin et al. (2007). The representations that did enter design work were typically ones that were interanimated by business concerns or technical possibilities/restrictions (and, on occasion, also by other user representations). They then went through a series of operationalizations and adjustments in the course of the design work. In this process, some representations accumulated (that is, gained more impetus and thrust), often qua their mutually reinforcing relations with other user representations and compatibility with key technical or economic considerations. Other user representations, even though all design team members agreed they were significant, went through a trajectory of erosion where they gradually lost priority and room in the design (Hyysalo, 2010; 2012).

One of the key points in the last decade's research on user representations is positioning the issue of the user into development and industry life cycles. Johnson's (2007, 2013) studies of the dynamics of user involvement in the social media service Habbo Hotel spanned the development from the first prototypes with hundreds of registered users in 2000 to it having over fifteen million users globally in 2010. It reveals that the developers used twenty-six major ways to generate user representations during this time, owing to changes in the service context as well as the knowledge the service developers already held about the users. In contrast to the typical psychology-based approaches of user-centered design, the key criterion for the company's user representations was not fixed over time, nor set to understand users and their practices per se, but rather set to reflect how valid (useful, even inspirational) the information was for the design and business concerns at each quarterly release. Johnson's work further highlights change in the relative adequacy of the modes of user engagement from a situation where the social distance between developers and users was low (the developers were close to the few hundred users), to increasing distance. In the early stages informal methods reigned, but as the developer-user social distance grew, more formal and arms-length methods were employed.

Similar layering and strategic ordering of the modes of user engagement were found by Jensen at the Danish medical aid company Coloplast (Elgaard Jensen 2013). Here also, the informal, close connection between developers was complemented with new means to enhance responding to strategic R&D targets. The early "sisterly empathy" became accompanied by clinical testing, external market surveys, end-user focus groups, expert panels, workplace observations, a usability lab, internal prototyping boards, a personal ostomy friends program and the Coloplast ostomy forum. These forms of relating to users followed each other in the methods arsenal of the company used in responding to business goals and the availability of new approaches to engage with users.

The generation and utilization of user representations hence appears to build on an existing stock of representations to which new ones are actively contrasted and compared. They are further anchored in the practices and rhythms of the R&D organization and advocates therein. In other words, they are bound to development life cycles and professional groups within an organization (Pollock and Williams 2008; Johnson et al. 2010; Elgaard Jensen 2013).

An important facet in the role of user representations in development life cycles concerns the phase of development. This is most blatantly visible in packaged software, where the early phases of developing a new type of product (or moving an existing product to new user base) are characterized by an "accumulation of functionality" and the endorsing of variety in use and user representations that are potentially relevant. Once the software has incorporated key user requirements, the previously endorsed variety of user representations tends to become regarded as local and particular, something to be diminished in favor of a more generic package and a more limited set of user and use representations (Wang 2007; Pollock et al. this volume, 2007; Hyysalo 2010). The dynamic typically includes the recycling of the software, programming languages and libraries of previous settings; hence, it inherits some of the user representations embedded in those. On occasion, this concerns the state of the industry life cycle, such as the moments when enterprise-wide software houses move to new areas (Pollock, Williams and d'Adderio, this volume).

Indeed, many user and usage representations do not stop at the company door, let alone stay inside a project room. As Konrad notes, "These conceptions [of users] may be specific for individual actors, small actor groups or they may be part of the social repertoires of larger communities of actors, e.g., within a technological field" (Konrad 2008, 7). Her research on the evolution of use and user representations of interactive television and early e-commerce describes the extremes. Interactive TV rested on user representations that remained remarkably stable internationally from the 1970s to the 2000s, even when local pilot projects had a somewhat different interpretation of them. In the e-commerce projects, however, representations of users, uses and desired features evolved rapidly, mostly following international developments and competitor offerings. The developers did not pause to wait for potential users to adopt the latest version and establish new use practices, but went on to develop new versions of e-commerce services while the older versions were being implemented (Konrad 2008).

Neither are user representations limited to designers and developers. The various users envision themselves as using future technologies as well as holding on to representations of themselves as the users of current products and services. This holds for people at a personal level as well as for user organizations that envision their future technological choices. In the e-commerce studied by Konrad, users' own representations of use evolved equally rapidly and followed the same international evolution of representations of what were adequate system features and usages as did developers' user representations. Campagnolo (Campagnolo et al. forthcoming; Johnson et al. 2014) similarly emphasizes the importance of users' user representations as constitutive of shaping demand and feedback to developers. McLaughlin et al. (1999) point to how the adoption and consequent process of "valuing" packaged software in different organizations hinged on the representations of the use and system that the management and different professional groups had. (Hakkarainen 2013; Hyysalo and Hakkarainen 2014) notes how users' representation of themselves as non-technical people formed a major challenge in a living lab collaboration in a Finnish health care setting. Only when the living lab implementation turned into a struggle did they (have to) reconsider the capacity of a startup company to handle technical development alone and moved beyond just developing procedures for technology use.

By now it is bordering the general cultural sociology of representation to point out that other stakeholder groups—such as policy makers, consultants, managers, researchers and so forth—also have representations of citizen groups as actual and potential users (Oudshoorn 2003; Peine and Herrmann 2012). These become relevant to the designer–user nexus insofar as they inform (or are positioned by) technology users and designers. This does not mean that to shape technology, a representation has to be literally designed in. As the examples above point out, technology can also be affected through being "one step removed" or through "indirect mechanisms" (Hyysalo 2006), through rumors (Burrell 2011), assessments and expectation setting (Pollock and Williams 2010) or through recourse to ideological maneuvering (Pfaffenberger 1992).

By now, we have outlined how the concept of user representation has matured from its initial framing of implicit/explicit representations and their relatively straightforward embedding in designs. We have particularly questioned ideas of any user research being simply adopted (or otherwise) by the developer organization. We have learned that user representations stem from multiple areas and typically have varying material carriers within the practices of R&D professionals (as well as among users). Consequently, the trajectories that are formed in the embedding of user representations in technologies are shaped by the dynamics present in inter-organizational fields and within particular organizations, as well as within design processes.

The thrust of the research on user representations in action can be capped by (re)defining that the fourth user is a relational entity, expended across time, between moments of technology design and use as well as across space, from the sites of design to sites of use. Users begin their life with the initial envisioning of technology-use pairs (either by developers or by flesh and blood users-to-be) and go through a series of transformations in technology development that eventually results in "nuts and bolts technology." The technology, in turn, shapes and is shaped by the actions of "flesh and blood people" and their representations of adequate use of the technology and its desirable form. Both actualized uses as well as representations of use continue to evolve in the course of the evolution of the technology, adjoining products and social practices (Fischer 1992; Flichy 2006; Hyysalo 2010).

In effect, the questions "Who are the users of technology?" and "Who uses technology and for what?" have become re-framed as a question of what networks and association comprise technology, its design, use and its users in a given moment (Baraldi 2009; Helgesson and Kjellberg 2009).

Such a more nuanced view points to some further research directions. In the space permitted here, we can just focus on one instance, this being the more careful attention to how user representations are embedded in technologies, addressed both empirically and conceptually. It is unproblematic that technologies come to embody representations, yet it is arduous to reliably infer exactly what representations they inhabit and how. For instance, most S&TS use of "scripts" in technology factually confuses user representations and technology characteristics (inscription-of-use in technology, Akrich, 1992; Akrich and Latour 1992). For example, in Neven's work (2011) and in the work of Rommes et al. (2011), "age scripts," "compliance scripts" and "gender scripts" gloss over how reports and interviewed people represent the characteristics of artifacts. This confuses representations with inscriptions and, further, blurs inscriptions with what Gjoen and Hård (2002) call the "user script," the user's own scripting of the artifact in question. Moving beyond a merely metaphorical use of scripts would require documenting how user representations have been translated into the material characteristics of technology—not merely asserting that the technology has this or that characteristic because its developers held certain representations of it prior to or after its design. Similarly, as technologies do not signify similarly across users (Holt 1995; Mol 2002; Hyysalo 2004, 2007), an analyst cannot just ask users about scripts in technology, nor pretend that the analysts themselves have such a privileged position that enables them to "read representations off" artifacts beyond a rough heuristic. How artifacts are enacted in practice needs to be studied to reveal the interrelation between user representations and the actualized characteristics of technology in real-life settings. Indeed, the authors of more recent studies have gone on to re-evaluate the 1990s conceptual templates (such as scripts and configuring the user) as "bizarrely politicized," in effect "demonizing" designers both in regard to their intentions and their capacity to configure the users (Stewart and Williams 2005).

CONCLUSIONS

Research on user representation in design has developed considerably since 1990s. From the initial finding of implicit user representations featuring alongside explicit ones, research has come to elaborate eight dominant source areas, each with multiple kinds of sources for user representations, with a variety of implicit representations included. Further, the research has come to deepen our understanding of the underpinnings of these representations in professional traditions in technology design as well as the importance of different material carriers of representations of users. A journey has also taken place with regard to conceptualizations of how user representations end up in products and services. From the framing of users being configured and inscribed, many studies have examined the circulation of configuring processes between producers and users over several generations of product development, as well as examined the complex interplay amidst different competing representations within single design processes.

The relational understanding of the user and a distinction between user representations and situated use help decipher the dynamics by which the post-launch interpretation and appropriation of new technology is anticipated during the design and planning processes before the market launch. Audience reactions are anticipated by active representational work that links different aspects of novel objects to their respective social contexts (regulation, business, technology, usages) and often, by proxy, to those parts of the development organization that (assumedly) hold competence in the area. This anticipatory representational work in design "endogenizes" (a part of) audience interpretations, rendering them manageable as part of the communication involved. Indeed, the user (as a relational category) helps designers to identify and express potential problems of interpretation (cf. Crilly et al. 2008, 440). The question, however, is not so much what an isolated product or product feature might mean, but how their meaning becomes constituted within the circuits of production and consumption over time (Callon et al. 2002; Latour 1991; Silverstone et al. 1992; du Gay et al. 1997; Kotro 2005; Pollock and Williams 2008) and how these are further enmeshed in product, company and industry life cycles, as well as in user practices.

The research reviewed here points towards careful in-situ studies of design practices with a keen eye on their epistemic and material aspects. Such studies would further benefit from bridging the research to longer development cycles and the historical continuums at stake. We call for focused further research efforts on key interest areas in the social study of technology instead of a settlement with the early sketches of a given topic. The research on user representation is apt for showing the need to keep on researching an important theme and the accompanying conceptual development towards more "mature" concepts with better descriptive force. In developer–user relations, continuous conceptual development is required to simply keep pace of the current empirical developments. As noted in the introduction to this volume, users are increasingly becoming harnessed to innovation processes as a naturalized part of company operations. Representations concerning how users are best gauged, interacted with, motivated and given voice, as well as how they are best exploited amidst these actions are likely to become accentuated in the development contexts of the twenty-first century. Naïve views of users both as engaged participants and as represented entities will be insufficient for staying in tune with the ongoing changes in the industry landscape.

NOTES

1. This chapter is a result of our cumulative undertaking since 2002 to identify research and themes related to user representation. Some parts of the current text are thus updates to sections we have published before in Hyysalo 2004, 2009, 2010; Hyysalo and Johnson 2015.
2. Within the actor–network theory (ANT), such relational ontology and related understanding of status of different entities was dubbed as a "material

semiotic" analysis of technology in 1980s and 1990s. Given that S&TS theories such as ANT regard meaning and meaning structures to reside within material practices that hold on to a process ontology (Blok and Elgaard Jensen 2011), we see "semiotics" rather as a communicative label for relational process studies rather than a defining, delimiting or necessary part of such an analysis or such a view to users.

3. This research on user representation also differs markedly from the 1990s' cultural sociology, which analyzed cultural representations on a general plane and typically from third-party sources only (Hall 1997; du Gay et al.1997). The S&TS orientation has also made it distinct with regard to research on developer practices within human–computer interaction and information systems research, which tend to be more process oriented and pay less attention to empirical details of how representation and translation has taken place (Hansen et al. 2007; Nandahakumar and Avison 1999).
4. To clarify our position on users, by user we refer to people, imagined, implicated, real or potential people, who are or could be using an artifact, technology, product, service or infrastructure (from now on, in short, technology). This includes people who directly operate the technology, often called direct or primary users. It equally includes people who provide feeds to the technology, help to keep it working or whose actions are directly affected by the technology, even if they do not directly operate it or use it only in rare intervals. These people are often called secondary users. There are also people whose actions or lives are implicated by the use of the technology, such as patients whose bodies are penetrated by the use of surgical instruments without them doing much of anything with them or, for instance, the administrative head of the hospital where the surgery with the new instruments takes place. Similarly, the cleaner of the surgical premises may never even be aware of the instruments used even as they affect the kind of mess and kind of hygiene s/he has to deal with. Such implicated or simply co-present people may or may not be users (Burrell 2011; Clarke and Star 2003; Preece 2002). Representations concerning these implied people can form a key part of user representations, e.g. part of a broader scenario of use (Konrad 2008), but some of them are better understood as representations of business or representations of maintenance or infrastructure. Needless to say, there is an overlapping area where the question is largely empirical, and we find the following heuristic sensible: would these people form a significant relationship to the technology or not, in a sense that the relationship has effects on either the person or the technology. The part of our definition that states "imagined, implicated, real or potential people" is key to understanding why we wish to speak of user representations. User representation helps in differentiating between the strictly speaking representational existence of the user (user representations, be they mental, social, physical or bodily) and the lived existence of people who engage with technology (a user, someone who has or has had a relationship to the technology). This is because flesh and blood usership is an emergent relationship that requires attending in-use situations (Helgesson and Kjellberg 2009), yet these same flesh and blood people have user representations of themselves and of others in relation to a range of present and future technologies.
5. Technical, economic, regulatory and political matters can be interconvertible for technologies in the making (Hughes 1979), and user representations can "piggyback" business representations. An example of this is that when teens began to form the bulk of the clients in Habbo virtual world (Johnson 2013), the business priority led to forming user representations of a safe virtual environment, later elaborated in "the Habbo way" design principles. Interconversion, however, does not happen in every instance, and we have chosen to err

on the conservative side and regard as user representations only those representations that clearly have a bearing on who will be using the technology and how. Hence, the micro-sales profit model and its SMS-payment system used by Habbo developers were business representations and technology representations that would have a bearing on user representations only insofar as direct user representations empirically became built around them (as we detail below).

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4 How User Assemblage Matters

Constructing Learning by Using in the Case of Wind Turbine Technology in Denmark, 1973–1990

Kristian H. Nielsen

INTRODUCTION

In an influential paper on learning by using, Nathan Rosenberg (1982, 122) argues that gains in productivity result from not only learning processes inherent to the design and manufacturing stages of technologies, but also "a separate category of learning that begins only after certain new products are used." Focusing his argument on high-technology industries such as aircraft, electric power generation and computers, all of which have shown impressive productivity growth throughout the twentieth century, he further speculates that valuable information of great economic importance would result from further empirical examination of the learning-by-using phenomenon. Given the high degree of systemic complexity involved in aircraft, power generation, and electric information and communication technologies, optimal parameters of design, maintenance and operating are difficult to obtain and time consuming to determine. Uncertainties with respect to performance quite often originate from uncertainties regarding technological design and manufacture, but just as often translate into uncertainties related to the utilization of technology. Examining the active participation of one particular user group, namely, airlines, in the early history of jet engine innovation, Rosenberg (1982) suggests that new practices of engine maintenance introduced by airlines were crucial in reducing air transportation costs. These maintenance practices did not result in actual improvements to jet engine design, but they nevertheless substantially affected the reliability and performance of turbojets (Rosenberg 1982, 135).

This chapter attempts to update and, more precisely, elaborate on Rosenberg's (1982) notion of learning by using. The empirical focus of the chapter is the field of wind turbine technology in Denmark from the 1970s through the 1990s. With regard to renewable energy technologies such as wind power, users have generally been viewed as active agents (Jamison 1991; Hess 2007), although their agency has often been downplayed in comparison with that of the state, wind turbine producers and wind energy research institutions (Heymann 1998; Est 1999; Kamp et al. 2004; Karnøe and Garud 2012). Emphasis has been placed on the capacity of governments to support wind energy research, development, demonstration and information through a number of energy policy mechanisms (Nielsen 2005) and on the ability of small manufacturing companies to produce reliable wind turbines for the home and international markets (Karnøe 1991). Users are an integral part of such stories; yet, little effort has been devoted to analyzing their particular contribution to wind turbine development. The notion of learning has received some attention as a factor explaining the relative success of the wind turbine innovation system in Denmark compared with other countries, such as the U.S., Germany, Sweden and the Netherlands (Andersen 1993; Heymann 1998; Kamp 2002; Ek and Soderholm 2010). Linda Kamp et al. (2004), for example, argue that the distributed innovation network of Danish wind turbine users, producers and researchers relied on learning by using and learning by interacting in order to construct and transfer knowledge, which proved crucial to the development of Danish wind turbine designs. Both types of learning necessitate close and permanent links between users and producers, and they are both particularly important to emerging technologies with a high degree of systemic complexity, such as wind turbines. This chapter adds to these analyses by more closely examining some of the learning-by-using routines and devices that different users have constructed and developed over time in order to foster learning from the use of wind turbines.

Conceptually, the chapter attempts to substantiate the learning-by-using model in two ways: first, it follows the development of learning by using over time, highlighting its dynamic and evolutionary nature. The phenomenon of learning by using is not static, and this characteristic tends to be downplayed. Rather, learning by using co-evolves with the technology and its users (Hyysalo 2006). Learning curves that show some parameter of performance, productivity or cost as a function of time are often used to demonstrate the impact of learning by using. However, little attention has been devoted to the detailed investigation of the co-evolution of technologies and the connected learning-by-using routines (Tyre and von Hippel 1995; Hyysalo 2006, 2009). For example, Rosenberg (1982) shows that jet engine maintenance costs dropped dramatically owing to the introduction of new maintenance programs based on diagnostic techniques; however, he does not closely consider the co-evolution of these techniques and the users who applied them to engine maintenance, i.e., the airlines. Gardiner and Rothwell (1985) more closely examine the dynamic interactions between jet engine manufacturers and their "toughest customers," the airlines, but they primarily focus on the development of engine design rather than the development of learning-by-using routines.

Second, this chapter addresses the interaction between the techniques, routines and users involved in learning by using by referencing recent literature on calculation devices and materiality in the sociology of economy (Callon 1998; Callon et al.2007; Pinch and Swedberg 2008; MacKenzie 2009).

Rosenberg (1982) emphasizes the close relationship between learning by using and material artifacts by stressing that, in relation to a given technology, learning by using is realized by complementary and relatively unsophisticated technologies or techniques, such as borescopes used to check wear and internal accelerometers used to monitor vibrations in jet engines, that are specifically designed to generate information about performance and operating characteristics. However—and this is where the literature on material markets may be able to provide additional substance to our understanding of learning by using—Rosenberg (1982) does not consider the constitutive or performative role of learning-by-using devices in "framing" users and the technologies that they use (Callon 1998), nor does he contemplate the agency of users distributed among social and technical entities. To conceptualize users as part social organizations and part material techniques, this chapter introduces the notion of "user assemblages."

Below, the conceptual combination of learning by using and the above-mentioned insights from the literature will first be addressed, and the user assemblage concept will be elaborated upon. Then, the evolution of two particular learning-by-using techniques, namely, the siting of wind turbines and the Danish approval scheme for wind turbines, will be presented. Particular attention will be devoted to the co-evolution of users, learning by using and wind turbine design and siting practices. The first learning-by-using device represents what Rosenberg (1982) calls disembodied learning by using, which has had little effect on the "hardware" design of wind turbines, while the second device, i.e., embodied learning by using, directly led to improvements in design.

CONSTRUCTING LEARNING BY USING: USER DEVICES AND ASSEMBLAGES

Owing to early academic contributions such as those of Rosenberg (1982), followed by a wide variety of approaches to considering users of technology (Oudshoorn and Pinch 2003), and owing to movements celebrating and facilitating user-centered innovation, users can no longer be construed as acquiescent recipients of technological change. In recent decades, attempts to generate even more user involvement have been accompanied by widespread appreciation of how users participate in the construction and deconstruction of technologies and their social environments (von Hippel 2006; Bogers et al. 2010). Arguably, users have never been simply passive dupes in technological design processes; rather, they have always been more or less active participants, even if only as imagined users fashioned by engineers and innovators when they contemplate future uses of technology. In fact, users may affect technology in several ways. The contributions in Oudshoorn and Pinch (2003) include the consideration of users and non-users in their treatment of the roles of users in the development of technology. While here, users most often refer to individuals or groups of people who use or appropriate technology for specific and often very different purposes, non-users offer resistance to certain technologies, or for personal, social or financial reasons, they are excluded from using them. Kline (2003), for example, shows that rural resistance to the telephone and electrification was a substantial obstacle to be overcome, as it really mattered to the producers and promoters of those technologies. Examining different ways of not using the Internet, Wyatt (2003) argues that even technologies that are being promoted as universal and potentially pervasive in culture have social and geographical limitations.

Primarily interested in understanding how design improvements and growth in productivity arise, Rosenberg (1982) has a different view of users. As previously mentioned, he introduces the distinction between embodied and disembodied learning by using. This distinction implies two different categories of users. Embodied learning by using leads to knowledge that can be employed to directly alter specific design characteristics. It is most often produced by "users" involved in research and development (R&D). These users, who are not normally referred to as such, may be internal to the industry responsible for developing the technology, or they may work in external R&D facilities, such as national laboratories. Disembodied learning by using, which Rosenberg (1982) calls "learning by using in its purest form," results from prolonged experience with the technology and normally occurs in contexts of application. It leads to information about performance and operation that may affect practices of use and result in increased productivity, for example, by lengthening the lifetime of the hardware, allowing for increased output or reducing operational costs. In Rosenberg's (1982) study, users producing disembodied learning by using are airline companies, which operate their own R&D facilities; however, the concept may easily be extended to include other types of organizations, such as air transportation security bodies, groups of concerned airline passengers and even people suffering from a fear of flying. Combining Rosenberg's (1982) approach with that of Oudshoorn and Pinch (2003) will lead to a two-by-two matrix in which two categories of users—users and non-users—can fill two different functions in relation to a given technology, namely, creating embodied or disembodied learning by using. Obviously, this way of categorizing users and their role in relation to technology is limited because users and non-users may respond to technological change in ways other than producing learning by using. Moreover, as Rosenberg (1982, 124) notes, it may be difficult to make a sharp distinction between embodied and disembodied learning by using because the consequences of one type easily blend into those of the other type.

Defining users in terms of their competencies or capacities has the merit of placing analytical emphasis on the material resources employed by users as they become involved in—or detached from—technologies. Rosenberg (1982) specifically examines the instruments and practices involved in transforming jet engine maintenance, but does not make any analytical points. The recent literature on different types of market transactions has been much more explicit in constructing links between market actors, their calculative agencies and the technologies (hardware and software) that are constitutive to framing such agencies (Callon 1998; Callon et al. 2007; MacKenzie 2009). One of the most powerful analytical tropes to emerge from this work is that of "market devices" (Callon et al. 2007). Market devices refer to the technical instruments that are used to configure market transactions: from simple order forms and goods catalogues to physical market spaces and index-based derivatives. Market devices are used to frame or delimit the range of feasible deals on particular markets. As such, they also define the possible types of sellers, buyers and intermediaries. In other words, market devices and actors on the market are co-produced (Jasanoff 2006). For example, Cochoy (2007) shows how the physical layout of supermarkets and the mundane practices of maintaining supermarket spaces configure both shoppers and retailers, while Millo (2007) argues that the introduction of index-based derivative contracts enabled new roles for regulators, traders and the exchanges. Millo (2007) also emphasizes that the construction of index-based derivative contracts involved a complex sociotechnical network in which one group or technique may be given priority as the key to understanding the emergence and practice of index-based derivative trading.

The notion of market devices may be useful to the study of users of technology and learning by using because it may direct attention to the tools and routines designed and implemented by different users as they attempt to facilitate different types of learning by using. Thus, devices for learning by using constitute instruments and their accompanying practices that not only make the production of new knowledge in the context of technology use possible, but also allow users to adopt new roles in the development of technology. Examples of such devices are the borescopes, internal accelerometers and the accompanying practices of jet engine maintenance designed by airline engineers as they struggled to reduce the costs of turbojet transportation (Rosenberg 1982). These devices facilitated the production of important information and reduced maintenance costs while also enabling a closer relationship between jet engine producers and airlines. An example of devices that have embodied consequences of learning by using is medical trials in which new drugs are tested. As Oudshoorn (2003) shows in her study of clinical trials of male contraceptives, the organization and techniques of such trials required a substantial amount of work because men were generally construed as being reluctant to the very idea of male contraception. This ultimately led to the emergence of a new user identity: the caring, responsible man. Again, learning by using was accompanied by social change. A third example comes from the field of wind turbine development; specifically, Harborne and Hendry (2009) argue that wind turbine demonstration projects and field trials in the U.S., Europe and Japan result in the production of knowledge with not only usefulness for wind turbine design, but also value in bringing together key stakeholders and facilitating their interactions. Although very different in scope and approach, Rosenberg's (1982), Oudshoorn's (2003) and Harborne and Hendry's (2009) studies all support the idea that material devices for learning by using are deeply entangled with users' social identities and understanding of the underlying technology.

As a shorthand for addressing the interaction of learning-by-using devices and users, this chapter introduces the notion of a user assemblage. Introduced by Deleuze and Guattari (1987), and then later expanded upon by social theorists such as Bruno Latour (2005) and Manuel De Landa (2006), assemblage theory posits that socio-technical orders can be meaningfully studied as the construction or assembling of existing heterogeneous and distributed elements defined by their ever-changing relationships. If this theory is applied to user studies, users and "their technologies" would be viewed as historically contingent, socially situated and materially constructed entities. In the context of learning by using, user assemblages are defined as the evolving methods and material techniques by which learning by using is realized in actual circumstances and the users who become engaged in learning-by-using practices. User assemblage thus promises to be a more comprehensive concept than the concept of user, as it prompts analysis of material and social interactions. The user assemblage of wind turbine technology includes different groups of users (for example, wind turbine owners, electric utility companies and R&D institutions), non-users (such as opponents of wind turbine development in specific areas) and many different types of learning-by-using devices. In the following section, attention will be devoted to the development of two such devices, namely, devices for learning by using in the process of siting wind turbines and devices for learning by using in the certified approval of wind turbine designs.

SITING WIND TURBINES: THE ASSEMBLING OF WIND TURBINE OWNERS, METEOROLOGISTS AND LEARNING-BY-USING DEVICES WITH DISEMBODIED CONSEQUENCES

The first energy crisis of 1973–74 sparked renewed interest in wind turbine technology in Denmark and many other countries around the world. In the 1950s, Danish wind power pioneer Johannes Juul conducted experiments in which he connected wind turbines to the power grid. However, at the time, fossil fuels were cheap, and nuclear power promised to end all energy problems; thus, he had been unable to persuade the Danish utility companies to further invest in wind power (Heymann 1998; Danish Wind Industry Association 2000; Nielsen 2010). As of the early 1970s, there were no electricity generating wind turbines in Denmark and, consequently, no users or learning by using. With the steep rise in oil prices and the risk of a limited oil supply from the Middle East, Denmark's near-total (about eighty percent) dependence on oil had become untenable. The Danish utility companies nevertheless continued to favor fossil fuels and nuclear power and remained opposed to wind power (Petersen 1996).

Partly because of Danish utility companies' reluctance to embrace wind power (and other renewable energy technologies) and partly because of the rise of renewable energy movements, other actors began to view themselves as potential users of wind turbines (Jørgensen and Karnøe 1996). The grassroots energy movement in Denmark began as an anti-nuclear power movement, but soon developed an active interest in developing small-scale technological alternatives such as solar and wind power. The Organization of Renewable Energy (Organisationen for Vedvarende Energi, OVE), founded in 1975, arranged so-called Wind Meetings, where all types of people with an interest in the development of renewable energy technology met and exchanged their experiences. In 1975, the organization published the first edition of a small guide to renewable energy systems available on the Danish market. Four editions of the guide were published, and the last edition, which included 148 pages, was published in 1980 (Terney et al. 1980). The first wind turbines to be sold on a commercial basis in Denmark were rather small (up to twenty-two kW). Their owners were typically passionate about renewable energy, and although some producers, such as Vestas, promised "security of supply at a fixed price," they were less concerned with profit and mostly eager to realize their own ideals of sustainability and self-sufficiency in terms of energy (Grove-Nielsen 2013).

From the beginning, private wind turbine owners were allowed to sell their electricity to the utility companies, and the return on investment became an increasingly important issue. On May 4, 1978, the first wind turbine owners established their own organization, the Association of Danish Wind Power Plants, and published a monthly members' bulletin. From the early 1980s onward, local cooperative wind turbine guilds or community wind turbine projects were formed in an effort to purchase and operate one or several wind turbines, partly because of the government subsidies introduced in 1978 and tax exemptions for some of the revenue of such community projects. The key feature of community wind turbine projects is that members of the local community have a significant, direct financial stake in the project beyond land lease payments and tax revenue. All (prospective) wind turbine owners, naturally, were—are—concerned about the performance of the wind turbines on the market. The output of wind turbines, in general, depends on not only the wind turbine design, but also on the wind regime at the site (mostly the mean wind speed, but also fluctuations in wind speed). The revenue for private wind turbine owners is more difficult to assess because it is also determined by the purchase price, the costs of connecting the wind turbine to the power grid, government subsidies, tax conditions and the power purchase agreements between owners and the utility companies. To be able to make qualified, independent statements about some of these issues, the Association of Danish Wind Power Plants created a rudimentary tool for collecting, sharing and processing information about the output and efficiency of their own wind turbine(s), the so-called "members' statistics."

The members' bulletin served as a medium of communication for exchanging information and opinions among wind turbine owners (for an analysis of engineering communication in the wind turbine field, see Nielsen and Heymann 2012). In the first issue, the editor (and one of the first wind turbine owners in Denmark), Torgny Møller, printed a note asking all wind turbine owners to submit the following data on their wind turbines:

(1) Name and address of owner;
(2) Manufacturer and size;
(3) Siting (categories: coastal areas, good inland site or poor inland) and estimated mean wind speed;
(4) Connection period and production figures;
(5) Purchase price and amount of government subsidy received (see below for more information about the subsidies and their impact on wind turbine development);
(6) Price paid for wind electricity by the local utility company and specific details of the power purchase contract.

The first members' statistics, with information supplied by owners of wind turbines, were published in March 1979 with the production figures from the first four weeks of 1979. Fourteen wind turbines (twenty-two to fifty-five kW) from Jutland and the islands of Funen and Zealand were included. The data enabled the mean electricity production figures to be calculated, and they were presented as a rudimentary quality assessment of the specific wind turbines on the market. The first tables included no information about siting and wind speeds (Isaksen 1979). Throughout the 1980s, members' statistics expanded rapidly, and by September 1985, data from more than 600 wind turbines were included, an increase of about one hundred turbines since the beginning of 1985 (Anon. 1985). A map of Denmark indicating the siting of the wind turbines and graphical illustrations of the monthly electricity production and the monthly energy content of the wind (the two figures, of course, are closely related, and the total electricity production in a given month has to be corrected for unusual wind speeds) were also provided. The wind power statistics of August 1990 contained information on about 1911 wind turbines, which filled fifteen pages of the members' bulletin (Anon. 1990b).

In addition to producing the members' statistics, the Association of Danish Wind Power Plants conducted regular surveys of the members' level of satisfaction with their wind turbine(s). The first survey was conducted in 1981, and the results were published in the members' bulletin in September of that year. The survey seemed to indicate that the experiences of using wind turbines highly varied. Some owners reported that their wind turbine had been stopped "countless times," while others had been completely spared from breakdowns. The survey also included questions about the wind turbine owners' level of satisfaction. For all but one of the ten wind turbine brands on the market at the time, there were some owners who rated the operation of their wind turbine as poor, and they added that they would not recommend that others buy the same make. The two owners of the Nordtank wind turbine were the only owners to report 100 percent satisfaction with their wind turbine (Anon. 1981a). The survey became an annual feature of the members' magazine. In 1990, 806 wind turbine owners completed the survey, assessing the quality of their wind turbine(s) on a scale from 1 (poor) to 4 (excellent). The total average was 3.06, indicating that Danish wind turbine owners were generally content with their wind turbine. The highest-ranking wind turbine make of the thirteen available on the market received a score of 3.42, and the lowest received a score of 2.17. The survey also included information about the owners' satisfaction with the warranty and maintenance provided by the manufacturers and other specialized suppliers of wind turbine services. The results also showed that the maintenance costs that wind turbine owners incurred were relatively stable across wind turbine makes and maintenance arrangements (Anon. 1990a).

At the time, the monthly members' statistics and the annual survey were presented as ways for the community of wind turbine owners to produce more transparency on the market for wind turbines and to support the general case for renewable energy. The Association of Danish Wind Power Plants surely wanted to promote the financial interests of its members by making electricity production figures and local wind conditions for specific wind turbine makes publicly available. However, it also wanted prospective wind turbine owners to use the statistics and the survey to purchase the best-performing wind turbines available and to choose optimal sites for their wind turbine. The argument was that the optimization of electricity production figures for all wind turbines in Denmark would be the best way to provide support for the general case for introducing more renewable energy into the national power system. In the course of the late 1970s and early 1980s, the Association established its own network of consultants to provide local municipalities and individuals interested in purchasing wind turbines with information about them (Anon. 1985).

It may also be fruitful to view the members' statistics and the survey as emerging devices for learning by using. In regularly reporting information about their wind turbines through forms provided by the Association of Danish Wind Power Plants, wind turbines owners collectively provided disembodied knowledge that did not directly lead to alterations in design, but rather led to new practices of "using" wind turbines. Based on the statistics and the survey, and often assisted by the consultants of the Association, individuals and community groups tended to choose the wind turbine makes that showed good electricity production figures in the members' statistics and that received favorable reviews in the members' survey. Additionally, disembodied knowledge about good sites for wind turbines resulted from the knowledge provided by the members' statistics and thus assisted wind turbine owners in locating (more) optimal sites for their wind turbines—an optimization practice that was also assisted by the Wind Atlas method starting in the early 1980s (see below). These learning-by-using experiences were collected, processed, published and communicated by the Association, its members' bulletin and its consultants. In other words, a user assemblage of wind turbine owners was in the making. This user assemblage consisted of very simple methods—rudimentary learning-by-using devices—to collect and share information about electricity production, wind regimes and owners' opinions, as well as the organized wind turbine owners and their means of communication, such as the members' bulletin and the network of consultants. Importantly, the learning-by-using devices and the owners' identity emerged together. The disembodied knowledge created and circulated by the members' statistics and the survey lent political power to the Association, which had already been recognized as an important and relevant player in the field of renewable power in Denmark by the early 1980s (Nielsen 2001).

Wind turbine owners trying to optimize their return on investment and seeking to promote the case for renewable energy in the power supply system were not the only users concerned with constructing learning-by-using devices to find the best sites for wind turbines. Meteorologists from the Wind Energy Section of the National Research Center at Risø—originally established in 1955 as a test facility for nuclear power reactors—also became involved. The statistical data on wind turbine performance reflect differences between wind turbine designs and between different wind regimes. Since the energy content of the wind is proportional to the third power of the wind speed, the wind power available increases eightfold when the wind speed doubles. This power law increases the demands on wind turbine design and siting. Ideally, wind turbines should have optimum efficiency at the maximum frequency of wind speed at a given location. In practice, however, the expected power output may be calculated by integrating the approximated power curve of the wind turbine (expressing the power output as a linear function of wind velocity) with the probability distribution of wind speed (specifying the frequency of different wind velocities, typically a so-called Weibull distribution). This was the technique that the meteorologists at Risø utilized in the late 1970s as they, funded by the national energy research program, began thinking about simple ways in which to assist wind turbine owners in finding good sites. The meteorologists quickly realized that information about the frequency distribution of wind speeds at good wind turbine sites is rarely available—simply because these sites are often located in remote areas where no data on wind are collected. Consequently, simple and reliable ways of approximating the actual distribution of wind speed were in high demand. The meteorologists decided to use the so-called log wind profile method, which defines a semi-empirical relationship between the vertical distribution of horizontal mean wind speeds and the roughness length, a corrective measure that accounts for the effect of the roughness of the ground on the wind flow. Because of this method, classifications of the roughness classes of the terrain most commonly found in Denmark were readily available.

In 1980, the Wind Energy Section published the first Danish Wind Atlas, providing wind turbine owners and others with a relatively easy way to assess the wind regime of available sites for wind turbines (Lundtang Petersen et al. 1980). The Wind Atlas described the open country in Denmark in terms of four roughness classes, 0–3, corresponding to four different wind regimes or log wind profiles. To simplify the numerical calculation of the integral of the linear approximated power curve and the logarithmic wind frequency distribution, the Wind Atlas included a table of the incomplete gamma function, which allowed a simpler integral expression by integrating the expression in parts. The resulting figure would then give the mean wind power production for the specific wind turbine design (characterized by the approximated power curve) at the specific site (characterized by the log wind profile). By multiplying this figure by the number of hours of operation, the Wind Atlas user would be able to estimate the total annual production for a given site, i.e., a given roughness class. The Wind Atlas methodology was designed to be user friendly, as it consisted of only two steps: (1) identification of the roughness class and corresponding probability distribution for the wind speed; (2) calculation of the mean (annual) power production. In other words, it was a relatively simple tool to improve local practices of siting wind turbines. Wind Atlas meteorologists estimated that their methodology would be able to estimate the expected wind electricity production for any given wind turbine model at any given site within a margin of ±five percent (assuming that the roughness classification for the site in question was corrected determined) (Lundtang Petersen et al. 1981).

The members' statistics provided learning by using that showed, as all users in the wind turbine business knew, of course, that the output of wind turbines crucially depends on their design and siting. Detailed knowledge about the operation and performance of virtually all wind turbines in Denmark was made available to wind turbine manufacturers, (future) owners, politicians, wind energy researchers and so forth. The data not only lent credibility to wind turbine owners and their claims that renewable energy was feasible, productive and financially sound, but also provided input to changing practices of siting that would increase the productivity of the wind turbines. The Wind Atlas was a relatively simple method for optimizing siting routines. Calculating the total power production of specific wind turbines at specific sites allowed wind turbine owners to make much better predictions of their return on investment and to choose the most optimal site for their wind turbine in their local area, despite the complaint by the Association of Danish Wind Power Plants in the members' bulletin that "[t]he wind atlas is a sound method with which to determine the production of a wind turbine, but, as it turns out, only experts are able to carry out the calculations necessary, which are too complicated for the lay person" (Møller 1983). However, soon after the publication of the Wind Atlas, the Association began offering prospective wind turbine owners consultancy support for making Wind Atlas assessments of annual wind power production (Anon. 1981b).

To assess the importance of the user assemblage of wind turbine owners, it is necessary to include the specific learning-by-using devices that were employed, such as the members' statistic and surveys, and to examine other types of input to changes in users' practices, such as the Wind Atlas method. Wind turbine manufacturers also used the Wind Atlas in marketing wind turbines, as they were offering expertise in using the method as part of their product portfolio, which included insurance, financing and maintenance for wind turbines in addition to the wind turbines themselves and Wind Atlas calculations. Wind engineering researchers at Risø, placed in a different department from that of the meteorologists responsible for the Wind Atlas, used the Wind Atlas to produce reports on the economy of smaller wind turbines (Jensen 1982). The user assemblage was thus highly distributed and far from homogenous and static. As the number and sophistication of learning-by-using devices evolved over time, the users and their interactions with other groups also evolved. Based on the user assemblage concept, it is difficult to determine direct relationships between specific learning-by-using devices, such as the members' statistics, improved siting methods and changes in the productivity of wind turbines. It is more logical to view the disembodied consequences of learning by using in the wind turbine field as a multidimensional and dynamic process in which several techniques for learning about and improving siting co-evolved. As we consider the embodied consequences of other learning-by-using devices, we may expect the same to hold true.

APPROVING WIND TURBINES: THE ASSEMBLING OF RESEARCHERS, MANUFACTURERS AND LEARNING-BY-USING DEVICES WITH EMBODIED CONSEQUENCES FOR WIND TURBINE DESIGN

Predictive knowledge about the expected power production of specific wind turbines at specific sites was important to wind turbine users. Such knowledge provided owners with reliable estimations of the expected return on investment. Reliability in terms of the service life of wind turbines and the expected costs of maintenance were also important issues for owners, manufacturers and others. When the Danish government subsidized the emerging market for smaller wind turbines in 1979, it was agreed that the subsidies should be made dependent on certified quality control. Only buyers of approved wind turbines would receive the subsidy, which amounted to thirty percent of the purchase prize at first and then varied from thirty to ten percent until the subsidy scheme was finally abandoned in August 1989 (Nielsen 2005, 110). The reason for the close link between subsidy and quality was to ensure that the manufacturers did not start flooding the market with unreliable wind turbines, which would be counterproductive to the introduction of renewable energy systems in the Danish energy supply. The government authorized the Test Station for Smaller Wind Turbines at the Risø National Laboratory to carry out approvals of wind turbines that would be eligible for subsidy. The Test Station had been established the year before as part of the national research program for smaller wind turbines. In what follows, it will be argued that the approval scheme established by the engineers of the Test Station constituted a type of learning-by-using device with important consequences for wind turbine design.

The original objective of the Test Station was to test different wind turbine designs and assist the emerging wind turbine industry in developing improved designs. Because of early criticism of its double role—as an assistant to the manufacturers and an approval authority—the Test Station was formally split into an R&D section and an approval section in 1981. The R&D section thereafter received funding from research grants, most of which came from the national energy research program, while the approval section received funding partly from the Danish Energy Agency and partly from approval and testing fees paid by the manufacturers (Andersen 1993). Despite the formal division, at the time, the Test Station maintained its physical unity. The division also seemed to have little impact on the actual work being done. Thus, the employees of the Test Station continued to conduct R&D in the fields of aerodynamics and structural mechanics, applying their results to the development of the rules of approval. They also continued to support the manufacturers in developing more reliable wind turbines. According to the 1986 evaluation of the national energy research program, the most important activity of the Test Station in the period from 1978 to 1986 was promoting the growing industry, primarily through wind turbine approval. The evaluators further concluded that both the Test Station and the manufacturers shared a trial-and-error approach to the development of the smaller wind turbines (Micheelsen et al. 1986).

From 1979 to the mid-1980s, wind turbine approvals consisted of so-called system assessments, in which the wind turbines were assessed with respect to their overall functional and constructional safety. As established codes of practice and standards of wind turbine construction were lacking, the assessments that were performed were relatively crude, and each wind turbine model had to be assessed more or less on an individual basis. Still, in collaboration with the manufacturers and under supervision of the contact group, the Test Station employees gradually developed a practice of approval that was the first step toward actual codes of practice for wind turbine construction (Lundsager and Jensen 1985). A new standard measurement program for conducting field tests of wind turbine prototypes at the Test Station was developed (see Figure 4.1), where the purpose of the test program was

Figure 4.1 The test field for wind turbine prototypes at the Test Station for Smaller Wind Turbines at Risø, ca. 1982. (Reproduced with the kind permission of Teknologihistorie DTU, the Technical University of Denmark.)

to find weaknesses in design and to provide constructive feedback to the manufacturers. By 1985, the Test Station's customized practice of approval had developed into a more general design basis, the so-called "load paradigm," which specified the static and dynamic loadings on wind turbine structures in more universal terms. The load paradigm defined the general design of a typical three-bladed wind turbine with a rotor diameter between five and twenty meters, a rotor solidity of seven to fifteen percent (the percentage of the total rotor area covered by blades), and a blade tip velocity of thirty-five to fifty meters per second. Based on the empirical design and operation knowledge of the manufacturers and the Test Station, the load paradigm was a semi-empirical method of calculating structural loads; thus, the need for more advanced, but also more risky, design calculations was eliminated. The paradigm was deliberately conservative—prescribing loadings somewhat larger than was thought necessary—owing to the Test Station's explicit aim to enforce design reliability through the approval scheme (Lundsager and Jensen 1985).

As is customary for Danish standards, the load requirements were not indispensable. If, by theoretical analysis or other means available, the designer could prove that his design did not need to withstand certain specified loads, the design might be licensed for a different set of loads. This possibility was included in the application of the design basis (the load paradigm) for several reasons. The two most important reasons are as follows: (1) the design basis had been developed from years of experience with the so-called Danish concept (the three-bladed design with the rotor placed in an upwind position on the tower), and allowance therefore had to be made for different design approaches; (2) at this stage in the development, overly rigorous enforcement of a design basis that is semi-empirical could prevent the development of an improved design (Lundsager and Jensen 1985, 8).

The knowledge embodied in the load paradigm, the practices of approval and the designs of Danish wind turbines evolved gradually. In 1980, many different wind turbines were available on the market (see Figure 4.1): three- and two-bladed designs with horizontal axles, vertical Darrieus wind turbines and "wind roses" with many blades attached to the rotor. By 1989, when the government subsidies were terminated, only one design had "survived," namely, the well-known three-bladed design with mechanical brakes and the rotor placed in an up-wind position on the tower. The technological evolution from a wide variety of possible wind turbine designs to only one dominant design configuration, of course, resulted from several factors, most of which cannot be assessed in this analysis. However, the learning by using at the Test Station in relation to the approval scheme for wind turbines that occurred in close contact with the manufacturers undoubtedly played an important role. The evolving practices of testing wind turbine prototypes for eventual approval and the associated codes of design, first made explicit in the load paradigm, enabled wind turbine engineers to make design improvements. The approval scheme was established to not only assure appropriate standards for wind turbine designs that were eligible to received government subsidy, but also support the R&D of the Danish wind turbine manufacturers, most of which were based in mechanical engineering and had little, if any, experience with technological innovation. Joined together by necessity, the engineers employed at the Test Station and engineers working for the wind turbine industry developed a mutual understanding of how to balance wind turbine approvals and development. On the one hand, the increasingly specific design rules prescribed by the Test Station would effectively restrict the innovative capacities of the industry. On the other, because a common approach had emerged, the Test Station was understood to also have to support the industry through knowledge transfer and technological support (Andersen 1993).

By 1989, the Danish government was already working with the wind turbine industry and the Test Station on a new type approval scheme. Similar to the existing scheme, the new scheme, a so-called type approval, would be implemented to support the manufacturers in the development of wind turbine designs. At about the same time, the government published ambitious plans for the utilization of wind power—for example, in the new energy action plan of 1990, known as *Energy 2000*, which stressed the role of renewable energy systems in the Danish power supply system (Danish Ministry of Energy 1990). Among other things, *Energy 2000* focused on the reduction of CO_2 emissions and accordingly established a target of 1,500 MW of wind power to be installed before 2005 as one of the most important means of reducing CO_2 emissions in Denmark. By 2000, this target had already been met, as more than 2,000 MWs of capacity had been installed in Denmark (Danish Wind Industry Association 2013).

The new type approval scheme was in high demand by nearly everyone involved in wind power development in Denmark. The Test Station wanted to develop its expertise in wind turbine research, development and demonstration through wind turbine approvals; the manufacturers were eager to implement quality management systems and to receive an official stamp of recognition with which to market their wind turbines at home and abroad, the wind turbine owners wanted the wind turbines on the market to be thoroughly tested and approved, the finance and insurance companies wanted some type of approval of the wind turbine systems financed/insured and the Danish government wanted some means of market control. All the involved parties agreed that a general increase in wind turbine quality was needed for at least three reasons.

First, the technological development of increasingly larger wind turbines, followed by an increasing optimization of components and materials, required more quality control in the construction, production, installation and operation phases of wind turbine manufacturing and wind power utilization. Second, the technical problems encountered by Danish wind turbines in California and on the home market—because of the lack of quality control, lack of service and maintenance and inexpedient component choices, including components that did not even meet the required specifications—also added to the need for greater quality control. Third, since 1987, wind developers in the Californian market demanded product certification by Norske Veritas, the international classification, consulting and certification society, for wind turbine projects financed by Danish investors (Nielsen 2005, 114–15). All of the above-mentioned wind power actors and many others collaborated in the planning of the new type approval scheme. To classify as a proper type approval, the scheme had to include Danish engineering codes of practice for wind turbine design and construction officially enacted by the Danish Engineering Society. Various ad hoc committees were established to build the technical and organizational bases for the type approval scheme, and these bases, including the Danish codes of practice for wind turbine design, were completed in 1992 (Dansk Ingeniørforening et al. 1992). The Danish type approval scheme now includes several sub-approvals, namely, design, production, and installation approvals, each of which may be performed by different bodies authorized to do so by the Danish Energy Agency. Additionally, an advisory committee—including representatives from the industry, owner's association, utility companies, insurance companies and Danish Energy Agency—advises the agency on general management issues. Moreover, a technical committee consisting of representatives of the authorized bodies handles the more specific technical and administrative problems.[1]

CONCLUDING REMARKS ON USER ASSEMBLAGES AND DEVICES FOR LEARNING BY USING

Composed of many subsystems, wind turbines are characterized by a high degree of systemic complexity. Moreover, wind turbines must operate automatically for many years while being exposed to high static and dynamic loads. The effects of wear and tear are extreme. Thus, it is not surprising that it has taken such a long time to determine the optimal design and siting as well as the maintenance and operating procedures for wind turbines. The particularities of wind turbines may also explain why learning by using has proved particularly crucial to the development of wind turbines in Denmark and elsewhere (Heymann 1998; Kamp et al. 2004). Using the recent literature on calculation devices, this chapter has introduced the notions of learning-by-using devices and user assemblages in an attempt to contribute to Rosenberg's seminal discussion of what constitutes learning processes of learning by using. Rosenberg's discussion is centered on learning by using in the aircraft industry and the ensuing improvements to aircraft maintenance. This chapter has examined two different instances of the evolution of learning by using in relation to wind turbines and the resulting consequences for wind turbine siting and design. A number of concluding remarks follow.

First, learning by using may usefully be construed as a complex, historical process characterized by varying degrees of contingency. Wind turbine users introduced their first learning-by-using device, namely, the members' statistics for wind turbine production figures without knowing that the collected information would be supplemented by the Wind Atlas methodology developed by meteorologists. The members' statistics and the Wind Atlas provided, albeit in different ways, standards for assessing different sites for wind turbines, and, ultimately, led to alterations in siting practices. Prolonged experience with the operation of wind turbines, i.e., the members' statistics, and knowledge about the correlation between wind turbine design and wind regimes gave users an improved understanding of the factors that determine the productivity of their wind turbine. Moreover, the two instruments empowered wind turbine users. The members' statistics produced a sense of unity among wind turbine owners, who were joined together in their effort to secure transparency on the wind turbine market and to support the case of wind power politically. The Wind Atlas ensured that uncertainties regarding return on investment would be minimized and thus increased the attractiveness of becoming a wind turbine owner. The category of wind turbine owners, or wind turbine users, then, largely depended on historical developments in the actual devices or instruments by which users would be able to learn from their experiences as users. Unforeseen interactions between such devices proved important to the community of wind turbine owners. In the case of the Test Station, methods of assessing wind turbine prototypes also gradually evolved with important inputs from wind turbine manufacturers. The assessment system for wind turbines developed into a more elaborate approval scheme based on simple design rules such as the load paradigm. By the end of the 1980s, as government subsidies for wind turbines were being phased out, the Test Station used its position as a combined approval and research institution to become the center for the existing type approval scheme for wind turbines in Denmark.

Second, the agency of users is distributed and heterogeneous. Users depend on learning-for-using devices for the collection and systematization of knowledge. Ultimately, what users are able to learn from their experiences as users is determined by the types of instruments that they use. In the case of the Test Station, the engineers had to develop several new tools for testing wind turbines to provide the type of knowledge that was needed for wind turbine approvals. Moreover, the Test Station was a special type of user because of its double role as an approval and research institution. On the one hand, the Test Station represented the government and had to ensure that the wind turbine models receiving government subsidy met certain minimal standards. On the other hand, the engineers at the Test Station had to constantly consider the demands of the emerging industry. This double agency of the Test Station was incorporated in the standards for wind turbine design and their implementation. Specifications such as the load paradigm were designed to provide only moderate restrictions on wind turbine design. In addition, the application of the load paradigm was flexible, as exemptions could be made if the manufacturers were able to make a good case for them. The specific learning-by-using devices produced by the Test Station engineers and the way in which they were used were important in shaping the social role of the Test Station. This case study thus shows why considering user assemblages rather than simply users is more logical. The traditional notion of the user is "naked" in the sense that users are typically depicted as having no material resources other than their bodily engagement with technology. Indeed, many users are exposed to technology in this way. However, for users capable of learning by using, the situation may be different. Learning by using, as Rosenberg (1982) emphasizes, is a complex, creative process in which different types of users develop different capacities and instruments that enable them to provide constructive feedback into processes of technological development and that makes it possible for users to build their identity as users.

NOTE

1. For more information about the Danish type approval system in both Danish and English, see the homepage of the approval scheme: http://www.vindmoellegodkendelse.dk.

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Part II

User-Producer Engagements Between Democratized Technology and Industrial Strategizing

5 Making Work Visible[1]

Lucy Suchman

INTRODUCTION

"How people work is one of the best kept secrets in America."

This provocative statement by David Wellman, a sociologist of labor, can be read as a kind of challenge to work researchers. The sense in which it rings true is particularly remarkable given the large and growing body of literature dedicated to work-flow modeling, business process reengineering and other methods aimed at representing work in the service of transforming it. At the same time that we take Wellman's statement as a call to action, however, we need to reflect carefully on the kinds of secrecy that surround specific knowledges and experiences of working practice and the implications of making them visible. The notion of secrecy implies things known differentially among different actors, usually because those who hold the secret deliberately withhold it from others. Without taking over the connotations of collusion in this sense of secrecy, we can ask why it might be not only inevitable, but also valuable that members of an organization know their own work in ways that others positioned differently in the organization do not. The premise that we have special authority in relation to our own fields of knowledge and experience suggests we should have the ability to shape not only how we work, but how our work appears to others. Self-representation on this view is a form of empowerment.[2]

Alternatively, we can ask under what circumstances it might be in the interests of some organization members not to know in detail the activities of others differently placed. Among the recognized benefits of job specialization are the ways in which we are able effectively to "black box" the work of others, not worrying ourselves about just how their work gets done while at the same time being able to depend on and make use of the products of their labors. In the case of many forms of service work, we recognize that the better the work is done, the less visible it is to those who benefit from it.[3] What we acknowledge less frequently is that bringing such work forward and rendering it visible may call into question the grounds on which different forms of work are differentially rewarded, both symbolically and materially.

In what follows, I adopt a view of representations of work—whether created from within the work practices represented or in the context of externally based design initiatives—as interpretations in the service of particular interests and purposes, created by actors specifically positioned with respect to the work represented. On this view, I argue for the importance of deepening our resources for conceptualizing the intimate relations between work, representations and the politics of organizations. More specifically for system design, this argument implies a reflexive engagement in our work as designers both with the images and accounts of working practices that are provided to us by organization members and with those that we ourselves create and use. The aim is a design practice in which representations of work are taken not as proxies for some independently existent organizational processes, but as part of the fabric of meanings within and out of which all working practices —our own and others'—are made.

REPRESENTATIONS SERVE INTERESTS

In *The Power of Maps,* Denis Wood explores the ways in which, as he puts it, "maps work by serving interests" (Wood 1992, 4). Obviously, they do so in all of the choices made, more and less explicitly, about how a particular territory will be represented. A map drawn for the purpose of asserting property boundaries will not generally indicate the presence of specific plants and animals within a given area. So, too, a representation of work activities created in the interest of introducing new information technologies is unlikely to include aspects of the work—questions of membership and identity, for example—considered beyond the reach of those technologies. Such acts of selection are inevitable accompaniments to the crafting of representations relevant to particular purposes. The problem arises when, as Wood points out, such selections are presented not as matters of practical, political and economic choice ("What's the purpose to which these representations are to be put; in whose interests; what does it cost to go out and look, or otherwise assemble alternative views"), but as matters of *necessity* (84–85). In the process, the interests involved in the work of mapmaking and map using are effectively obscured, while what is depicted comes to be naturalized as an obvious and disinterested view.

Even the most seemingly unmediated, veridical representational forms like video recordings do not wear their meanings on their sleeves to be read definitively once and for all.[4] Rather, the significance of recordings is contingent upon their reading in the context of particular moments of interpretation, informed by particular interests. Brun-Cottan and Wall (1995) provide a clear example of this in the case of work and system design, where a recording of an expert user using an automatic feeder to scan document pages was initially read by software engineers as evidence of the worker's failure to appreciate features of the system's design. Specifically, on discovering that one page in a multi-page document had been placed in the feeder in the wrong orientation, the worker realigned that page in the set of originals and then proceeded to re-scan the entire document, rather than making use of the page realignment feature provided.

Another viewing, reframed by Brun-Cottan and her co-workers who had been present at the work site, showed the worker's strategy in fact to be the more sensible in the context of his own working practice. While use of the machine's page realignment feature would have obviated the need for re-scanning the entire set, it would have required more of the worker's time and attention. Dropping the entire document set in for re-scanning took more of the machine's time, but it left him free to attend to other things. The same images—in this case, the assumed-to-be-impartial images recorded by a video camera—were subject to substantially different interpretations by actors differently positioned, with correspondingly different interests in relation to the activities viewed.

REPRESENTATION AND CONTROL

One central interest in representing work for purposes of system design is to create technologies aimed at the coordination and control of complex, distributed activities. Agre has developed an analysis of what he characterizes as the progressive (re)orientation of human activities to the requirements of designing and implementing such technologies. In this context, he argues that the current wisdom in system design holds that the less of its user's behavior a system encodes, the less functionality it can provide (Agre 1994, 113). At the same time, the more behavior is encoded by technical systems, the more technologies may come to prescribe human activities. Consistent with Yates's history of corporate communications from the mid-nineteenth century (Yates 1989), technologies designed for the coordination of complex distributed activities are commonly used as well for reporting on those activities, as a basis for centralized assessments of the efficiency and correctness of the local operations in which the technologies are embedded. In this way, technologies for the local coordination of work become incorporated into the interests of global control.

Recent workplace studies document the interweaving of coordination and control in computer-based information systems in various sites (see Bowers et al. 1995; Sachs 1995). In looking at the work of airport ground operations, I became intrigued by the analogy between representational devices used by natural scientists in tracking and analyzing the behavior of animal populations (for example, as described in Lynch 1990) and representations used by airline workers to coordinate and report on the movements of planes (Suchman 1993). A crucial difference, of course, is that representational artifacts used within airline operations are an intrinsic part of the same activity that they are designed to track.

Referencing and updating the airline schedule, for example, is a central activity of ground operations workers, at the same time that the schedule is taken at the end of the day as a spatial and temporal representation of what they have done. Moreover, looking closely at how online communications and reporting systems are actually used in airline operations underscores the double form of accountability involved in these technologies. That is, the systems designed to track planes are simultaneously used by workers as resources for communicating their own activities to co-workers, and by management as resources for evaluating how the operation is running. As currently constituted, the technologies of accountability in airline operations afford a kind of autonomous space or maneuvering room that can be used by workers to maintain a reasonable relation between prescriptive representations like schedules and the actual contingencies of getting airplanes off the ground.[5] New tracking devices (such as sensors on plane wheels that automatically record the time of "push back" of a plane from a gate) at least reconfigure, if not further close down, that space.

REPRESENTATION AS STEREOTYPING

Not only do representations of work involve perspectives and interests, but work has a tendency to disappear at a distance, such that the further removed we are from the work of others, the more simplified, often stereotyped, our view of their work becomes.

In a recent project to prototype new technologies in a law firm, for example, we discovered an ongoing struggle over the status of a form of work called document coding, done to support the litigation of large cases. In their distance from the work of document coding, attorneys at the firm held highly simplified views of what the work involved. Specifically, document coding was described to us as a form of unskilled, even "mindless" labor, representing a prime target for automation or outsourcing as part of a general cost-cutting initiative within the firm. When we looked at the work of document coding, however, we saw the interpretations and judgments that litigation support workers were required to bring to it. Thus, we found ourselves in the middle of a contest over professional identities and practices within the firm: a contest between one characterization of work, made possible by distance, and another held by those who did the work (and confirmed by our own observations of what it entailed).[6]

The relation between our own social location and our view of others is in part what sustains boundaries among organizational actors, including boundaries between professional designers of technology and technology users. The distance of professional designers from the sites and activities that are the subjects/objects of their work has given rise to a range of techniques

Table 5.1 An equivocal reflection on making work visible. Reprinted with permission from Suchman (1995).

An Equivocal Reflection on Making Work Visible

This table, created at the kitchen table of a colleague with whom I share interests in work studies and system design, inspired the accompanying article. I generated it as I read through a paper of hers, in which she and a coauthor present arguments for the importance of representing work practice, and new strategies for doing so (see [7]).

As I read I found myself embracing the proposals they put forward, while at the same time I heard other voices in my head speaking back to them, raising questions and concerns or reformulating their words in alternative, and somewhat contradictory, terms. I attempted to represent this unfolding, multi-vocal dialogue with their text in the form of a table.

Despite its two-column format, the table should be read not as a facing off between mutually exclusive and opposing positions but as a kind of responsive dialogue—more of the form "Yes, but"—that expresses the standing tension between a desired vision of representational practice on the left and various voices of suspicion, contradiction, or concern on the right.

Representation in the political/democractic sense is carrying the voice of a constituency into relevant venues of decision-making. Recognizing the conditions of professional design work, specifically its distance from workers as technology users, the aim in representing work is to provide workers/users with a richer presence or stronger voice in sites of professional design.	Representation is creating an image asserted to stand in place of or speak for an other; an imaging developed through engagement with the other but then taken off, to some distant site. In the case where representations are meant to serve the interests of developing new technologies, the other is cast only in terms relevant to professional design, not in her own.
The goal of making work visible for system design is to develop more appropriate technologies from the point of view of those who will be using them.	The goal of making work visible for system design is to find new ways to promote and sell technologies.
Workers define technology, as active creators.	Users are a source of relevant knowledge for designers, passive recipients of technology.
Workers' perspectives are made available, present through representations; they speak in their own voices.	Representations are manageable user surrogates; they speak for them to the interests of professional designers.
Representation involves the artful crafting of peoples' stories.	Representation involves the strategic manipulation of images.
With video records, workers/users speak with their own voices. The portability of video representations makes it possible for their voices to carry widely.	Video records open further possibilities of exposure/danger; their portability exacerbates this.
Video's openness to multiple viewings and interpretations enables unanticipated uses.	Researchers can't control readings that may be made when video is seen by others, in other contexts, with other interests.
Video records make evidence for claims open to contest.	Video records persuade, close down debate.
Video records maintain the animation, dynamics of lived experience.	Video records freeze activity, while affording a (mis)illusion of experience.
Working practice is lived experience, only partially representable.	Working practice can be revealed, "captured," analyzed into constituent parts and transformed into manipulable, objectified knowledge.
The aim of making work visible is to represent work's non-rationalizable, contingent, embodied structuring.	The aim of making work visible is to represent work as rationalizable, abstract functions/processes, enacted through specific behaviors/practices.
Representations may become resources for workers' own use in negotiations with management.	Making work explicit, visible increases workers' vulnerability to rationalizing agendas.
Representations work against automation based on simplified notions of work.	Representations make work available for further rationalization, automation.

aimed at representing relevant others in ways responsive to design concerns. An interest in bringing into view the lived experience of workers left out of standard representational forms motivates recent initiatives to invent new, less reductionist representational forms.[7]

REPRESENTING PRACTICES

During the past ten years or so, a collection of studies of work practice across a range of settings have been carried out under academic and industrial auspices, in dialogue with enterprises of system design.[8] In these studies, researchers have undertaken to look closely at the use of technologies in specific organizational settings and to bring their observations to bear on the design and implementation of innovative computer-based systems. While by no means in full agreement, practice-oriented approaches to the representation of work in relation to design share some basic assumptions and commitments, among them:

- At some moment, by some means, the specifics of how people work become crucial to the design of working systems;
- The explicit/tacit distinction in relation to what workers know identifies not only, or even primarily, a psychological dimension but also a social one. That is, the explicit/tacit is not only a difference between what we can see, talk, or even think about, but also between what our social milieu sanctions as legitimate to be seen, spoken or thought;
- Practice-oriented designing requires sites (times, places, and artifacts) through which shared understandings of work can be constructed across multiple, often conflicting, perspectives;
- The production and use of representational artifacts in system design is a form of work in its own right, to which the same analyses should be applicable as those we bring to the work represented;
- The validity of representations of work turns on the extent to which they are generated out of other ways of knowing the work they represent, and used in relation to those working knowledges.

This last premise is perhaps the most crucial. Representations of work are not only the purview of researchers and analysts. To a large extent, representing work is the stuff of which organizations are made. In particular, a central concern for practitioners and analysts alike is the relation between normative accounts of how work gets done and specific working practices. The problem is not that normative accounts are incomplete, or that actual practice fails to realize them, but that by definition, normative accounts represent idealizations or typifications. As such, they depend for their writing on the deletion of contingencies and differences. As long as such representations remain embedded in the doing of the work, they serve as a useful tool for organization members in their practical reasoning about and action within the organization. Problems arise, however, when normative representations are either generated at a distance from the sites at which the work they represent goes on or taken away from those sites and used in place of working knowledges. Wood's analysis with respect to maps is again relevant here. He argues that the notion that maps are representations that stand on behalf of the terrain mapped actually limits their possibilities, and suggests:

> *Freed from a pretense of objectivity that reduced it to the passivity of observation, the map can be restored to the instrumentality of the body as a whole.*
>
> (Wood 1992, 183)

Similarly, freed from the notion that normative representations are a flawed approximation of working practice, we can begin to build representations that are, in Watson-Verran's (1993) terms, aimed at working disparate knowledges together. The power of such representations lies in the extent to which they acknowledge the often power-differentiated dialogues in which design gets done and resist the appropriation of different voices and interests into one dominant logic or single representational form.

LESSONS FROM ETHNOGRAPHY

Amid ongoing discussion of the relation of ethnographic interests to those of design, recent workplace ethnographies provide both general frameworks and specific analyses of relations among work, technology and organization.[9] Workplace ethnographies have identified new orientations for design: for example, the creation and use of shared artifacts and the structuring of communicative practices. At the same time, the agenda of imagining possibilities for new technologies has led ethnographers to look more deeply into the material bases of working practice.

With the turn to ethnography comes as well a rich resource of critical reflections on what anthropologists Clifford and Marcus (1986) have named the "poetics and politics" of ethnography as representational practice. Representational practices, including those of ethnography, are shaped historically, materially, rhetorically, institutionally and politically:

> *Power and history work through them, in ways their authors cannot fully control . . . Ethnographic truths are thus inherently partial—committed and incomplete.*
>
> (Clifford and Marcus 1986)

Critical ethnography rejects the notion that we can somehow innocently write descriptions of others, whether in the service of understanding or of intervention. Instead, both the terms "we" and "other" are opened up to question.[10] For traditional ethnography, "we" implies some community of observers and their audience—a community that is assumed but left outside the story. "Other" implies those who are the subjects of ethnographic observations and accounts but are not themselves full participants in the ethnographic enterprise. Rendered into our representational forms, their diverse stories and experiences become texts for which we are the expert readers.

In place of this objectivist stance, recent anthropology proposes a view of ethnography as an encounter between actors differently embedded within particular social/cultural milieus. On this view, culture is always relational. Rather than describing attributes of a population from some neutral position outside the field of view, accounts of cultural meanings and practices are inevitably created from particular standpoints that set up the lines of comparison and contrast between the speaker/writer and the persons and practices described. The representations ethnographers create, accordingly, are as much a reflection of their own cultural positioning as they are descriptions of the positioning of others.[11] This is not a problem or limitation to be overcome; it is a fundamental aspect of representational work, to be understood and incorporated into our practices and into what we produce. Making sense and use of representations of some aspect of the social world involves our own positioning in relation to what we are seeing as much as any meaning inherent in the images themselves. This means the goal of representing work should be not simply to create images that can be appropriated to the interests of design, but to understand our relationship, as work researchers, designers and other practitioners, to those images and to the practices of representing that create them. In that way, the images and associated practices might become a basis for dialogue among us rather than reinforcing the boundaries between us.

REPRESENTATION AS CRAFTWORK

For some time, researchers and system developers committed to a more participatory or cooperative design practice have been interested in the possibilities of making work visible in the context of ongoing dialogues among work researchers, system designers and those "others" whose work is the subject of our own (see, for example, Muller and Kuhn 1993). The goal is to develop our representational practices in ways that maintain the connections among representations, their authors, their interests and other knowledge and images that might be relevant. As Harley (quoted by Wood 1992) puts it with respect to maps, on such a view:

> *Maps cease to be understood primarily as inert records of morphological landscapes or passive reflections of the world of objects, but are regarded as refracted images contributing to dialogue in a socially constructed world. We thus move the reading of maps away from the canons of traditional cartographic criticism with its string of binary oppositions between maps that are 'true and false,' 'accurate and*

inaccurate,' 'objective and subjective,' 'literal and symbolic' or that are based on 'scientific integrity' as opposed to 'ideological distortion.' Maps are never value-free images . . . Both in the selectivity of their content and in their signs and styles of representation, maps are a way of conceiving, articulating and structuring the human world which is biased toward, promoted by, and exerts influence upon particular sets of social relations. (78)

A map or other representational device is a piece of craftwork, crafted in the interest of making something visible. Things are made visible so that they can be seen, talked about and potentially, manipulated. It is the last that constitutes the power, for better and worse, of the construction of representations of work. With agendas of intervention come questions of interests, questions that need to remain central and lively elements of research and design. Once we recognize that representations are artifacts constructed from particular social locations and within specific forms of practice, we can expand our concern with the adequacy of representational forms to include ongoing dialogue and debate regarding the various places of representations in work and system design.

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NOTES

1. This chapter is reprint of Suchman (1995). Permissions are granted by ACM and the author.
2. It is on this premise, for example, that Brigitte Jordan and her colleagues have been developing what they call "workplace interaction analysis laboratories," as a forum within which front-line workers themselves are able to reflect critically on the design of their own working practices and associated technologies. On interaction analysis, see Jordan and Henderson (1995).
3. For further discussion of invisible work, see Clement (1993), Shapin (1989) and Star (1991).
4. Of course, calling video recording unmediated ignores all of the choices involved in deciding such things as what to record and when, how to position the camera, whose camera it is and what that means to those recording and being recorded, and so forth.
5. The phrase "prescriptive representation" is coined and developed in relation to the work of sales representatives in Beshky and Østerlund (1994). In a critique of the design rationale offered for systems like The CoordinatorTM,

I have tried to underscore the increasingly complex interweaving of communication and control functions in networked communications systems (Suchman 1994a, b). I argue that the current proliferation of systems aimed at the management of work flow represent at least in part a most recent attempt to encode prescriptive representations of work activities into information systems, as a device for the normative regulation of organizational behavior.

6. For more on this case, see Blomberg et al. (1994) and Suchman (1996).
7. For an example of new forms, see Wall and Mosher (1994).
8. These studies are too numerous to cite here, but many are referenced in the articles cited in footnote 9.
9. For discussion/debate on ethnographies of work in the interest of design, see Anderson (1994), Blomberg et al. (1993) and Hughes et al. (1993).
10. Recognizing the assignment of technology users to the position of "other" within system design makes available critical resources from recent anthropology and feminist research. See, for example, Clifford and Marcus (1986) and Watson-Verran (1993). For efforts to reflect on these relations where "we" are system designers and the "others" system users, see, for example, Clement (1993), Hales (1993) and Suchman (1994c).
11. In fact, many critical ethnographers reject the notion of ethnography as representation altogether, insofar as that implies some kind of correspondence between ethnographic accounts, read as authoritative texts, and the practices they recount. As an alternative, Stephen Tyler proposes the notion of "evocation" (Clifford and Marcus 1986:130). For the purposes of this article, however, I will retain the term "representation," using it just as a general term for artifacts intended to depict aspects of the social world for particular purposes.

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6 Straddling, Betting and Passing

The Configuration of User Involvement in Cross-Sectorial Innovation Projects

Torben Elgaard Jensen and Morten Krogh Petersen

INTRODUCTION: THE RISE OF USER INVOLVEMENT AND USER INVOLVEMENT CONTROVERSIES

It is difficult to find a point in history where users were not somehow involved in innovation. Innovators have always gained inspiration from observing users and interacting with them, and from being users themselves or from imagining future users (Woolgar 1990; Akrich 1995). Also, users have always responded actively to innovations. Unruly crowds of users have twisted, fitted, worked around and reappropriated any product encountered (Oudshoorn and Pinch 2003; von Hippel 2005). Thus, it is a historical constant that users have always been involved in innovation.

However, the *forms* of user involvement vary. Significant changes have taken place in this area, not least with respect to the methods and arrangements through which designers organise their interactions with users. Since the 1970s, and particularly in Western Europe and the US, there has been a growing rapprochement between, on the one hand, activists and social scientists taking an interest in design, and, on the other hand, technical and design experts taking an interest in user studies (Petersen 2013; Hyysalo et al. 2016). As a result, a series of methods and approaches has emerged aimed at connecting users, user knowledge and user creativity to design and innovation processes. Entire schools or traditions of user involvement can now be distinguished: user studies in science and technology studies (STS) (Oudshoorn and Pinch 2003), corporate ethnography (Cefkin 2010), living lab approaches (Ehn et al. 2014), participatory design (Ehn 1993; Asaro 2000), computer-supported collaborative work (Wainer and Barsottini 2007), design thinking (Brown 2009) and lead user studies (von Hippel 2005). Professionalised and systematic forms of user involvement in design and innovation have thus become a fairly widespread part of design and innovation activities. Contemporary R&D units, design firms and consultancies draw from a wide selection of user involvement methods. They probe user preferences through interviews, observation studies, user panels, usability testing and behavioural data tracking. Some designers even pursue more active forms of user involvement through such arrangements as joint designer-user workshops, idea competitions and eliciting feedback through prototypes or various types of online forums (Johnson 2007; Brown 2009; Elgaard Jensen 2013).

Given the force and the growth of professionalised user involvement, one might imagine that the purpose, organisation and outcome of such practices were relatively settled issues, but this does not seem to be the case. In fact, there are indications that controversies around user involvement are growing rather than diminishing as professionalisation is pushed forward. One such indication can be found in the work of Lucy Suchman, a pioneer and leading scholar of user involvement. Drawing on ethnomethodology, Suchman has repeatedly made a strong case for user studies and user involvement by arguing that technological systems become meaningful and workable only through users' continuous negotiation of system features and responses in relation to the immediate situation at hand (Suchman 1987). The situated actions of users are thus not only important, but also constitutive of the relevance, usefulness and meaningfulness of a socio-technical system. For this reason, Suchman advocates fine-grained ethnographic studies of users' situated actions and reasoning as an integral part of the design process (Suchman 1983, 1987; Suchman et al. 1999). Suchman's commitment to in-depth studies of users and their interactions with technology is, however, significantly tempered by a series of unintended effects that she has increasingly called attention to in some of her more recent work. In a paper published in 1995, Suchman suggests that user studies may *also* become a part of efforts to rationalise work, to transform it into objectified knowledge and to render users and user knowledge in a passive form, where it can be strategically manipulated by designers (Suchman 1995, 60). In this way, user studies may turn out to serve the interests of developing, deploying and selling new technologies which may not serve the interests of users. Suchman does not believe that such abuse of the humanist intentions of user studies is inevitable, nor that it will occur in every single case. But she does believe that the dilemmas are ubiquitous, which leads to the uncomfortable conclusion that user studies have no intrinsic, fail-safe or stabilised meaning. Another source of concern is institutional embedding of user studies. Much of Suchman's work has taken place within the Xerox Corporation, and large technology corporations have indeed been some of the frontrunners in adopting ethnographically informed user studies (Cefkin 2010). However, despite the willingness of these corporations to engage with user studies, Suchman argues that these institutions, at the end of the day, seem quite immovable in their persistent pursuit of profit and managerial control (Suchman 2003). User studies may thus easily become subordinated to these motives. As a final element to Suchman's reflections on the ambivalences of user involvement, she has recently expressed concern that the discipline of anthropology has increasingly appeared to become a "brand" which is being "consumed" by the communication strategists of corporate firms. The employment of "exotic" anthropologists may be used to signal corporate willingness and ability to get closer to users to design unique user experiences. This is, Suchman argues, a way of territorialising "the other" (Suchman 2007).

The various concerns raised by Suchman indicate the ambivalence and controversy surrounding user studies and user involvement activities.[1] This situation resonates with that outlined in the introduction to this volume, which describes the current landscape of user involvement as characterised by an "uncomfortable status quo" (Hyysalo et al. 2016). On the one hand, users have come to the fore, their creativity is increasingly recognised and the stock of methods for articulating their ideas and relating them to design has grown immensely. On the other hand, there have been considerable efforts to turn user involvement and the increased visibility of users into objects of industrial manipulation and strategising. So, while the stock of user involvement methods has grown and their utilisation has become widespread, it is also increasingly realised that user involvement is not an innocent, uncontested, or fail-safe activity. When users and designers meet, it is therefore common to find a variety of hopes and fears. There are hopes of creating better technologies and products, there are political aspirations of "democratising" or broadening the influence on technology, and there are concerns that some sort of exploitation or betrayal will take place. There is, in other words, an open game of defining and configuring user involvement activities. What is and what should be their purpose? What is and what should be their outcomes? The agenda for this volume, as outlined in the introduction, is to provide an "updated account of the current scene of user involvement" and to investigate some of the "meeting grounds" on which "hopes of democratized technology" encounter "creative capitalism" (Hyysalo et al. 2016). Following this agenda, this chapter focuses on one particular meeting ground: a number of government-sponsored, user-involving innovation projects. On this particular meeting ground, we explore how participants engage the practical challenges of conducting an innovation project and how they create a particular configuration of user involvement.

PROJECTS AS A TYPE OF MEETING GROUND

The user-involving innovation projects that we explore in this chapter came into being as part of the Danish government's general policy to increase national competitiveness in a globalised world (Pedersen 2011). In 2007, the government established a €55 million funding programme for what it termed "user-driven innovation" (Elgaard Jensen 2012, 16–18). In the subsequent three years, the programme sponsored more than 100 projects, creating an unprecedented burst of activity and collaboration around user involvement in Denmark. The primary empirical material for this chapter consists of qualitative studies of eight of these projects. (The projects are described in more detail later in this chapter.)

Like many other occasions before and after, the sponsored projects created meetings between users and designers. However, to characterise the peculiarity of innovation projects as a meeting ground, we will point out two conditions that set this arena apart from many other meeting grounds in the contemporary landscape of user involvement.

First, the very idea of a project implies a *limit on time*. The majority of projects had a duration of two years. This duration was marked and framed in a strict and formalised way. As part of the application process, project partners were required to write a project plan that defined the purpose and phases of each project. Near the end of the project, they were required to account for their activities and results in the format of a written report. User involvement under these time conditions can be distinguished from open-ended arrangements. Examples of the latter include the gradually evolving community effort to provide a permanent wireless service in Leiden (Verhaegh et al. 2016), or the ongoing efforts of software vendors to fine-tune their products and users (Pollock et al. 2016).

The second distinguishing feature of projects as meeting grounds between designers and users concerns the scope of the project partners. The government's funding programme can be described as a sort of forced networking exercise. Applicants were required to assemble consortiums that included both "knowledge institutions" (often universities) as well as partners from either the private sector or public organisations (Pingel 2007). The funding strategy was thus similar to the Mode 2-inspired approach (Gibbons et al. 1994), which is currently practised by many national and international funding bodies, such as the European Horizon 2020 programme (European Commission 2014).

In the case of the user-driven innovation programme, the government very specifically encouraged social scientists, especially anthropologists and sociologists, to team up with technical experts and commercial partners. With these requirements, the projects generated meetings between partners with different backgrounds and potentially different approaches and stakes in the issues (Elgaard Jensen 2012). The resulting cross-sectorial project consortia thus created stronger demands on the integration of differences than, for instance, peer communities that thrive on finding like-minded participants (von Hippel 2005), or private sector projects that attempt to keep development efforts secret and "in-house" (Elgaard Jensen 2013).

The stream of cross-sectorial projects is only one among several types of meeting ground in the current landscape of user involvement. In Denmark, the projects became highly visible for some years, due to the relatively generous funding, strong political support, a substantial communication effort and a large number of participants. However, the relevance of the externally funded innovation project as a type of meeting ground is arguably broader than that observed in the Danish cases, since both national and international innovation policies frequently make use of project funding as an instrument.

Projects are not only sizeable patches in the landscape of user involvement, they are also fascinating empirical sites. The *combination* of limited time and cross-sectorial participation tends to create a high degree of intensity and articulation. Project partners are required to come together, negotiate, get things done, finish on time and explain themselves to the funding body (and other stakeholders) after project completion. This brings differences and pragmatic solutions to the fore. Exploration of projects is, in our experience, therefore a rich empirical opportunity to get a sense of the challenges, ambivalences and controversies of contemporary user involvement.

METHODS, DATA AND ANALYTICAL APPROACH

As mentioned above, the Danish user-driven innovation programme specifically invited social scientists to participate, and since we have worked with both user studies and STS, we have taken an interest in the programme since its beginning in 2007. With a group of colleagues, we applied for funding within the programme, which was granted in late 2010. From that time onward, we became members of a research alliance[2] and responsible for a work package aimed at mapping how previous projects within the programme had approached and conducted user involvement.

To begin our exploration, we collected and read all the available policy papers and background reports. This material included the arguments and analyses that led to the political decision to launch the programme (Rosted 2003; Høgenhaven 2005; Jørgensen et al. 2005; Riis 2005; Rosted 2005). It also includes communications to potential applicants about the requirements and criteria for funding (Research and Innovation Agency 2006; Pingel 2007).

A second data collection effort was directed at the projects. At the beginning of our data collection, in 2011, a large number of projects had already been initiated, and we therefore had the opportunity to interview project participants, to read their reports and, on some occasions, even to visit projects in operation. This chapter draws on qualitative studies of the eight projects for which we gained the most comprehensive knowledge. The details of the projects and the kinds of empirical material gathered from them are listed in the materials section at the end of this chapter. To give our readers an initial sense of these projects, we list the objects that the projects attempted to develop or design as follows: a platform for online grocery shopping (Project 1), the architecture for an outpatient clinic (Project 2), systems for collecting organic waste for a bioethanol plant (Project 3), collaborative procedures for sub-contractors on doors (Project 4), bathrooms suitable for elderly and physically disabled people in nursing homes (Project 5), systems for waste recycling (Project 6), new indoor climate solutions (Project 7) and novel usages of textile materials in hospitals (Project 8).

Our empirical material allows us to investigate the programme and the projects in various ways. In the first round of analysis, we trace what may be called the broader discursive landscape in which the programme and the sponsored projects operated. We examine the hopes and fears invoked directly or indirectly in the policy papers. The purpose of this examination is to establish an initial sense of the agendas that participants may have brought to project meeting grounds. In the second and more elaborate part of our analysis, we investigate the projects as a meeting ground by focusing on the pragmatic challenges that arose in the course of running the projects. In this analysis, we draw extensively on our interviews, observations and collected documents, and we propose a model of the typical sequence of pragmatic challenges that must be handled in a user-involving project. By attending to the pragmatic challenges of the projects, we attempt to tease out the dilemmas, tensions and challenges that arise around user involvement on this specific meeting ground. Then, in our discussion and conclusion section, we emphasise key differences to other types of meeting grounds, and we point out three defining characteristics of the kind of user involvement that takes place in externally funded innovation projects.

THE DISCURSIVE LANDSCAPE: THE HOPES AND FEARS OF USER INVOLVEMENT

In the policy papers related to the user-driven innovation programme, there is a striking difference between the notions of user involvement that emanate from the two different ministries involved the programme: the Ministry of Industrial and Business Affairs and the Ministry of Science and Innovation.

The Ministry of Industrial and Business Affairs played a key role in preparing the political decision, and it was therefore first to formulate its notion of user involvement. From 2003 onward, this ministry produced a series of reports (Rosted 2003; Høgenhaven 2005; Jørgensen et al. 2005; Riis 2005; Rosted 2005) that defined user involvement as a specific strategy for increasing national competitiveness (Moltesen and Dahlerup 2007; Pedersen 2011). The line of argument was as follows: in a globalised world, nations traditionally compete on either costs (i.e. low wages) or development of significant new technology. Wage competition requires a willingness to accept a low living standard for large segments of the population. Technology competition requires very large investments. Neither of these strategies is particularly easy or appropriate for a small country like Denmark. As an alternative, the ministry argues, Denmark might compete on user knowledge. To do this, Denmark should learn from successful industrial clusters and large corporations that employ anthropologists and other social scientists for the purpose of uncovering the needs of users, including their unacknowledged needs (Rosted 2005). The message and the imagery from the Ministry of Industrial and Business Affairs is clear: user involvement is associated with the hope of gaining competitive advantage and with the fear of losing out in global competition. In more practical terms, the ministry suggests an approach to user involvement which deploys social scientists as investigative experts (cf. Sunderland and Denny 2007). That is, social scientists should go out and study users, and should bring back information about users' acknowledged and unacknowledged needs to the designers and developers.

The *other* ministry involved in the programme, the Ministry of Science and Innovation, published its policy papers slightly later. This ministry played a somewhat smaller role, since it administered only thirty percent of the total funding. In its key policy paper, the Ministry of Science and Innovation evokes an image of users as active participants in design, rather than passive objects of anthropological study. The ministry makes explicit references to the Scandinavian tradition of participatory design, and it suggests that dialogue between developers and users is a *necessity* in the contemporary world: "Innovation must include an open exploration and dialogue about new opportunities between key actors in the development organization and future users" (Agency of Research and Innovation 2006, 7). Further, the policy paper depicts user participation as a democratic endeavour: "Being a democratic approach, user-driven innovation is both an overarching value and a crucial and efficient method" (ibid: 7). The notion of user involvement articulated by the Ministry of Science and Innovation is thus couched in a different set of hopes and fears. User involvement is here associated with the hope of a more democratic approach to design, and indirectly associated with the fear that the interests of users may be thwarted if commercial actors become too controlling of the process.

There is, however, also a good deal of common ground between the two ministries. They both declare confidence that user involvement will work as a method for developing new products and services, and, as a result, become a contribution to national competitiveness. The Ministry of Science and Innovation calls it "a crucial and efficient method" (Agency of Research and Innovation 2006, 7), and the Ministry of Industrial and Business Affairs describes it as "one of the most important keys to increased competitiveness for many Danish firms" (Rosted 2005, 28).

The policy papers from the two ministries provide a number of opportunities to justify or criticise user involvement activities (cf. Boltanski and Thévenot 2006). Presumably, a project can be justified as a contribution to either competitiveness or democratisation—or perhaps to both. It is also imaginable that a project could be criticised for exploiting users by taking advantage of their unacknowledged needs; or to the contrary, a project could be criticised for wasting time and money by presuming that user involvement activities are a (democratic) goal in themselves. In rhetorical games of this kind, one could also imagine other sources and previous controversies about user involvement being evoked to assess what specific projects achieve or do not achieve.[3]

The purpose of this chapter, however, is not to speculate excessively, but rather to examine more closely what took place at the meeting ground of the projects. For this reason, we note at this point that the funding programme created opportunities for financial support, as well as particular discursive resources and ideals. In the remainder of this chapter, we focus on the actors in the projects and explore how they managed and accounted for the more operational challenges of user involvement.

HOPES, FEARS AND PRAGMATISM AT THE PROJECT LEVEL

Although the user involvement projects in the Danish programme were all different, it is still possible to point to certain conditions and requirements that created a common set of practical challenges that had to be handled in each project.

As mentioned, it is important to emphasise the almost banal fact that the user involvement activities were organised as *projects*. Projects are, by definition, limited in time: they begin and they end. At the beginning, the project partners must produce a project description for their application. At a bare minimum, they must define a particular *problem* or *topic* that the users are involved in or related to. At the end of the project, the partners must deliver *something* that has come out of user involvement.

As we have also mentioned, the programme administrators required the participants to work *across sectors*. To receive funding, universities had to collaborate with private companies and/or public organisations such as hospitals and municipalities (Pingel 2007). Often, consultancies with social science competencies were also involved. The typical division of labour would be that the companies and/or organisations delivered the topic to be worked on, while the university partners and/or the consultancies delivered the social science expertise to study and involve users (Petersen 2013).

This division of labour and the limited time and resources within which the projects needed to be carried out and completed also entailed a particular *sequential division of attention*. We illustrate this process with Project 1, which aimed at developing a concept for online grocery shopping. The project was headed by a consulting firm, The Copenhagen Institute for Future Studies, which brought together a small web design bureau, a large supermarket chain and a group of ethnologists from the University of Copenhagen (Project 1, project application). Before beginning and before even applying for the project, the consulting firm carried out a simplification. The project could not possibly take its point of departure in all the supermarket chain's internal organisational politics, technical uncertainties and more or less developed ideas and agendas related to how it would interact with its customers online in the future. The topic had to be much simpler, and the consulting firm therefore decided to ask: how should we design an online trade platform for grocery shopping? By asking this particular question, it was assumed that the supermarket chain would, in fact, decide to develop a platform. Further, and maybe more importantly, it was assumed that all technical issues would in fact be solved. So, to get off the ground, the partners needed to impose strict limitations on the attention devoted to organisational and technical complexity. With this simplification in place, the ethnologists could begin collecting information on a broad variety of users, their families and their shopping practices. At this stage, the complexity of the knowledge on users grew rapidly—photographs, observation notes and interview transcripts poured in. Later, toward the middle of the project, the ethnologists stopped collecting material from the families and devoted their attention to the analysis and organisation of this material. The ethnologists were now engaged in the task of bringing their complex material into a simpler form that could be handed over to the other partners in the project. The handover of the material was the first of several events in which relatively simplified and condensed material was handed over to other partners. At the end of the project, the ethnologists' material (along with other materials) was communicated and passed on to a number of "receivers" at a closing conference. The receivers included the project's supermarket partner, as well as representatives from other supermarket chains and consumer organisations. At this time, the relatively simplified understanding of the users would be brought into contact with people embedded in organisations animated by complex technical and organisational issues.

The account of the supermarket project is sketchy, but we hope to convey the series of tasks that were common to all the user involvement projects carried out with support from the policy programme: (1) technical complexity must somehow be reduced to define and initiate the project; (2) complexity in the understanding of the users must somehow be increased as the project commences; (3) user complexity must somehow be reduced as the project draws to a close; (4) finally, a form of transmission or reconnection must ideally take place between the achieved understanding of users and the current organisational and technical complexities of the participating organisations and other interested parties. The fourth task of "reconnecting" was, strictly speaking, beyond the scope of the projects, because these government-sponsored projects were not permitted to develop marketable products for private companies, as this would eschew competition.

Figure 6.1 illustrates the common tasks before, during and after user involvement projects. The two curves indicate how technical issues and user issues must be complexified and simplified at various stages. The frame in the middle of the figure indicates the meeting ground of the project, with the entry point of the project description (small rectangle to the left) and the exit point of the final report (small rectangle to the right).

We now draw on our empirical material from all eight projects to elaborate on these common phases and tasks. In this way, we develop an account of how the project partners, in practice, managed to involve users, thereby creating a specific type of meeting ground for designers and users.

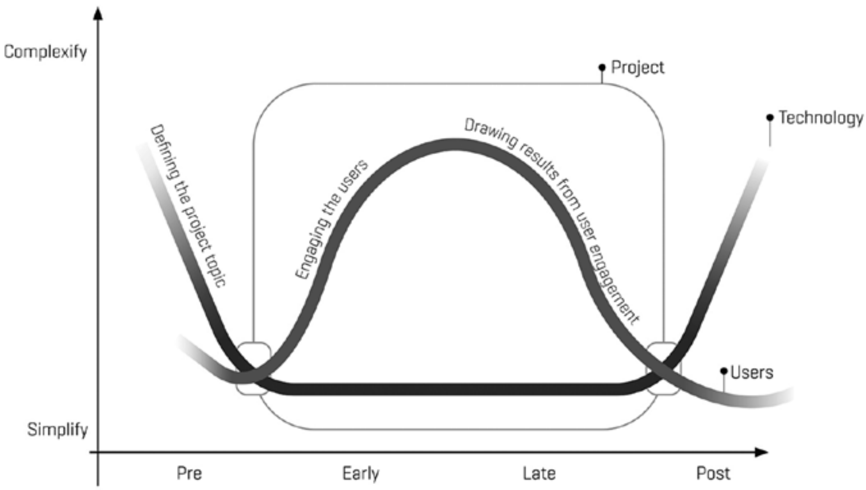

Figure 6.1 Pragmatic challenges of a user-involving project.

(1) Simplification of Technical, Organisational and Contextual Matters

There is no end to the list of things left out of the projects by the partners from public or private organisations. It therefore makes no sense to try to account for the entire world outside the projects. However, if we focus on the project descriptions and on the accounts of the initial phases given to us by the partners in interviews, we can get a sense of some of the types of simplifications that the projects deployed.

In several projects, there were simplified projections about the progress of technical matters. One project involved users in the design of an outpatient clinic. This clinic, it was assumed, would be located in a future time where all the current information technology problems of the hospital had been solved (Project 2, interview). Another project involved users in developing ideas and actual means for the collection of organic waste for a bioethanol plant. It was assumed that the necessary enzymes for the plant would be developed and that the plant would be built (Project 3, interview).

A second type of simplifying assumption concerned organisational decisions and processes. Except for one project, in which the university partner defined its own task as orchestrating the collaboration pattern between the companies involved (Project 4), the projects all assumed that the management of the participating organisations would maintain interest in and uphold their support for the topics addressed in the projects. It was also a common assumption that the projects would be able to survive amidst other projects that might be fighting for resources and attention in the organisations. And finally, all of the user-involving projects implicitly assumed that user involvement would not affect the projects negatively, for example, by making the project topics more contested, cumbersome or raising, as one of our respondents from a consultancy put it, "great societal questions" (Project 5, interview) which the companies involved had little interest in discussing.

A third type of simplification, seen in many projects, concerns the market or the social context in which the results of the projects would eventually find their place. In the project focusing on the design of bathrooms, it was assumed that the elderly population would welcome self-help technologies (Project 5). In the project concerned with collection of organic waste for the production of bioethanol, it was assumed that everyone would want their own regions to become more environmentally friendly and that they would therefore support a projected bioethanol plant (Project 3).

All these assumptions, whether technical, organisational or contextual in nature, could be challenged or complexified. But the point remains that *some* kind of simplification must necessarily take place. If not, there would be no focus, no delimited object to work on and hence no user-involving project at all.

(2) Complexifying User Understanding

Once the project topics had been defined, delineated and accepted by the funding administrators, the project partners launched a series of activities that would quickly complexify user understanding. All the projects we examined drew on several methods to study or involve users: interviews were conducted and transcribed, homes and workplaces of users were visited, observation notes were written and photographs and videos were taken. User workshops left all sorts of traces, from post-it notes to video recordings. In every project, the empirical material quickly accumulated. One participant, a social science researcher, described the great challenge of interpreting "hundreds of pages of observation notes" (Project 8, interview); another, a consultant, simply described this phase as being "covered in data" (Project 3, interview).

But the sheer quantity of the material was only one aspect of the complexity reported by the partners. In several projects, the partners realised that a broader scope of users would be relevant to the problem at hand. One project, concerned with designing and implementing new waste handling practices in a residential area, developed a novel recycling solution for a nearby shopping centre (Project 6). It turned out that not only customers and shopkeepers played a role, but also the caretaker of the centre (Project 6, interview).

Not only more users, but also more materiality complicated each scenario. The partners often became aware of troublesome infrastructures when they began to explore users' everyday lives and possible relations to new arrangements. For instance, in the project on collecting waste for a regional bioethanol plant, it turned out that the renovation company strongly opposed a new dustbin because it fitted badly with existing bins and hence could cause obstacles to daily operations (Project 3, interview).

The users' established practices and identities also frequently came into view as a troublesome "infrastructure" that had to be taken into account. In the project that sought to develop a new bathroom design for elderly and disabled citizens living in nursing homes, several of the citizens and care professionals characterised the new prototype as "monstrous" (Project 5, interview). In this way, they called attention to a distinct incompatibility between the new bathroom and their existing identities and practices as citizens and caretakers. Such statements of challenged identities and practices were, of course, also noted by the project partners and added to the list of complexities.

(3) Simplifying User Complexity

At a certain point, any user-driven innovation project must begin to simplify the information it has gathered about the users. The process of simplification is usually mentioned at some point in the project descriptions, but often in very general terms, such as "translate user insights into new concepts [. . .] and business opportunities" (Project 8, project description), "clarify the structure of the users' practices and their needs" (Project 1, project description) or simply "analyse the material" (Project 6, project description). We do not know whether the project partners had more elaborate but implicit simplification strategies from the beginning, whether they invariably drew on the standard simplification approaches from their professional fields or whether they invented new simplification strategies in the course of the project. What we do know, however, is that the work of simplification becomes clearly visible if we turn our attention to the finishing phases of the projects. At this stage, we see the appearance of distinct objects, such as a cardboard box scale model of an outpatient clinic (Project 2), a video of two subjects acting out a use scenario with a cardboard mock-up of a machine (Project 6) or a seven-point list of concepts that summarises the concerns or "rationalities" deployed by users as they shop for groceries (Project 1). All of these physical, visual or textual objects, and many more, resulted from transforming complex material from earlier stages into a simpler form.[4] These simpler objects were all intended to play some role in the communication between the effort to understand users and the effort to develop design. We suggest that two basic types of role can be distinguished, depending on whether the simplified objects attempted to communicate facts about the users or proposals for design.

In some cases, the simplified objects were clearly produced for the purpose of *describing the users*. The conceptual description of user rationalities in the supermarket project is one clear example. The listing of seven rationalities, which can be used to analyse and explain why different people shop differently, was the final result of a very long process of finding and establishing the informants' patterns of reasoning in the material (Project 1, interview and report). Other projects used the format of personas (Madsen and Nielsen 2010) to turn their material into a brief form that could be passed on to designers as an authoritative description of the users (Project 4, documents produced by the project). An interesting variation of describing the users occurred in one project: here, the designers from the partnering companies were invited to take part in the analysis of the empirical material gathered from and with users. The purpose of this exercise was to "install" the description of the users directly into the designers' minds. The simplification, in this case, would be the experiences and memories that the designers would carry with them from the workshop (Project 7, interview).

A second breed of simplified objects aimed at *describing possible designs*. One project collected a large amount of material from field studies at Danish hospitals (Project 8). Later, this material was used to produce a catalogue of about ten design ideas (Project 8, catalogue of ideas). A second project conducted a several-hour-long simulation game of the procedures in an outpatient clinic within different and possible future architectural layouts. In collaboration with the researchers and consultants involved, the game participants produced one layout proposal, which was forwarded to hospital management (Project 2, observations of simulation game and interview). Several projects arranged some form of design workshop in which users and representatives from the participating organisations collaborated (best elaborated in Projects 1, 6 and 7). These workshops often resulted in mock-up solutions in physical materials or, as described above, in photographs or videos of users rehearsing possible use scenarios at the workshop or in the field.

The transformation of elaborate material into simpler descriptions of users or possible designs should not be thought of as a perfect condensation process (cf. Law 1997). An ideal image of this sort would grossly misrepresent the pragmatic task of completing a project. The project partners (often the social scientists) must process large amounts of materials with the obvious risk of missing something that might be valuable from their own perspective or from the perspective of others. To manage this challenge, it is not surprising that the participants drew on the standard formats of their professions and institutions (cf. Hyysalo 2006, 2010). We thus observed ethnologists deliver conceptual structures (Project 1), engineers deliver drawings (Project 8) and researchers from a design school deliver videos, photographs and 3D objects suitable for exhibits (Project 6) (Elgaard Jensen 2012). To the social science professionals, these formats are often very meaningful and are clearly the best available options. However, within the time frame of the projects, it was rarely possible to get a full sense of how well the chosen formats would bridge the complexities of user engagement and the complexities of other professions, such as designers and managers, who would receive the packaged results of the projects.

Deployment of standard formats was one important simplification strategy. But a substantial part of the movement toward simplification also consisted of simply ignoring material which the partners deemed irrelevant, uninteresting or impossible to fit in. In some cases, the involvement of users engendered objections and obstacles impossible to reconcile with the overall aims of the projects (Petersen and Munk 2013). In such cases, several projects maintained that the design ideas should be pursued, despite resistance from some users. As mentioned above, one project proposed a new bathroom design meant to enable elderly or disabled citizens to take care of their own personal hygiene more independently despite the criticisms against such a solution voiced by some users and care professionals (Project 5, interview). Another example comes from the project that attempted to develop waste collection systems for a bioethanol plant. In this case, the consultancy involved continued to advocate the vision of an environmentally friendly waste collection system despite considerable scepticism from a number of the expected users (Project 3, interview).

In sum, the projects arrived at simplification through deployment of standard formats as well as through more direct screening out of matters deemed irrelevant. In each case, pragmatic choices were made with regard to focus, content and the format into which the material was rendered. Other choices could have been made, but some kind of choices had to be made to finish the projects in a meaningful way with the time and resources at hand.

DISCUSSION: THREE CHARACTERISTICS OF A MEETING GROUND

We began this chapter by noting the ambivalent character of user involvement. User involvement activities have grown since the 1970s and are now considered stock-in-trade for many designers and innovators. However, during the same period, concerns about user involvement have also emerged: will a detailed understanding of user practices simply fuel efforts to rationalise and manipulate users? Is the use of "exotic" anthropologists merely a part of companies' communication strategies?

In observing the Danish user-driven innovation programme, we note that the broader concerns resonate with specific ideas about user involvement articulated in government policy papers. In these texts, users are cast in different roles ranging from relatively passive objects of anthropological examination to active and competent participants in a democratic development of technology. The government-supported projects may thus be seen as a meeting ground for these different notions and configurations of user involvement. Our qualitative studies of the projects show, however, that "meetings" do not mean a clear choice between *either* democratisation *or* exploitation. It would, in fact, be quite misleading to imagine that each of the projects stands at some sort of crossroads. This point can be illustrated by another look at the project on online grocery shopping. In this project, the participants from the supermarket chain came to the project with the view that their customers should be seen as individuals who could be divided into a number of segments. The participating ethnologists successfully challenged this thinking by arguing that moments of purchase in the supermarket should be understood as part of a broader set of meal practices. These practices involve planning, shopping and cooking, and they relate to households rather than to individuals (Damsholt and Jespersen, 2014). Under this broader social view, the ethnologists gave voice to important cultural practices which could be interpreted as a contribution to "democratisation" in the sense that users' social lives and practices were now recognised and taken into account. At the same time, it would be naïve to think that the supermarket chain would not use its new and more nuanced understanding of the users to increase sales, if that opportunity should arise. In that sense, the project could also be seen as step toward exploitation.

Our suggestion is therefore that the government-supported cross-sectorial project *is* a site where the hopes and fears of democratisation and exploitation meet, but is it *not* a site where these notions of user involvement become disentangled and where a choice between them is made. The projects operate in an uncomfortable status quo (Thrift 2006). We take this *straddling approach* to be the first characteristic feature of this particular meeting ground.

The second key characteristic is the projects' general approach to the particular technological objects that they are concerned with. We refer to this approach as a *betting approach*. To make our point, it is useful to draw a contrast to community innovation efforts where an evolving group of users engage in an extended process of tinkering and bricolage (de Laet and Mol 2000; Verhaegh et al. 2016). In such processes, there are neither fixed limits on time and resources and the types of technical elements included, nor on the types of usage that can be brought into the process. The socio-material arrangement may be described as fluid (Law and Mol 2001). In contrast, we described above how the projects come into being only if and when they impose limits on fluidity. The projects must make simplified assumptions about the technological, organisational and contextual elements that their engagement with users will relate to. In Actor–Network Theory terms, the project managers formulate particular actor-worlds (Callon 1986a), or problematisations (Callon 1986b), by assuming that particular elements will come to play particular roles. The projects are thus betting that certain conditions will hold and that particular conditions will be realised at an expected time in the future. These bets are more or less risky. In certain cases, they may be entirely wrong, which will render the user involvement activity rather meaningless. One blatant example is the bioethanol project, which was based on the assumption that the partnering company would develop a particular type of enzyme and that a factory would be built. Neither the enzymes nor the factory materialised, as the market conditions for such enzymes changed during the project period (Project 3, interview).

In more fortunate cases, the projects bet on assumptions that are indeed supported by the partnering organisations and other actors (e.g. Project 6, interview). A bet may seem doubtful at first, but may gradually pay off or become true. One project assumed that elderly and disabled people would want particular designs that enable them to live their lives more independently from care professionals (Project 5, report on the topic and approach of the project). This assumption turned out not to be entirely true. But if the project developed a bathroom design that would interest some users to some degree, then it might be possible to interest even more users if the self-help bathroom solution were made a part of nursing home organisation, where the needs for social interaction and assistance were taken care of through other arrangements and activities.

Although the betting approach is crucial to projects, there is no absolute contrast to the fluidity of other arrangements. In practice, innovation projects are not entirely fixed on their bets, as they often allow their initial simplifications to be slightly adjusted along the way. At the same time, community efforts—despite their inherent fluidity—must depend on some small measure of fixed, initial assumptions about what can be achieved. The overall tendency is nevertheless clear. The involvement of users in innovation projects is invested in and with particular bets. Projects therefore do not aim at a continual adjustment of their assumptions, but rather at exploring the effects of carrying through a particular user-involving experiment and the bets entailed. The explorative and innovative ethos of the betting approach was aptly expressed in a text written by one of the participants in Project 6: "The modus operandi is the playful: "What happens if we do it this way . . . ?" The experimental "what if . . . ?" entails great learning potential, but it is inherently difficult to predict the value of its outcome (and if we knew, there would be no reason to try it out)" (Halse 2010, 18). To conceptualise and run a project it is therefore necessary to make a bet, to create potential for learning and to accept the risk that the value may never materialise.

The third and final characteristic feature of the projects is the type of relations they establish with users. We use the term *passing* to denote this feature. Accounts of other types of meeting grounds between users and designers emphasise the significant positive effects generated when users take possession of new technologies and gradually improve their workings (Rosenberg 1979; Hyysalo 2006; Nielsen 2016; Verhaegh et al. 2016). With this learning-by-using effect in mind, the innovation projects appear to be severely truncated. Because the projects were supported by a government funding programme, they were not permitted to develop marketable products, only "concepts" or "ideas". But the sense of truncation was also organisational: as soon as the projects ended, the participants in the cross-sectorial projects dispersed and returned to their work organisations.

Despite these observations, it would be too hasty to conclude that the projects created no important relations for users. The relations were merely of a different kind. In our description of the projects, we depict the work that was carried out to complexify the notion of users and later to render this material into a simplified form that could be communicated and passed on at project completion. In this work, some sort of event, reflection or practice associated with users was translated into forms which could be received by other practitioners at a later time and at a different location. The temporary (passing) engagements of users in the projects were thus used to create a transfer (passing) of objects into the hands of designers, managers and other decisions-makers. It is thus possible to see the numerous projects in the user-driven innovation programme as an extended experiment in turning passing engagements into passing objects. Project partners asked themselves: how can I turn my forty-five-minute interview with a user into something that would interest the decision-makers in the municipality? Or, how may I turn the pile of photographs that I have taken during my one-day visit to a hospital ward into something that would interest designers at a company that produces textiles for hospitals?

The questions asked and the answers given were unique to each project. Different users were engaged in different situations, and different designers and managers were to receive the packaged outcomes of the projects. A key resource for enabling and creating this passing was the deployment of the standard formats of simplification that the social science professionals would bring to the project. The necessary simplifications could not have been achieved if vast and wide-ranging textual and visual materials had not been translated into personas, conceptual structures, design sketches, demonstrations or some other convenient formats. The creation of objects that could be passed on was thus the outcome of all the creative, professional and pragmatic work in the projects, which identified users, engaged them, generated data and rendered these data in a persuasive form and format (cf. Latour 1986). To achieve the final passing effect, the handing over of objects was accompanied by the types of activities usually known as communication and dissemination: end-of-project conferences, publications, media appearances and meetings with selected stakeholders.

The objects created by the projects were thus like signals, messages or packages sent toward designers, managers and policy decision-makers with the aim of persuading them to take a particular description of users into account, or to pursue particular ideas for possible designs. *This* is the type of user relations created by the projects. However, since project time and resources were limited, the acts of passing objects onto others also took on the character of an uncertain bet. When the projects ended, it was not known whether the objects emanating from the projects would be passed on, or whether they would pass away.

CONCLUSION

In this chapter, we argue that the growing commitment to user involvement in innovation and design comes with a growing concern about these activities. Commentators now express deep fears of user exploitation as well as high hopes of democratisation. The tensions between possible exploitation and democratisation are played out on a variety of different "meeting grounds", where users may encounter designers and other stakeholders in the development of new technologies and services. We examine the specific type of meeting ground created when funding bodies support user-involving innovation projects, involving partners from several different sectors (e.g. universities, private companies and public institutions). These projects, we argue, involve users on different terms than, for instance, the continual R&D activities of corporations or the community innovation efforts of private groups of citizens.

Based on our study of the Danish funding programme for user-driven innovation, we indicate three particular characteristics of state-supported projects as a meeting ground: (1) the projects operate with a *straddling* approach rather than a final choice between hopes of democratization and fears of user exploitation; (2) the projects follow a *betting* approach in the sense that their user involvement is premised on a series of simplifying assumptions or bets on the present and future states of technology, organisation and context; (3) the projects generate a *passing* relationship with and from the users: a temporary—passing—engagement with users is translated into textual and physical objects, which are then passed on to designers, managers and other decision-makers.

The reconfiguring of users that takes place in projects—their involvement around particular bets and the passing relations created between them and others—is a noticeable feature in the contemporary landscape of user involvement. It suggests a way of facilitating user involvement while straddling the issue of whether user involvement is a step toward technological democratization or a tool of creative capitalism.

NOTES

1. Another important indication of this ambivalence can be derived from the so-called biographical approach to user studies in STS. Through longitudinal studies, these authors have exposed the extraordinary difficulties of holding on to user perspectives in the course of extended and distributed technical development activities (Pollock et al., this volume; Hyysalo 2010).
2. The TempoS research alliance included participants from Aalborg University Copenhagen, the Technical University of Denmark, the University of Copenhagen and the Danish Design School (Jørgensen 2010).
3. See Törpel et al. (2009) for a review of discussions related to participatory design, and Cefkin (2010) for a review of discussions related to business anthropology.
4. Our analysis of simplification is inspired by the version of actor–network theory developed in the 1980s. Based on case studies, actor-network theorists argue that power, knowledge and persuasiveness are material and practical accomplishments, which are often achieved by translating relatively disordered material into material forms that are more durable and mobile (Callon 1986a, 1986b, Latour 1986, 1987, Law 1997).

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Empirical Materials of the Projects Analysed:

Project 1: Internet Grocery Shopping

Materials Include:

- Project application
- Detailed project plan
- Report on the results and experiences of the ethnologists' work
- Article on an interview method developed within the project (Breddam and Jespersen 2010)
- Interview with the ethnologists involved, conducted 5 March 2010.

Project 2: Health Care Innovation Lab

Materials Include:

- Observation of a one-day best-practice workshop initiated by project partners
- Observation of two project meetings
- Two one-day observations of the practices of user involvement, in this case, a simulation game
- Interview with the project partners running the practices of user involvement
- Final report on project results and experiences
- A number of documents produced by the project, including fact sheets, newsletters and internal documents describing, analysing and assessing the practices of user involvement initiated by the project

Project 3: User-Driven Production of a Second-Generation Bioethanol Plant

Materials Include:

- Project application
- Interview with the consultancy that ran the practices of user involvement, conducted 2 February 2011
- Presentation of project results and experiences produced by the consultancy involved

- A number of documents produced by the consultancy involved in the project, including photographs documenting the work process of the consultancy, quotes from interviews conducted by the agency and a cartoon outlining the main steps of the project

Project 4: InnoDoor

Materials Include:

- Interview with researchers affiliated with the university partner involved, conducted 13 March 2012
- A number of documents produced by the project, including descriptions of its approach to user involvement, preliminary approaches and the final result of the project—a model for how to involve companies in user-driven innovation projects

Project 5: Bathrooms For All

Materials Include:

- Report on the topic and approach of the project
- Interview with the consultancy involved, conducted 7 February 2012
- Final report on project results and experiences

Project 6: Design-Anthropology Innovation Model

Materials Include:

- Project application
- Book published by the project (Binder et al. 2010)
- Interview with the designers initiating the practices of user involvement, conducted 8 February 2010.

Project 7: Indoor Climate and Quality of Life

Materials Include:

- Project application
- Two annual project status reports
- Interview with the academic partner running the user-involving activities, conducted 13 January 2012

Project 8: Textile Qualities

Materials Include:

- Project application
- Detailed project description
- Status report, 2010
- Interview with the academic partner running the user-involving activities, conducted 22 February 2010
- Catalogue of ideas produced by the academic partner

7 Generification as a Strategy

How Software Producers Configure Products, Manage User Communities and Segment Markets

Neil Pollock, Robin Williams and Luciana D'Adderio

INTRODUCTION

This chapter emerged from our dissatisfaction with the ways in which the design of information technology applications been conceptualised in early science and technology studies (STS) writings and in related work from what we might call "socially-oriented computer science" (for example, in fields like participatory design and computer-supported cooperative work). Here, critical accounts of "technocratic" approaches had emphasised the shortcomings of the traditional engineering viewpoint underpinning established systems design methods and their failure to understand the actual needs of the organisations that would adopt them—and particularly those of end users. We coined the term "design fallacy" (Stewart and Williams 2005) to capture how, across a range of writings, a heroic (or perhaps demonic) account of the role of designers in system design had emerged in which (these studies presumed):

> *designers inscribe particular views of the user, user activities and priorities into the artefact, but these are often "the wrong values", based on an inadequate or misleading view of the user and their requirements.*
>
> (Stewart and Williams 2005, 195)

This is exemplified by Woolgar (1991), who pointed to the ways in which design can "configure" the user insofar as "only certain forms of access/use are encouraged" (ibid: 89). In this process, Woolgar suggests, the diversity of actual or potential users of a new technology become submerged behind a monolithic singular conception of *The User.* Oudshoorn, Rommes and Stienstra (2004) similarly argue that specific users' needs may become overlooked—even where there are attempts to build systems around user needs. In their study of *Amsterdam Digital City*, a failure to attend to the particular needs of female users resulted in a system that was designed around the tacit preferences of (some) male users. They conclude that "configuring the user as everybody is an inadequate strategy to account for the diversity of users" (Oudshoorn et al. 2004, 54).

To overcome this, it was important to build systems around specific and detailed understandings of particular users and their purposes and practices within the organisation. In the case of workplace technologies, this might call for ethnographic studies of potential "end users" or direct user participation in design teams.

We argued against this rather episodic conception of design and the user, with its emphasis on one particular avenue and moment in which users could contribute to innovation by feeding in knowledge and experience to initial design. Our studies of workplace technologies had highlighted multiple points of interaction between developers and users over time. For example, Fleck's (1988) concept of "innofusion" had flagged the ways in which workplace artefacts were transformed in the struggle by suppliers and users to implement and make them useful. This yielded an evolutionary understanding of the innovation of ICT applications that pays attention to dispersed "social learning" (Sørensen 1996) processes over multiple cycles of technology design, implementation and use, in which user-inspired innovations, arising as artefacts, are implemented and used and may feed back into future design.

These considerations applied with particular pertinence to the development of "enterprise systems": complex IT applications that supported increasingly wide arrays of the activities of large firms and public organisations. In recent decades, these had overwhelmingly come to be supplied as generic packaged solutions. For example, all the FTSE 100 firms run packaged enterprise solutions supplied by the German software firm SAP which, with its main competitor Oracle, are the largest global software firms after Microsoft.

This situation stood in contrast to the traditional approach in STS and cognate disciplines, which—informed by the "localist turn"[1]—strenuously emphasised the *diversity* of organisational practices, and the consequent need for customised solutions based around the unique requirements of particular organisations and their members. So how was it possible for packaged solutions not just to survive, but to dominate the world of enterprise solutions? How can we explain this "seemingly impossible project" of developing standardised enterprise solutions?

We found very little STS literature on the design and development of these packaged solutions. Indeed, within the more specialised literature on information systems, on software engineering and on requirements analysis, discussion of the development of commercial off-the-shelf enterprise solutions was surprisingly rudimentary—it underplayed the complex challenges entailed in developing generic solutions. With very few exceptions, these accounts lagged far behind the sophistication of the industrial practices to address them that were revealed by the empirical study we discuss in this chapter. Thus, Regnell et al. (2001, 51) emphasised the autonomy of software developers and their ability to "invent", or at least decide about, requirements for packaged software offered "off the shelf" to a mass market. STS and information systems writings seem to reproduce a similarly "heroic" account of unilateral control exercised by system developers. They see in this process the power of enterprise system developers to impose inflexible standardised organisational practices upon adopters. Thus, Howcroft and Light (2006) describe the vendors' ability to "decide" which functions would be built into their products, depending on whether enough customers ask for them, as evidence of their "technical exercise of power" (a view that seems difficult to reconcile with the fact that it is the user organisation that chooses to adopt—and spend millions on—purchasing and implementing these packages).

The vast majority of empirical research into enterprise systems involves studies not of their design, however, but of their implementation. Researchers focused in upon organisation members as they struggled to adopt these complex suites of software and adapt their embedded functionality to the particularities of their own organisational practices. In the immediate aftermath of implementation, their experiences emphasised the inflexibility of the packages, the lack of fit between their embedded libraries of standard business processes and organisations' own particular methods of working. Packaged enterprise systems were portrayed as inappropriate solutions, requiring the user organisation either to embark upon expensive and risky customisation of the software or to adopt unwanted changes to meet the demands of the package. Drawing on these critical perceptions, a negative account of supplier capabilities and their products emerged that seems hard to reconcile with the continued and growing resort by user organisations to packaged solutions.

This chapter set out to explain how it was possible for vendors to produce packaged solutions that can bridge not only the heterogeneity of activities within organisations, but also the enormous differences between organisations within sectors. This was not achieved by the modernist dream of universal solutions that could cater to all organisational needs. Packaged "enterprise system" suppliers like SAP did "conquer the world". However, this was achieved one sector at a time. Thus, SAP moved from its base in manufacturing and chemical firms to financial and other private services and latterly to public services. Our empirical research focused upon two key stages in this process. We examine a young firm with a novel product to explore how solutions generated in particular organisational settings can be developed to meet the needs of larger numbers of organisations within that sector. We then examine how an established enterprise solution, developed in one sector, was extended to another sector. We describe a set of revealed strategies through which suppliers produce software that embodies characteristics common across many users, what we term *generification work*. One aspect of this process of generification is the configuring of users within "managed communities", but it also includes "smoothing" the contents of the package and, at times, reverting to "social authority". Our argument is that generic systems do exist but that they are brought into being through an intricately managed process, involving the broader extension of a particularised software application and, at the same time, the management of the user community attached to that solution.

Following this study, our investigations into packaged software have continued. Much of this work has been published in our book *Software and Organisations: The Biography of the Enterprise-Wide System—Or how SAP Conquered the World* (Pollock and Williams 2009). It may be helpful to point to some ways in which our understanding of the innovation process and the insertion of the user have further developed since this book was written.

First we extended our gaze from the implementation arena, that accounted for the vast bulk of studies, to also include settings of design, and then to other sites and moments in the product life cycle, for example, of procurement and of post-implementation support. Studies of the latter revealed the complex strategies by which the vendors of standard solutions sought to manage their relationships with their global customer base. To reduce the costs of providing technical support to over 30,000 customers worldwide, one major vendor had shifted support from regional support offices to a global network with three support centres providing 24/7 coverage round the world accessed via an online portal. This move also necessitated finding new ways to regulate the demands made by their customers and to demarcate between problems for which they or their customers would be responsible (Pollock and Williams 2009a). A specific substantive implication was that, if we wanted to understand how enterprise software could be provided as a standard solution, it was important to pay attention to the relationships between vendor and user across the whole product cycle—including development, implementation and post-implementation support—and indeed, across multiple product cycles. There was also a wider methodological implication. Our intellectual journey demonstrated the need to go beyond the single site studies that have been the mainstay of case studies in business schools and of ethnographically informed work in science and technology studies. It was not sufficient to restrict enquiry to particular settings and moments (e.g. of design or implementation). Instead, we pointed to the richer understandings that emerged through multi-local studies and for work, which extended the scope of enquiry longitudinally to explore what we have described as the Biography of Artefacts and Practices (Hyysalo 2010). This kind of investigation clearly poses particular challenges given the restricted scale and duration of typical research projects. Our deeper understanding emerged through bringing together findings from various externally funded projects as well as doctoral research. This extended purview implied changes in the organisation or research—which was, out of necessity, a *team task* or indeed, a collective achievement (Williams and Pollock 2012).

Second, and arising from insights across our research community, was the recognition that the project of supplying packaged enterprise solutions has to be understood as an on-going set of relationships between a supplier and “a community” of user organisations and specialists involved in their implementation and use (Koch 2003). Here, our attention has been drawn to the more or less permanent linkages established between vendors and their communities of customers, which are publicly and collectively organised in particular through user groups (Johnson et al. 2013, Mozaffar et al. 2016). These groups play a variety of roles, conditioned in particular by the strategies of vendors to manage these communities (for example, some vendors run user groups themselves; others allow them to operate more autonomously). Their roles may include, for example, orchestrating the uptake of periodic product upgrades—mobilising client expectations and concerting commitments. The user group emerges as a site for the accumulation and exchange of knowledge about the affordances of their supplier's (and other) offerings, and about bugs and possible fixes and about the scope for customisation and "workarounds". Through these processes, the user group becomes a potential site for innovation, by identifying opportunities for product enhancement. Later studies showed how this could be a resource not only for developers, but also, potentially, for third-party suppliers or even for user firms themselves to get involved in the provision of complementary products (Johnson et al. 2013).

But this "communitarian" view is by no means an open and egalitarian process. Not all users are equal. As we show in this chapter, vendors segmented their user base and gave their requirements differential attention depending on their strategic importance. Pollock and Hyysalo (2014) have explored the ways in which vendors carefully select "pilot sites" around which their products are developed that will be exemplary adopters, allowing them to demonstrate the value of their products to the market. By examining the strategies by which vendors managed their relationships with their user base—comparing and contrasting the case of enterprise systems and an online social network/game—we came to the view that the ways in which vendors characterise their user market were not so much collective representations of actual users as aggregates of how different user sub-sets appeared through the lens of the providers' commercial strategy market (Johnson et al. 2013). By segmenting the market (operationalising the idea that there were groups of users that were broadly similar or that could be treated as if they were similar), these user categorisations provided more manageable ways for developers to think about their services and how they could be supported and further developed.

This analytical journey leads us to a very different view of the user and innovation. From an initial STS view, which emphasised the autonomy of the designer/developer and their distance from and power over "the user", we arrive at a view of innovation as conditioned by a complex web that also included users and other players (Mackay et al. 2000). Our historical perspective provides further insights into how multiple cycles of product development and implementation are patterned by this increasingly intricate array of relationships between technology producers and users. And over longer timeframes, we can see how this social topology is itself being reshaped as producers elaborate their consumer engagement strategies—and as users become aware of the opportunities to gain more purchase over product evolution. In short—as this book makes clear—we find a world in which engagement and innovation are closely coupled.

NARRATIVE BIASES IN STS: LOCALISATION

The nature of software development has changed in the last thirty years (Friedman and Cornford 1989). Whereas user organisations once built or commissioned their own software, they now prefer to buy "commodified solutions". Initially, these were "low-level" software systems (such as operating systems, utilities and application tools), but increasingly, they are also the "higher level" organisational information systems (such as payroll, procurement and HR) and industry-specific systems such as those we are discussing (Brady et al. 1992; Quintas 1994; Pollock et al. 2003). From the point of view of scholars sensitive to organisational diversity, this move is highly implausible, since software packages like ERP encompass a wide range of organisational activities which, because of their intricacy, are likely to vary from one organisation to another (Fincham et al. 1994, 283). In contrast, and buoyed up by the seeming success of these systems, proponents argue that they can be adapted to work in most organisations within the same class and, in principle, across different classes of organisations. In explicating these arguments, scholars point to the similarities that exist between organisations, as well as to the "flexibility" of generic systems that allows them to be custom fitted to even the most idiosyncratic of settings (Davenport 2000). As a rejoinder to these "universalistic" presumptions, a large body of fine-grained empirical research has pointed to the difficulties adopters have with implementing them, as well as the large levels of unwanted organisational change they require—standardised systems may thus bring risks and unanticipated costs. The aim of much of this research has been to demonstrate that getting these systems to work is an "accomplishment", an active process whereby users reconcile the gulf between system and actual work practices (McLaughlin et al. 1999).[2] If they can transfer between settings, it is only as a result of this major localised effort; they work because they have been redesigned around the cultures and practices of user organisations.[3]

In our view, the STS literature tends to overemphasise the collision between specific organisational practices and generic system presumptions at the point of implementation within specific user organisations (see, for example, Walsham 2001; Avgerou 2002). This, we would argue, reflects the various narrative biases within current STS and sociology: that contexts of use are always individually different, unique and typified by highly idiosyncratic practices, whereas technologies are "singular" and "monolithic", and localisation is the means by which the standard and the unique are somehow brought together.[4] A further concern is that localisation studies do not adequately address the longer-term co-evolution of artefacts and their social settings of use. This is not to say that we should view generic solutions as embodying features that can and should be applied in all contexts. We must also resist universalistic accounts and develop a language and set of concepts to describe how generic solutions are designed to pass over organisational, sectoral and national boundaries while embracing aspects of the specific features within these settings. In this respect, we argue that the notion of localisation, together with the concept of generification, can be taken further to explain this circulation. Our argument is not that the organisations in which the software circulates are the same; rather, it is that, through various generification strategies, these local sites *can be treated as the same*. How, then, are we to account for those times when the generic systems do actually travel across many contexts (Rolland and Monteiro 2002)?

FROM IMPORTING TO EXPORTING

Ophir and Shapin (1991) asked a similar question some years ago in relation to scientific knowledge. This was a reaction to the "localist turn" in the sociology of scientific knowledge (SSK): scholars, sceptical of the claim that knowledge diffuses because it is "true", sought to show how the universality of science was both an "acquired quality" and "local affair". They did this by emphasising how facts were produced with reference to specific places and times, that they were the product of particular communities, and that there were tacit practices involved in their production (Knorr Cetina 1981; Turnbull 2000; Hanseth and Braa 2001). Ophir and Shapin"s (1991, 15) question was, "If knowledge is such a "local product", then how does it manage to travel with such "unique efficiency"?" Others voiced similar questions at the time and this led to a growth in "laboratory ethnographies" and an interest in demonstrating just how knowledge *escaped its locality*: this was the claim that knowledge only became universal after the contextual features of locality or "particularity" were *deleted*. Moreover, to "solve" this problem of how knowledge moved from one laboratory to another, Latour (1987, 1999) introduced various terms such as "immutable mobile" and, more recently, "circulating reference".

While these terms have become commonplace within the STS vocabulary, they also have been criticised. Firstly, much of the criticism objects to the overly imperialistic language used by Latour and other proponents of actor–network theory: "immutability" seems to suggest that devices remain standardised at the centres at which they are produced, the locales at which they are used and as they pass through the channels between these places. In particular, the notion of immutable mobility directs attention away from the localised work of adapting an inscription or innovation to a local context of use and setting up the conditions for its effective "travel" (Knorr-Cetina and Amann 1990).[5] Secondly, the terms are also criticised for implying that marks of locality are simply deleted. On the first point, and writing some years earlier, Ravetz (1972) had attempted to give a more sensitive treatment of the spread of knowledge by arguing, not for the immutability of scientific knowledge, but for its "malleability". Knowledge, tools and instruments, he argued, were widely adopted through processes of "smoothing". That is, scientists importing methods or techniques from outside their normal domain would ignore any obscurities or unresolved conceptual difficulties surrounding that object.[6] In terms of the second point, Turnbull sought to build on Latour's work by showing how the local, rather than simply being erased, was often "aggregated". He illustrates this through a discussion of the way in which indigenous knowledges spread though a process of bridging:

> *I argue that the common element in all knowledge systems is their localness, and their differences lie in the way that local knowledge is assembled through social strategies and technical devices for establishing equivalences and connections between otherwise heterogeneous and incompatible components.*
>
> (Turnbull 2000, 13)

In other words, local knowledge diffuses through the creation of "similarities" and "equivalences" between diverse sites. Such equivalence making requires a number of different devices and strategies, such as "standardisation" and "collective working", some of which we will explore further with empirical material.[7]

THE STUDIES

We analyse two software packages, which are at different stages in their "biography" and characterised by different levels of product maturity and standardisation.[8] The first is a student administration system—the Campus Management module (CM)—developed by the German software house SAP, to integrate with its already highly successful ERP R/3 system. To develop CM, the supplier had involved a number of universities as the "surrogates" on which the software would be modelled before it would finally be launched to the wider market as a "global university solution". While SAP was new to the higher education sector, it has developed software for unfamiliar settings many times before. The second study is of the student accommodation system PAMS, which was built by a company we call "Educational Systems". PAMS was initially designed around the needs of one Scottish university, but is now being used by over forty other institutions in the UK, and the Supplier is currently investigating the potential market overseas. PAMS has associated with it a growing and active "user group" that meets regularly to learn about new product developments and petition for the building of further functionality. Whereas SAP already had in place established design methods and processes for software package design, Educational Systems did not; the latter company was new to both higher education and to the development of software packages.[9]

BIRTH OF A PACKAGE

The "birth" stages of the biography of a software package are the most dramatic. In this phase, there are few users in place, and the large community upon which the package will depend for its circulation is yet to be enrolled. Seemingly, there are many choices influencing the extent to which the package will become "generic" and therefore attractive to the widest possible groups of users. Suppliers will spend time deciding which organisational practices will be catered to and which will not. In truth, however, and despite the seeming importance of this stage, the suppliers appeared initially to follow a strategy of simply and rapidly "accumulating functionality".

Accumulative Functionality[10]

Software packages are designed around a basic organisational functionality, what is sometimes described as the "generic kernel". The idea is to paint the organisational reality of adopters onto this kernel by developing numerous "templates", which users can then choose between and tailor to meet their local conditions. These templates form the "outer layer" of the package, and are built up over time through interactions with past customers. Suppliers only reap benefits from developing new templates when they are able to use them again and again (thus recouping development costs). In the birth stages, both suppliers found that, rather than simply re-using templates, they were repeatedly forced to modify or build new ones. For instance, Educational Systems found that with each new customer for PAMS, the templates required modification. The sales director describes this in relation to the "payment schedule" process:

> *When we first wrote PAMS for* [Scottish University] *they produced a Payment Schedule that gave the student the choice of paying in 3 equal installments (1 per term) or equal monthly installments. The logic was therefore simple in that PAMS added up all of the charges and divided by the number of installments.*

However, when they made the next sale to "Highbrow" university, there were some differences which required changes to the software:

> *The next customer,* [Highbrow], *also offered the choice of paying in termly installments, but they massaged the amounts to take forty*

> *percent in term one, forty percent in term two, and twenty percent in term three, as they wanted to get as much paid as possible before the student ran out of money. We therefore added a tick box on the payment plan to say "use ratios", and this then gave access to an extra column that allows them to enter the % against each installment.*

He describes how they could accommodate the next user with the changes conducted for Highbrow: *"The next customer* [Seaside] *also produced a termly plan, but used the number of days in each term to compute the amount. Fortunately, the work we had done for* [Highbrow] *was capable of managing this, as the days in each term could be entered as numbers as well as percentages"*. But, once again, when another user adopted the package, they were forced to make changes: "[Central] *came along. And they offered students a discount if they paid by a certain date, so we had to add another (optional) column that stored the settlement date for each instalment and we added the code to compute the value of this discount"*. The sales director goes on to describe the modifications required by two further universities: "[City], *on the other hand, charges a penalty for late payments. So we added a process that calculated a charge for late payment"*. And "[Rural] *wanted this banded as their fees change according to the amount owed, so we added extra functions to band the charge according to the value"*.

What is clear is that as each new site adopts the package, new and different requirements need to be catered to. Importantly, this occurs not simply in the payment schedule process but in all the other templates stored in the system library. The Supplier appeared to be building into the system whatever functionality was asked for. However, it was becoming obvious to Educational Systems that accumulating and not re-using functionality was *particularising* PAMS. In the case of the payment schedule, for instance, every time a change was made to the template, this would be accompanied by a modification to the graphical user interface. A user was then forced to view a screen, which included buttons and menus specifically intended for other institutions. As a result, there was now a need for increased training where users were told which options and buttons related to them and which did not. However, this mode of redressing the particularisation of PAMS became problematic once the system was made available for operation by students over the Internet. One of the managers describes the problem:

> *. . . how do you get rid of the things that a particular site doesn't want? For example, in our payment process we handle things like "settlement discount". Somewhere like* [Welsh university] *do not use settlement discount but they just ignore the fields on the screen. If you put that on the Web, all you do is end up with calls from customers, from students asking "Why haven't I got any settlement discount?" When actually the answer is that "We do not use it, so we do not want to display it". So how do we get over that?*

During the birth stage, then, suppliers are presented with choices. If they continue with the strategy of accumulative functionality, PAMS will become increasingly baroque, locked in to the particular requirements of their specific array of existing users. This realisation led to a switch in strategy. As the managing director of Educational Systems puts it: *"We are not going to accommodate as much diversity as we have in the past because it constrains our ability to grow and resell"*. Any changes we make to the package from now on, he says, will have to have wider applicability: *"When we built change into the software we have always tried to build it in a way that isn't customer specific and we try to always broaden it a bit so that we have functionality that has a potentially wider audience"*. During one particular conversation, he described how they now try to "discourage too much diversity". Yet, this presents the Supplier with an interesting problem: how do they continue to make the software attractive to, and, indeed, encourage, a wider range of new users without having to include every demand for new functionality? Importantly, how do they "discourage too much diversity" without discouraging the users attached to this diversity?

MANAGEMENT BY COMMUNITY

If the software is truly designed to travel, then it seems that the suppliers must avoid dealing with individual users. Indeed, the translation from a particular to a generic technology corresponds to a shift from a few isolated users to a larger extended "community" (Cambrosio and Keating 1995; de Laet and Mol 2000). Moreover, it is through establishing and engaging with the users primarily through the kind of forum described above that suppliers are able to *shape* these communities and to extend the process of generification. In other words, through participating in community environments, such as the user-group meetings and requirement prototyping sessions, individual organisations were often dislodged from attachments to particular needs.[11]

Community Management Strategies

The suppliers had close ties with individual user organisations in the earlier phases, but they felt forced to shift to an alternative form of relationship as the technology matured and the user base grew. The openness of the software that was stressed during initial interactions was reversed: where they had previously negotiated on a one-to-one basis with users, they now appeared increasingly reluctant to differentiate users. Individual conversations about design issues were *shifted* to a more public forum. This shifting out is also demonstrated in the case of SAP, which had elaborate routines for managing its communities (and though the same strategies were visible within Educational Systems, they appeared much less developed). SAP had developed CM by gathering requirements during site visits and from other direct correspondence with users. The problem in accumulating functionality in this way was that they were "flooded with particular requests".[12] How might they construct something more generic from these requests? Moreover, if they were to "discourage diversity", how would users react if they felt their needs were not being met (and perhaps those of a neighbour were)? Thus, there was potential for this problem to become a focus of conflict (and the precious pilot sites on which the future of the product depended might be discouraged or, worse, lost).

Witnessing

During the requirements prototyping sessions, a wide number of potential users were invited to the SAP University in Waldorf, Germany. The reported functions of these meetings, which would last as long as two weeks, were to receive feedback on Beta versions of the software and to continue the requirements gathering process. It was the latter process that was the most striking. Participants from over a dozen universities and as many countries were seated in a room. Each appeared determined to spell out in magnificent detail just how *their* particular requirements differed from the prototype on the screen in front of them, or, just as likely, from the view being articulated by their neighbour at the next desk. In the excerpt below, they discuss the storing of student transcripts and whether universities need to store details on both passed and failed courses. A consultant standing at the front attempts to make sense of the comments by scribbling them onto overhead projector slides:

> SAP CONSULTANT: *Does everyone want the ability to store two records?*
> AMERICA SOUTH UNI: *We would maintain only one record . . .*
> SAP CONSULTANT: *Is there a need to go back into history? If transcript received and courses are missing, do you need to store this?*
> AMERICA NORTH UNI: . . . *no record is needed.*
> AMERICA SOUTH UNI: *We need both to update [the] current record and then keep a history of that . . .*
> BELGIAN UNI: *In our case, things are completely different . . .*

This exchange points to the diversity of institutions present and the extent to which their requirements are similar or, at times, contradictory: where some users require one kind of record to be stored, others need a more comprehensive record, and one institution records things in a different manner altogether! Yet it is here that the Supplier was finally able to observe the similarities and differences between institutions (and to begin to shape them in some way).

These meetings were also interesting for the way in which they appeared to shape the users' attitudes toward the overall generification process and their determination to have particular needs represented in the system.

Through spending time getting to know the size and complexity of the task at hand, the participants appeared far more accommodating towards collective requirements, even to the extent that they would often compare institutional practices ("Oh! You do that . . ."). They had to concede that, even though it was a generic system, the Supplier was determined to search for each and every difference between sites. No differences were ignored. No one group, or so it seemed, was explicitly favoured. Towards the end of one particularly long session, some of the users even began to suggest that the SAP was perhaps "over determined" to find and articulate differences. The America South Uni participant, for instance, described to the others sitting at his table during a coffee break how he thought SAP had "too much patience" in allowing everyone present to spell out their particularities in such detail.[13] This comment was insightful in that it suggested an interesting shift in the provenance of the generification process and in who takes responsibility for it. Problems were seen to be the result of users, who were intent on describing their particular needs, while the Supplier, who had actually gathered them together in this way, was guilty only of being "too patient".

In summary, by shifting design from the level of the individual to that of the community, the Supplier moved the software package from the private domain of each user site, where only particular needs could be articulated, to a public setting, where community or generic requirements could be forged. A further advantage of allowing users to participate collectively was that they were able to "witness" the continued openness of the process. Indeed, somewhat ironically, some participants express concerns that it was not the supplier who was prolonging or complicating the generification process, but the users who were doing it to themselves.

MANAGEMENT BY CONTENT

Whilst management by community revealed diversity, there was also a need to shape and smooth this diversity, to *manage through content* (Knorr Cetina 1999).[14] There were two aspects to these strategies: firstly, to translate collective requirements into functionality that might be used by all of the sites present; and, secondly, because these sites were surrogates for potentially *all other* universities, to then translate the community functionality into a much more generic functionality. One method of establishing such templates was through searching for *similarities* between sites. These similarities did not emerge easily, but had to be pursued and actively constructed. Consequently, we think it is useful to describe this process in more detail, and so we focus on a discussion of "progression" within the CM module.

Process Alignment

One consultant had asked participants to describe their rules for progressing students from one year to another, and to explain how a student's grades contribute to her overall programme of study. A complicated conversation develops, with various people interjecting. The Consultant struggles to bring the discussion back on topic by attempting to summarise and name the particular process being described:

> SAP CONSULTANT: *We've got one aspect now. Just want to get some common things. How [do] we name the baby? Let's go to the grading issue. [We want to specify if [the] module will contribute to[the] programme of study in any way as a credit or grade. Is there any rule how it contributes? Is it linked to students? What is it linked to that it gives credit?*
>
> SWISS UNI: *Could be a rule or a decision given by someone?*
>
> SOUTH AFRICAN UNI: *The student can still do the exam and be graded, but it might be true that the grade or credit did or did not influence the student's progression . . .*
>
> CANADIAN UNI: *We wouldn't use these rules: we take all courses into progression. We have rules based on [the] courses students take.*
>
> SAP CONSULTANT: *It is the same at* [America North]. *It is the US model. It is the difference between the European and the US model.*

There are a number of interesting aspects in this exchange. When faced with diverging requirements, the establishment of generic features seems impossible. However, the Consultant does not admit defeat, but accepts the next best thing to a single generic process: "two" generic templates. Moreover, she constructs these two templates by aligning or superimposing processes that are already roughly similar to one another ("It is the same at America North"). This then leads to the establishment of a generic feature ("It is the US model"), which means that the requirements of a large group of universities is now seen to have been captured under one process. We also see in this exchange the naming of a further generic template, described as the "European model", which emerges to capture all the differences that do not fit into the "US model". From now on, there will be two modes of progressing students within the CM module (meaning that they will adopt either the US or the European process). Drawing on Epstein (2016), we might describe this as both the production of "generalised differences" and a form of "process alignment". Finally, once these two categories were established, they were continually compared: both the supplier and the participants acted if it was self-evident that everything inside each of these processes was identical, and that anything or anyone outside of one classification could be easily accommodated in the other. Indeed, only one of the participants, a South African university, was from an institution outside the US or Europe. And since interactions during these meetings had shown them that they had many similarities with other users, particularly the British participants, they appeared to be happy to align themselves with the European model.[15] Process alignment appeared to be a successful method, with supplier representatives routinely framing their questions in ways that promoted this form of generification ("Does everyone want the ability to . . . ?", "Does anybody else have this?").

Having an Issue Recognised

An interesting, though not altogether surprising, development was that the users began to learn that if they were to have their particular needs represented in the system, then they too should engage in alignment work. An America South Uni participant makes a case that the system should record grades for failed courses, and very quickly, other users begin to give their support:

> AMERICA SOUTH UNI: *We have concepts called "forgiveness": a student retakes a course he's not done well in and he is "forgiven". The old grade is recorded but not included in the GPA* [Grade Point Average].
>
> CANADA WEST UNI: *We do the same thing. When we have symbols that aren't graded—like "withdrawn" or "incomplete".*
>
> SAP CONSULTANT: *This is a big issue for everyone . . .?*
>
> CANADA WEST UNI: *We definitely have to store it. These non-grade things don't have a pass value or fail value, they are a "third" value.*
>
> SAP CONSULTANT: *I call it "additional module results".*

Here, then, an issue is recognised as generic through this accumulation of support. Moreover, the Consultant appears happy to include the feature in the system, since she is both able to name it (as "additional module results") and establish an equivalence among the other institutions whose needs are catered to under this one concept.

The Organisationally Particular

It was common during these sessions to find requests that could not be made compatible across sites. Consequently, they had to be rejected or sifted from the process. The most common method for doing so was simply to categorise requirements as "specific". For instance, during a discussion around the storing of surnames, an America East Uni participant describes how they have a specific need to record maiden names after marriage. They suggest adding a new field to the screen (an Info_Type), but the Consultant dismisses this as unworkable: "If we went for country-specific or customer-specific Info_Types now, then we could not utilise R/3 resources. The resources would be too great". On this issue, unlike previous ones, the other universities do not align, and thus, it is not recorded on the acetate. The official reason for this was that the change would not link back to the generic system (and this meant that CM would no longer integrate with the ERP system of which it was a small part).[16] The suggestion instead is that America East should create a new Info_Type themselves when they customise the module back at their own institution. In other words, making the system fit America East's needs is *postponed* and shifted onto the customisation stage at the user site (Hartswood et al. 2002, 28).

Smoothing Strategies

Throughout these requirement-gathering sessions, many of the participants would go into great detail concerning their specific needs. The consultants would often use an interesting range of social strategies and devices to simplify and curtail particular requests, and we explore one such strategy with overhead projector slides (acetates).

Working the Acetate

In response to one lengthy description, the Consultant used the physical limitations of the acetate to abbreviate a request ("Just trying to think how this can fit all on one line"). On other occasions, particular issues would be rejected for being already covered under existing themes. Pointing to the acetate, the Consultants would say, "We had that issue already", even when it was not always clear just how the new issue had been covered. Indeed, the acetate was something of an "obligatory point of passage" (a device or gateway through which the requirements needed to pass, see Callon 1986); once scribbled down, an issue could be considered to have been recognised by the Supplier, but of course, it was far from easy to inscribe it on the acetate. The participants also recognised the importance of the acetates. In one discussion, the university representatives' sites are describing progression rules, and an America South Uni participant prefaces his intervention by stating that "you'll need a new page". While of course, he is attempting to signal his university's uniqueness, the Consultant dismisses this by pointing to the existing, well-annotated acetate and stating how there is "one line left". Later, when the America South participant appears to be about to list a further set of differences, the Consultant states that "the page is full". We would say that this *working of the acetate* was a particularly strong form of smoothing because it appeared as a simple material necessity and was thus not recognised as generification work.

From Generification to Generifiers

In the final stages of the CM project, there was once again a notable shift concerning the shaping of the package and the locus of generification. Dragging the design from the private domain of direct user engagement to a public setting had apparently been a drain on the Supplier's resources, and the requirements prototyping meetings were no longer seen to be as "productive" as they once had been. Below, one participant from a Belgian university writes in a report that:

> *The current way of working with workshops is very labour intensive for the people of product management and development at SAP Waldorf. The biggest problem is that there is a very mixed public attending these workshops. Some of them already have a lot of expertise in CM and they see the workshops as a roll-in of requirements and for giving feedback after testing. For others this is their first experience with CM and they see it more as a kind of training. SAP wants to change this. In the future there will be standard training courses for larger groups. For roll-in activities there will be focus group meetings. These will only be attended by experts on the subject (limited groups of people) and they will focus on narrow subjects.*

This shift was met with objections from the users, who stated a preference for collective engagement rather than the smaller group or individual interactions. While this appears somewhat counterintuitive, the reason for the objections became clear some weeks later when one user reported that it was now increasingly common for their requests for functionality to be rejected. This was because it was said, by SAP, to be functionality required by only one university. In other words, because there were no longer community meetings, it now appeared difficult for the Supplier to work out and for the user to determine what was a generic need and what was not. And it appeared that they had decided to assume that the majority of the requests did not represent generic needs. In order to prove their needs were generic and not particular, the universities had begun to search for similarities between themselves and the other sites (see Pollock and Cornford 2004). In other words, once back in the private domain, the burden of generification was pushed onto the users. The participants had no choice but to become "generifiers" themselves. If they did not fully participate in the generification process, if they were not good generifiers, their needs would not be effectively represented within the package. And it appeared to be better to have your needs represented in a generic format than not at all!

MANAGEMENT BY SOCIAL AUTHORITY

The ability of a software package to become mobile is a result of the successful extension of a particularised application, and, at the same time, the extension of the community attached to that system. It is the latter aspect which is of interest; specifically, how the process requires the enrolment and configuring of a user community that is subject to, and actively participates in, this generification process. However, the kind of work required in this form of ordering varies from the sophisticated smoothing/sifting strategies and boundary work described above to what might be described as more direct "social authority" strategies. This was particularly evident in later phases of the packages' development, when the heterogeneous nature of the user base and the fact that it was beginning to swell with "latecomers" resulted in pressures to pull the packages in different directions.

Segmenting the User Base

The initial "openness" of the package was a useful strategy for building the community by enrolling users into the design process. Now, in the later stages of the package biography, this openness was something of a drawback. As was evident in the quote from the Belgian university above, users were still expecting to have their particular requests met, and what was unsettling some of the established pilots was that the latecomers were also making additional demands that might slow or complicate progress. This also occurred in the case of PAMS. The sales director describes how early on, when the company did not yet have a finished system, it had had to create an expectation among users that their specific needs would be met. It was now difficult to correct this view:

> *. . . but, of course, it raises a level of expectation . . . you can be a year downstream in an implementation with somebody, and suddenly they throw up this requirement that has never been vocalised before, but because they bought as an early adopter they perceive that they have that type of relationship that means that you will do it for them. Even though they may well be the only people in the UK that actually want it!*

Rather than simply refuse to cater to any kind of particular requirement, however, the Supplier had segmented the community into three distinct categories: as "strategic", "consultative" or "transactional" customers. While these terms were part of the vernacular of the PAMS team, they were still thought to warrant some explanation by the managing director when he mentioned them to us:

> *. . . it is where we perceive it is worth putting the effort: Strategic Customers, Consultative Customers and Transactional Customers. Transactional customers don't want to spend money. They want everything for nothing. So for every day you put into them you get nothing back. So you put your days into Consultative customers who want to work with and spend with you. Whereas Strategic are all about people who help share the vision of where the product is going to go over the coming years.*

From his point of view, strategic and consultative customers were central to the future development of PAMS, whereas transactional customers were peripheral to its evolution. The former were regularly quizzed and consulted on the addition of new features and the general direction of the package, while the latter were actively kept at a distance. One example of how this strategy structured the users' interactions with the package was seen in the issue of "customisation" and the question as to whether a user could modify the generic kernel.[17] During a conversation we had with a PAMS programmer, for instance, he praises a modification carried out by one early adopter and describes how this has even been fed back into the generic package for use at other sites: "[The London Uni] *have done a fair bit . . . eighty per cent of that has been incorporated into the standard package . . . They were willing to run ahead . . . they had the resources"*. During the same conversation, he criticises another user for making a modification to the kernel and describes how it was explicitly stated that they are not allowed to make changes to the source code: *"We make sure that it's in the contract that they don't do things like that. We have had customers manipulating the data . . . from the back-end . . . Very dangerous . . . They promised not to do it again"*. This suggested that the ability of a user to customise PAMs and still have their system supported by the Supplier was directly related to the status they held at that time. This, of course, begs the question as to just how a user might find themselves placed in one or another category.

Good Generifiers

Typically, the status of a user was simply related to "when" they adopted the system, with the first group of users being closer to, and latercomers further from, the Supplier. One other key criterion was related to how willing a user was to reshape practices to conform to the templates embodied within the system. The managing director of Educational Systems describes how:

> *[o]ne of the other things we found about Consultative customers where they have entered into a dialogue with us is about how they might change how they do things. There is a lot of functionality in PAMS and there are areas where the universities aren't particularly efficient . . . So the Consultative customers are more willing to look at how they do their business and how they might improve their business based on suggestions for us based on existing functionality or commissioning us to add extra functionality.*

Encouraging users to carry out organisational change to align with the system is an important strategy for managing the user base, and is also a way to reduce the need for the further accumulation of particular functionality. It is a method, in other words, of moving users towards the "organisationally generic". Moreover, suppliers actively recruit customers who appear willing to engage in such change, and they reward them with greater access to the shaping process.[18]

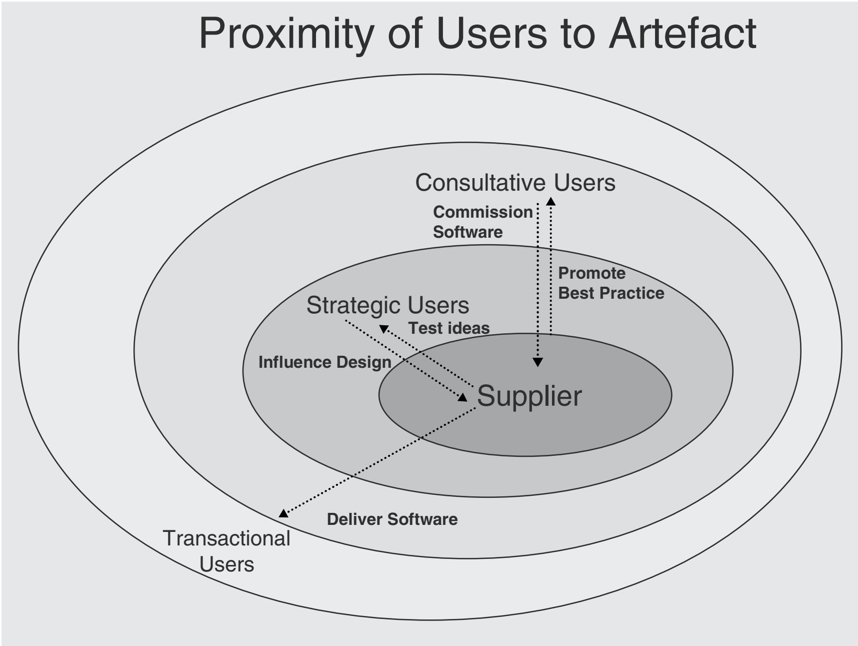

Figure 7.1 Proximity of users to artifacts.

In summary, Educational Systems does not have the large user base enjoyed by suppliers like SAP, and thus it has to be sophisticated in how it brings pressure to bear on users. We saw a form of selection where the Supplier was prioritising which functionality might be allowed into the package. Users were divided into those who sought to align with the organisationally generic features being developed, often through conducting processes of change within their own organisations, and those who did not. The former group, as a reward for being "good" surrogates, were actively involved in shaping the evolution of the package and were regularly consulted on which features they would like to see in the package. The latter, by contrast, were pushed to the margins of this shaping process, where they were not consulted or involved in design or evolution. Just what they could do with the system was policed (see Figure 7.1).[19]

PROMISING FUTURE?

We now delineate a final stage of the software packages biography: *the future*. The software packages might be thought to have a promising future or "career" ahead of them, promising because the effort to create a generic technology required moving towards maturity in order to escape particularisation. As a result, there are still many places to which the software can travel. In its promotional literature, for instance, SAP boldly states how the CM module embodies "no country specifics". Yet, despite what this says, there were times when specific requirements appeared valuable for the circulation of the software package. Or perhaps, it was simply impossible to avoid including the particular within the generic technologies being built.

Surrogate for Whom?

Some users were able to convince the Suppliers that their needs had "generic potential". One criterion determining the ability of a user to get features embodied in the system revolved around the issue of just "who" they were a surrogate for. The UK market was seen as a "strong subsidiary" by SAP, meaning that the inclusion of a British university in the community might open up potential markets elsewhere. And as a result, the British university was able to wield significant influence. For instance, the Supplier agreed to build the "UCAS admissions link", a piece of functionality that would be a significant drain on resource and, importantly, one that could *not* be applied in other countries. During our research, we began to learn that the CM module embodied many other particular features. One document describes how "[i]n addition to generic functions, Campus Management also offers country-specific functions. These are functions that are only used in a particular country and cover needs arising from local legislation or business practices". In other words, including a particular functionality allowed the CM module to move within the same sector, but also to *different* countries.

The case of Educational Systems raised a different issue, as the addition of a particular functionality offered PAMS the potential to move both into a new country and *across* an industrial sector. The Supplier was considering whether to launch PAMS in the US and, of course, one issue of import was how well PAMS would fit with the peculiarities found there. One area where a difference was perceived was in how student rooms were allocated. Whereas UK students are simply assigned individual rooms, US students typically share a room and can therefore state their preferred type of roommate. The managing director described how this difference would require that "social engineering" software be added to PAMS. Initially sceptical about the costs of such a development, he also saw how this might be useful for the evolution of PAMS:

> *That is a piece of functionality that we could add-in and usefully use over here. So it may well be something we can use. One of the things we can certainly use is the ability to have multiple layouts in a room . . . . So we can build those changes into the software in a way that actually positively impacts on our ability to sell the software in the UK.*

The addition of this "social engineering" functionality would mean that PAMS would have more utility in existing UK universities *and* the private sector hotel industry, one area the Supplier had recently targeted. Their aim, in other words, was to identify where particular characteristics could have a more general appeal. We might describe particular features that aid the circulation of the package ("the UCAS admission link", the "social engineering" etc.) as "generic examples of the particular".

Paths of Diversity

There were other forms of diversity included in the system. Earlier, we discussed the template for the "progression" of students and how the Consultant had developed not one, but "two" templates. This was interesting, as it was one of the rare occasions when the Supplier had to create "multiple" templates for the same process—what we might describe as *poly-generic* templates. In their promotional literature, the Supplier describes these poly-generic templates as giving the system extra flexibility through allowing adopters more choice:

> *Progression—Depending on your particular environment, you may want to measure the progress of your students in different ways. One option is to determine the academic standing . . . . Another option is to evaluate a student's progress. . . . SAP Campus Management supports several progression methods thanks to our global approach to solution design. The flexibility of this application allows an institution to change processes in the future without the need to install a new student information system.*

By allowing poly-generic templates, the supplier has created the basis for internally segmenting the user community, so that the templates allow users to follow different routes depending on their particular circumstances. They have, in other words, established "paths of diversity" through which users might navigate. This was still a form of generification, as the Supplier was allowing users to choose between one of several large groupings. In this final section, we consider what the inclusion of diversity and generality means for shaping the generic system and the community of users.

Opening the Black Box (and Finding a "Black Blob")

We have shown how the generic system results from various kinds of boundary work. With the drawing and redrawing of borders, the system embodies a range of features and potentially caters to a wide range of organisations (see Figure 7.2).

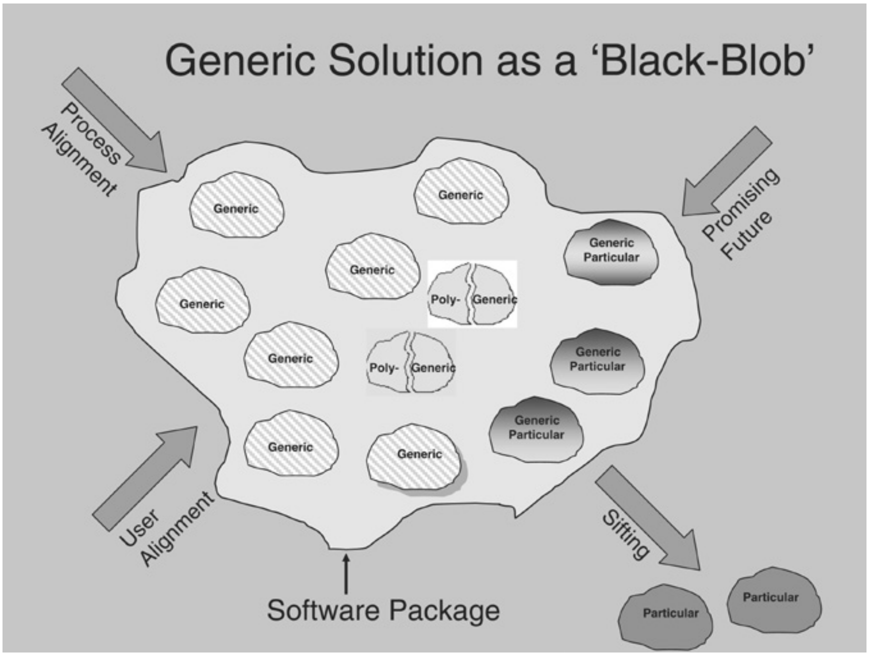

Figure 7.2 Generic solutions as a "black blob".

Let us describe the system. The bulk of its features are the organisationally generic templates that suppliers attempt to build. These form the majority of the organisational "outer layer", where suppliers hypothesise that organisations are similar and that the participating sites are good surrogates for all others in that class of organisation.[20] There are also compromises in which designers, unable to devise a single template, build in several templates to carry out broadly equivalent bundles of organisational processes. These "poly-generic" features reflect the diversity of user organisation practices and contexts that cannot be readily captured within a single template. Finally, there are "generic particulars", where idiosyncratic requirements are deemed to be important for aiding the future circulation of the package. These are only a few examples of how the generic and the particular are made to fit together. With further research, we would be able to generate further instances and a more complex picture. But our point should be clear: when examined closely, generic solutions are not the monolithic systems that much of the literature seems to suppose (see Walsham (2001) and Avgerou (2002) as examples). Rather, they are the result of intricate boundary work involving generification (the creation of generic templates), the particularisation of the generic (the poly-generic templates) and, at times, the generification of the particular (the generic particular templates). In our view, the design and evolution of software packages are characterised by the working out of the relationship between the generic and the particular.[21] Indeed, this occurs not simply in design, but throughout the lifetime of the software package.

During the research, we thus began to recharacterise these generic solution as "black blobs" (Michael 2000). Within STS, technologies are commonly described as "black boxes" in order to emphasise how their form and function are stable, that prior processes of shaping are obscured and that the user is configured into using the object in certain ways. By contrast, the software packages are also bounded objects, but their internal workings continually contort as they move around, and as new functionality is added. While the overall appearance of the software package (and in the case of the highly modularised packages like SAP, as its core "kernel") may seem to remain intact, the addition of a new template, for example, causes the packages to morph and extend themselves in different directions. It is through this morphing/extension process that software packages are able to move from place to place, and to reach out into new settings. Such amoeboid movements, in turn, enable users to grab onto and then align themselves with the various protuberances and protrusions.

CONCLUSION: BLACK BLOBS TRAVEL BETTER THAN BLACK BOXES

Certain software packages can be made to travel with "unique efficiency", to borrow Shapin's (1998) description of scientific knowledge. In doing so, they unsettle prevailing core assumptions in the sociological understanding of organisational technologies. Put simply, much of the sociological and STS literature pays particular attention to the mismatch between system and actual work practices, and emphasises the local adaptation necessary to bridge the gulf (McLaughlin et al. 1999; Walsham 2001; Avgerou 2002). While we do not downgrade the importance of this focus on how technologies are imported, we point instead to the need to go beyond studies of "simple location" and also examine how systems are able to work *across* different organisational contexts and how they are exported. Rather than focus on the collision between unique organisational practices and the generic solution, we should *also* address how technologies are made (and continuously remade) to bridge these different locales, as part of our enquiry into the broader and longer-term co-evolution of artefacts and their social settings of use. We have argued that generic solutions *do* exist and that they do travel to many different places, though of course, they don't go everywhere. They arise through the broader extension of a particularised software application and, at the same time, the management of the user community attached to that solution.

We noted some interrelated moments in the biography of these solutions. There was a distinct *birth stage* at which suppliers designed specific user requirements into the software. This was followed by a number of delimited responses in the subsequent maturation of the package, when the suppliers attempted to move away from the simple accumulation of particular functionality. One interesting aspect was the shift to capture collective rather than individual requirements, in order to establish organisationally generic features through alignment and smoothing practices. Such practices helped establish greater compatibility across sites, as equivalencies were established in organisational practices, and differences were worked together and generalised. Suppliers attempted to align processes that were already roughly similar, what we called "process alignment work". The collective gathering of requirements also had a secondary consequence of shifting expectations about the kinds of need that would be met by the system. Through "witnessing" the level of user diversity, and realising that the only way to represent needs was to engage in the process, the users' conceptions of their own needs shifted in a way that aligned with those of other participants. In other words, users were in some respects self-governing concerning the articulation of their level of particularity and generality. This raises questions about which users have the capacity to extend and broaden a template: on what grounds, and by which methods?

To summarise, it is not just sociologists of science and technology who are interested in the relations between the particular and the generic, and how the boundary between them is established, managed and shifted (O'Connell 1993). Software packages are a high-value industrial product, necessitating extensive interactions between suppliers and users. Building software packages calls for suppliers to develop and sustain sophisticated strategies for managing diversity, and setting boundaries and priorities for dealing with their market of user organisations. User organisations similarly need to learn how to respond to and interact with such strategies. As communities grow and inevitably encompass a wider range of organisational types and requirements, this user base also needs to be organised if the supplier is to avoid being confronted with a potentially overwhelming array of requirements. This, as we have shown, involves different kinds of boundary work, in terms of understandings of which types of organisations lay "close to" and which "further from" the supplier's conception of the ideal type of user, and in terms of the willingness of the supplier to accept or sift particular requests from users. The "black box" view of the generic solution, where it simply "invades" and "disciplines", is too crude. What we have shown is that establishing a generic solution is a precarious achievement of various kinds of generification strategies. These are strategies in which the suppliers and users of software packages constantly work towards a pragmatic resolution of the tension between the generic and particular. As a result of this generification work, software packages can circulate and user communities can grow; that is to say, diverse organisations and standard technologies *can* be brought together.

NOTES

1. The localist turn in this connection reflects the extraordinary influence of seminal analyses by writers like Lucy Suchman and her focus on "situated actions . . . taken in the context of particular, concrete circumstances" (1987, viii), which underpinned the recent resurgence of ethnographic research into changes in technology and work practices within organisations.
2. In their comparative study of IT systems, to give just one compelling example, McLaughlin et al. (1999) deploy a commonplace vocabulary to highlight how users actively "appropriate" (MacKay and Gillespie 1992), "domesticate" (Sørensen 1996) or "work around" (Gasser 1986) the shortcomings of newly arrived technologies.
3. An exemplary instance of this kind of writing is Avgerou (2002).
4. The concept of narrative bias invites us to reflect upon the repertoires of classic stories that particular schools of analysis often develop with characteristic contexts, problem diagnosis, dangers and solutions (Williams et al. 2005). See also Woolgar and Cooper (1999) for a similar discussion of "iconic exemplars" in STS.
5. Thanks to Michael Lynch for framing this point in this way.
6. We are grateful here to Jamie Fleck for bringing this set of arguments to our attention.
7. We should also mention Timmermans and Berg's (1997) work, as they have suggested that artefacts can be both universal and local at the same time. Putting forward the notion of the "local universal", they argue that universals *do* exist, but they emerge together with the local. This is an important contribution. However, our interests are different in some respects. Their account is firmly on the side of work practice and the appropriation of a medical standard and how despite various "local circumventions" and "repairs" carried out by users of a particular protocol, the notion of "one" standard still persists. Also, *local universal* is an analytical notion they invented to separate out the world of practice from the world of standards, and then to show how these worlds are reconciled with one another. Our concerns, in contrast, are with design practices and how actors *themselves* negotiate and establish the boundaries between what is particular and generic. And in this respect, we view as sociologically interesting the way *suppliers* attempt to bring together and manage both of these aspects while building a generic software package. Gieryn (1999) discusses a similar point in relation to the authority of science and how laypeople understand what counts as good and bad science. It is important, he says, to focus on how actors perform this boundary work, rather than privileging the analysts' view.
8. For a more detailed discussion of the "biography" of a software package, see Pollock et al. (2009).
9. The material presented here stems from observations (by NP) of what are sometimes called "requirements prototyping" sessions (meetings in which suppliers demonstrate early versions of systems and elicit feedback), and user group meetings at the suppliers' premises. A number of semi-structured interviews and informal discussions were also conducted with supplier consultants, programmers and users. Finally, one of the authors (NP) was commissioned to conduct a study on the suitability of launching PAMS abroad. Along with a co-researcher, Tasos Karadedos, NP met regularly with the management team to discuss strategies and potential markets. Material from this study is also presented here.
10. This discussion of accumulative functionality is partially drawn from Karadedos (2003).

11. Here, we loosely draw on Woolgar's (1996) notion that a technology "performs" a community. He uses the term in conjunction with the "technology as text" metaphor to show how readers arrive at a preferred form of use. He suggests that within the technology/text, certain identities and positions are offered with which the user can choose to align.
12. This was taken from an email exchange between one of the pilot sites and the supplier. The author was discussing the danger of design that was focused on individual sites and not the community.
13. Indeed, the participants were becoming increasingly frustrated by the supplier's attempts to understand each and every difference among all the universities present and to reconcile these with the needs of the others present. For the suppliers, such a process appeared to be useful, as they saw it as a means by which the module might become *more generic* and thus potentially applicable to the widest variety of higher education institutions.
14. Knorr Cetina develops the notion of "management by content" to describe how people are mangaged specically through the content of their work as opposed to management through an organisational structure or hierarchy (1999, 172).
15. We later found out during the final stages of drafting this chapter that the South African university eventually decided not to implement campus management. Their reasons, and the continuing evolution of CM, are the subject of continuing research.
16. There is an interesting issue here of how the universities were squeezed into existing software models that had nothing to do with higher education. We have explored this issue in Pollock and Cornford (2004).
17. Usually, changes to the source code provide suppliers with something of a dilemma. On the one hand, modifications developed by users are an important source of innovation and are often fed back into the generic package for use at other sites. On the other hand, such evolution can be disruptive and if things go wrong during such modifications, this often leads to disputes about where responsibility rests for sorting things out. See Pollock (2005) for a lengthy discussion of this issue in relation to the authorised and unauthorised customisations and "work arounds" conducted on standardised computer systems.
18. Interestingly, we also routinely witnessed how a user might shift from one classification to another. The very first adopter of PAMS, for instance, was in the process of moving from the centre to the periphery (and there was even talk that it was now becoming "transactional").
19. This diagram is a development of one found in Karadedos (2003). Permission to reproduce it has been granted.
20. These are of course equivalences only in the *realm of design,* and whether they emerge in the *realm of practice* will depend on other generification strategies.
21. Indeed, the globalisation theorist Roland Robertson (1992, 102) has gone as far as to describe "contemporary globalisation" as marked by a similar process, or what he describes as the " . . . institutionalisation of the two-fold process involving the universalisation of particularism and the particularization of universalisation".

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Part III

Innovation Practices and User Communities

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8 Innovation in Civil Society
The Socio-Material Dynamics of a Community Innovation

Stefan Verhaegh, Ellen van Oost and Nelly Oudshoorn

INTRODUCTION

Innovative agency in the twenty-first century is no longer exclusively enacted by and located within commercial firms and knowledge institutes, nor is it exclusively powered by research and development activities. Recent literature has stressed the distributed innovative agency of citizens, amateurs, hobbyists, consumers and patients, both individually as well as collectively, as the initiators and developers of innovative new products and services (Oudshoorn and Pinch 2003, 2007, von Hippel 2005a; Leadbeater 2009). Boundaries between categories such as producers and consumers are dissolving into new categories such as prosumers, innovation and diffusion are enriched with the notion of innofusion (Fleck 1994) and the ranks of professionals and amateurs are joined by pro-ams (Leadbeater and Miller 2004).

User collectives and their potential capacity for socio-technical innovation deserve greater recognition and understanding. In policymaking, innovation is often framed exclusively in economic terms related to the creation of financial value within markets.[1] This understates the societal importance of radical innovations initiated and nurtured by (emerging) civil user communities, simply because such innovations take place outside the realm of markets. Therefore, more research attention could be devoted to exploring the dynamics that emerge when collectives of ordinary users, networked with information technology, start to turn novel ideas into working artifacts and common use practices, particularly the processes involved in making these innovations work.[2] Hence, the central question this chapter addresses, is how can we understand the dynamics of innovation developed and sustained by user collectives.

For the conceptual understanding of these dynamics, we draw primarily on two fields of research that address the innovative agency of users and user collectives, namely innovation studies (IS) and science and technology studies (STS). In both fields, scholars have addressed this innovative role extensively, but have taken only limited advantage of their respective insights (cf. Oudshoorn and Pinch 2003, 2007; von Hippel 2005a; Rohracher 2005). Clearly the two domains pursue different objectives, as reflected in their research agendas. Within innovation studies—in particular, the studies of von Hippel and his colleagues—the primary concerns lie in innovation theory and policy. Peine and Hermann (2012) frame the approach of innovation studies as one that looks at the phenomenon of user innovation from an economic and management perspective, primarily through positivist lenses, aiming towards integrating insights from a broad range of empirical studies into an overarching conceptual understanding of the generation and diffusion of user innovations.

In the field of science and technology studies, by contrast, the focus on users is often inspired by a socio-political, and sometimes normative, agenda aimed at involving more social groups in technological development and empowering specific user groups. More recently, however, mutual interest between these two fields seems to be growing, and one can observe cautious shifts in agendas and methods. Von Hippel has broadened the scope of his work by re-positioning the role of users as more central and essential in innovation processes, culminating in "democratizing innovation" (von Hippel 2005a). While questions relating to the democratization of technology have topped the research agenda in STS circles for some time, the interest in innovation processes has only recently started to grow.

Our study positions itself theoretically in the junction of the scientific domains of IS and STS. We draw on concepts that in our view are mutually supplementary. Indeed, we hope that this combination bears new conceptual fruit, as we aim to develop a new vocabulary for understanding the dynamics of user-initiated innovations. In earlier publications, we presented our first conceptual offering: c*ommunity innovation* (van Oost et al. 2009, Verhaegh 2010), in which we drew on von Hippel's notion of innovation community and the socio-technical network approach from STS to characterize the bottom-up innovation practices of user collectives. Community innovation sets itself apart from other types of innovation in the way in which *innovation co-evolves inextricably* with the user community itself in the form of a hybrid collective (Callon 2004).[3] This chapter aims to develop a more elaborate understanding of the specificities of these community innovations.

Relating to methodology, we built on the STS tradition of a qualitative in-depth analysis of an exemplary case. We analyzed the dynamics of a successful innovation community that developed a new innovative citywide wireless backbone infrastructure, Wireless Leiden (WL), allowing all citizens to digitally communicate for free, even offering free Internet access. Wireless Leiden was initiated in 2001 by a small group of residents and was developed into a non-profit organization consisting of hundreds of volunteers that built, in the following years, a unique wireless infrastructure covering large parts of the city of Leiden, one of the oldest cities in the Netherlands, and its surrounding villages.[4] In the analysis of this case, we will develop a new vocabulary for the dynamics of civil community innovations.

The chapter is structured as follows. First, we sketch our theoretical framing for analyzing the dynamics of community innovation and the methods we used. The empirical analysis is informed by two types of conceptual lenses focusing on user-technology relations: first, the material-semiotic lens, and second, the lens of distribution of work. Second, we elaborate on our qualitative case study of Wireless Leiden. In this section, three types of work underlying the rise and growth of Wireless Leiden are described. Finally, we will elucidate some underlying mechanisms that we consider as characteristic for understanding the dynamics of community innovations and introduce a new vocabulary to capture these innovation dynamics.

CONCEPTUALIZING THE DYNAMICS OF COMMUNITY INNOVATION

Innovative Agency of Users and User Communities

The innovativeness of users and user communities is well documented in the impressive user-oriented branch of innovation studies initiated by Eric von Hippel in the mid-1970s. Von Hippel and his scholars have put "users as sources of innovation" (von Hippel 1988) firmly on the innovation studies agenda. Until the late 1990s, these studies primarily focused on the innovative agency of individual users—user-innovators—with a special focus on the so-called "lead users", a small category of users that are able to articulate future market needs. Lead users can (and often do, but need not necessarily) innovate the technologies that they use, towards their articulated needs. More recent publications in this field also include the study on the innovative agency of collectives of users and user communities (von Hippel 2005b, von Krogh et al. 2003). The rise of the Internet in general and open source communities in particular has clearly boosted the interest in innovative user collectives. Moreover, in other domains such as, for example, extreme sporting, user communities were highlighted as the most important source of innovations in sports equipment (Shah 2000). Von Hippel (2005a) introduced the overarching concept of "innovation community," which he defined as an organized cooperation in the development, testing and diffusion of user-initiated innovations. User innovators involved in innovation communities freely reveal and share their information and knowledge, a feature that is central to innovation communities. Innovation communities can have users as well as manufacturers (individuals as well as firms) as members, and in some innovation communities, manufacturers may use this information to create commercial products.[5] Von Hippel's vision of innovation communities puts information exchange face-to-face and digital, central. Some communities, but not necessarily all, can also fulfill important social roles for their members as networks that provide sociability, support, a sense of belonging and social identity. The primary interest, however, of innovation studies in innovation communities is their economic value: innovation is primarily framed in terms of its commercial potential.

The domain of technology studies has also highlighted the importance of user agency in understanding the processes of shaping technology (cf. Oudshoorn and Pinch 2003, 2007; Rohracher 2005). As Oudshoorn and Pinch (2003) have described, this "turn to the users" can be traced back to Ruth Schwartz Cowan's exemplary research on user-technology relations. In order to conceptualize the active role of users in innovation, she introduced the notion of "the consumption junction", defined as "the place and time at which the consumer makes choices between competing technologies" (Cowan 1987, 263). Cowan argued that a focus on consumers and the network relations in which they are embedded enables historians and sociologists of technology to improve their understanding of the success and failure of technologies. The social constructivist perspective on technological development as developed by Bijker et al. (1987) also emphasizes the notion that innovations should be understood as the result of the mutual shaping of technologies and social groups, including users (Bijker 1995). Most importantly, Kline and Pinch have shown how users can adopt an active role in the redesign of an artifact, independently of the producer, referring to these users as "agents of technological change" (Kline and Pinch 1996).

Considering the early work of Eric von Hippel and colleagues, it is important to notice that they reflected on agency of technologies in innovation. For example, von Hippel and Finkelstein (1978) explored how artifacts themselves could enable or constrain processes of user innovation through material design.[6] However, this explicit attention to the innovative agency of the artifacts themselves involved in innovation processes was not further developed. And this brings us precisely to one of the key points of difference in perspective between STS and IS approaches for studying the involvement of users in innovation.[7] An explicit attention to the agency of artifacts (Callon 1980; Callon and Law 1982), which is the core of material-semiotic actor-network approaches, has been acknowledged by STS scholars as crucial for understanding socio-technical change and, as we argue in this chapter, innovation by user communities as well.[8]

Building Hybrid Collectives: Focusing on Visible and Invisible Work

In order to be able to describe bottom-up initiatives by groups of users, a conceptual framework is required that can deal with the dynamics of multiple actors interacting on multiple levels in order to be able to map the interaction between groups of "users" fulfilling different roles and different artifacts in different socio-technological networks. These networks consist of people and material artifacts, in constantly changing combinations. To capture this network character of the interactions between humans and non-humans, Callon and Law introduced the concept of "hybrid collectif" (Callon and Law 1995).[9] This notion takes into account the network character of technology and considers innovation as a collective endeavor, thus providing a very useful concept for analyzing community-based innovation processes. This concept also provides a material-semiotic approach, as it takes into account the material agency of artifacts within such cooperative collectives of individuals in addition to their enabling and constraining influence, an aspect that is missing in von Hippel's concept of innovation community described above. Furthermore, we also address the role of political and ideological stances in the dynamics of community innovations, an aspect that is relatively absent in the innovation studies analysis, yet important for understanding the engagement of actors in the innovation community (Hess 2005; Söderberg 2011).

By combining theoretical insights from innovation studies and technology studies, we aim to understand the dynamics of innovation by user collectives as a process of building heterogeneous, hybrid networks inspired and shaped by political incentives and concerns. However, there is one pitfall we should endeavor to avoid. A much-debated criticism of Actor–Network Theory is its biased "executive approach" towards powerful actors, with the unintended consequence that the voices of less powerful or visible actors are made invisible in such accounts of the development of technology (cf. Star 1991, Clarke 1998).[10] When studying community-based innovation, one may be tempted to follow the "lead users" because their work is often foregrounded in news media and literature. In order to avoid such an executive approach, we focus explicitly on *work* done by all involved actors. This focus on work is inspired by researchers working in the tradition of symbolic interactionism who have done important research on understanding what they called the "ecology of visible and invisible work" (Star and Strauss 1999). They used this notion to refer to the dearth of attention given to representing specific knowledge and skills as formal work. They argued that the question of "what counts as work" makes specific expertise and specific groups of actors invisible. Consequently, these scholars set out to make visible the "work that goes unnoticed" (Star 1999, 386) with the "expertise often hidden from view" (Star and Strauss 1999, 11). In line with the research program of these scholars, we aim to unravel the various types of work of all actors involved, not only the lead users, but also the users that are often described as end users.[11] In the case of innovation by user collectives, technical tinkering or management work may not necessarily be delegated to lead users or managers, but to end users and technical devices, or other actors.

Based on the theoretical framing described above, we summarize our conceptualization of innovation by user communities:

(1) Innovation by user collectives is an activity of network building. The resulting community innovation can be described as a *hybrid collective*;
(2) Building and sustaining hybrid collectives requires *work*. This work is distributed over the network and involves the full spectrum of users involved (from lead users to end users), as well as non-human actors;

(3) Political and ideological incentives and concerns may drive and shape the actual work involved in building and sustaining these hybrid collectives.

This framing allows us to rephrase our research question as: *what types of work are involved in building and sustaining a hybrid collective by an innovative user community?*

METHODOLOGY

We have chosen a qualitative, explorative study of one single, in-depth case study (Yin 2003). This choice enables us to make a detailed analysis of all actors and work involved in one exemplary case of a community innovation: Wireless Leiden, one of the largest and most successful Wi-Fi communities in Europe. In the Dutch city of Leiden, a small group of residents developed a citywide wireless infrastructure (with regional ambitions) offering the residents of Leiden possibilities for free communication, under the name Wireless Leiden.[12] Wireless Leiden began in 2001 with one long-distance Wi-Fi connection and developed as a community innovation consisting of a locally situated Wi-Fi network of more than seventy nodes and approximately a thousand unique users in 2006 (van Oost et al. 2009). By 2012, it had grown to almost a hundred nodes. The activities of Wireless Leiden were not restricted to the city of Leiden and it environments. In 2005, Wireless Leiden started to expand regionally, promoted its activities in other cities and even built two Wi-Fi nets in Turkey, thus stimulating the potential diffusion of freely accessible wireless communication infrastructures. These Wi-Fi initiatives exemplify the importance of user groups for innovation in ICT.

Wireless Leiden is a sustainable project, measured in terms of infrastructural (backbone) network nodes, number of users, successful partnerships and the heterogeneity of their end user group. Interestingly, on its website, the project defines itself explicitly as both “successful” and “innovative”. In addition, Wireless Leiden includes a very heterogeneous group of users when compared to other wireless networks. Members who are interested in the different aspects (the technical, financial and social) are involved in the project. Wireless Leiden also seems to have handled the scaling up of its end user population very well. All of these features make Wireless Leiden an exemplary case for studying the rise, growth and stabilization of a community innovation driven by a collective of users. Both the user collective and the technical Wi-Fi infrastructure co-developed mutually, allowing us to study in depth the variety of work performed to create a hybrid collective.

For data collection, we relied on three sources. The first source was the Wireless Leiden repository. This site proved to be a tremendously rich source of information, as the general policy of Wireless Leiden is based on openness and transparency. Their open source ideology was not confined to the traditional open source software and hardware, but also included all strategic, organizational and discussion materials and documents. All information was shared on the Wireless Leiden repository. The second source of data comprised thirty qualitative in-depth interviews held with Wireless Leiden participants in various user roles. The third method of data collection consisted of participatory observations. In total, thirty events (such as board meetings, node building meetings) and work practices (for example node building, repairing and installing nodes) were observed. Observational notes were supplemented with various photographs of situated technological elements and work practices.[13]

INNOVATION WORK IN WIRELESS LEIDEN

In this section, we describe the various types of work involved in the building of Wireless Leiden. We discern three types of work: alignment work, domestication work and care work. This distinction in three types of innovation work resulted heuristically from the theoretically informed data analysis. *Alignment wor*k is central in the first phase of building a heterogeneous network, and refers to the work involved in creating successful alliances between various network elements, both human and non-humans actors. The other two types of work focus on the growth and stabilization of the community innovation. Innovations can only become successful if the network is extended to new places and actors. In our case study of Wireless Leiden, the work of a new actor group of home users becomes visible. We have conceptualized their work as *domestication work*. Equally important is the constant need for maintenance in the form of *care work* in order to keep a hybrid collective together and to prevent it from dissolving. This type of work involves caring for both the material and human part of the collective. As the focus of the chapter is on the human-technology relations in these hybrid collectives, we emphasize the caring for material actors that took place.

Alignment Work

This type of work is dominant from the very outset of the building of community innovation. In order to analyze the alignment work, we use the IS notion of user innovator (von Hippel 1988) combined with the STS concept of *heterogeneous engineering* (Law 1987), which refers to the various types of work involved in aligning both technical and social elements into an actor-network so as to build stable coalitions that are necessary for the successful development and implementation of innovative technologies. In innovation by user collectives, users are enacting such heterogeneous engineering when bringing into line various elements that are necessary for the development and stabilization of both the innovation community and the community innovation itself. Moreover, we suggest including the agency of material actors in the analysis of alignment work, a feature that is absent in von Hippel's work on innovation communities (von Hippel 2005a, 2005b). In this section, we describe two forms of alignment work: first, the work needed to reconfigure Wi-Fi into an outdoor wide area network, and second, the alignment of a multitude of new actors into heterogeneous user roles.

A Collective Re-Engineering of Wi-Fi

The genesis of the wireless community network in Leiden can be traced back to 2001. At that point in time, Jasper Koolhaas, a Leiden inhabitant, encountered Wi-Fi technology for the first time. Koolhaas, trained as an electrical engineer and fascinated by computer technology, immediately saw the potential of Wi-Fi for creating a free wireless infrastructure. He described the origin of his idea of using Wi-Fi in a completely novel way as a classic Eureka experience:

> *When thinking about this [Wi-Fi technology] a bit longer, at one point I suddenly thought: Holy smoke, this is not just interesting—this is earth-shaking. For the first time in history ordinary people, like you and me, can build a wireless communication infrastructure themselves. Until then this was restricted to governments or big companies . . . Admittedly, radio amateurs were already doing the same for some time, but those infrastructures were only accessible for licensed amateur radio operators. And Wi-Fi is in an unlicensed band, free to use for all.*[14]

By envisioning this innovative future use, Koolhaas clearly enacted a user-innovator role, and not with an economical or personal incentive, but with a normative socio-political one.[15] His role as user innovator can best be understood in terms of a heterogeneous engineer, a builder of a new network of various types of socio-technical relations aimed at democratizing the use of the ether. The first challenge was to re-engineer the indoor Wi-Fi into an outdoor wide area network.

In 1985, the Federal Communication Commission (FCC), the American regulatory agency, had decided on a limited, unlicensed spectrum part of the ether. Free Wi-Fi was only meant for indoor use, and the regulations resulted into devices with limited power and small antennas (Hayes et al. 2010). In order to pursue the aim of re-engineering Wi-Fi into a long-distance, outdoor device, Koolhaas aligned a local network of computer hobbyists. In the first instance, their attempts were unsuccessful. It was only after involving two Leiden radio amateurs and the alignment of their innovative antenna design, that the behavior of long-distance Wi-Fi waves could be mastered. As the initiators worked without any form of funding, another challenge was finding cheap ways of protecting the delicate electronics against rain and wind. They looked for cheap solutions. Using mundane objects like drainpipes and plastic lunch boxes, they constructed a simple and cheap but effective long-distance outdoor Wi-Fi-device.

This innovation of a long-distance outdoor Wi-Fi device can be characterized as collective re-engineering. Various new alliances of various types of knowledge, skills and materials had to be established. User innovators are central in this type of innovation work, although it is important to emphasize that the diversity of users and material agency are also crucial in the analysis of the various forms of alignment work between human and non-human actors involved in the early periods of bottom-up innovation by user collectives. We also found that design choices in these user initiated collective innovations are socio-material and normative in character. The re-design choices described above reflect the envisioned use, that is, a cheap infrastructure allowing free, unlicensed digital communication between ordinary citizens.

Aligning New Actors, Shaping Heterogeneous User Roles

Although the re-engineering of Wi-Fi devices already involved quite some alignment work, most alignment work was needed for creating a citywide infrastructure. In order to realize the further growth of Wireless Leiden, both the wireless infrastructure and user base were developed simultaneously; one could not evolve without the other. Managing this co-evolutionary development of material infrastructure together with building a social community required strenuous alignment work. In this process of aligning various material and human actors, different types of user roles were constructed and various kinds of work and responsibilities were distributed across these various user roles. In this "phase" of the development, the innovative agency clearly goes beyond the individual lead users. The network building becomes much more complex, involving the alignment of a great variety of diverse human and non-human actors.

One of the main challenges was to find financial resources for covering the costs of new wireless nodes (a citywide infrastructure required over fifty nodes). Meanwhile, a new participant had joined the initiators, Huub Schuurmans, a former public relations officer and scientific attaché who had worked in Silicon Valley. Schuurmans became the driving force behind the widespread publicity for Wireless Leiden and fundraising. He actively aligned a great deal of organizational users who sponsored the node production of Wireless Leiden in exchange for free connection. Alongside organizational users, he aligned new citizens to become volunteer users in the building of a node or in lending their rooftops to allow the placement of network nodes. Finally, a greater number of home users were aligned as Wireless Leiden was able to offer free Internet access through the sponsoring of an Internet service provider. In order to realize new nodes, the Wireless Leiden group performed various heterogeneous alignment activities: finding a sponsor, asking volunteers to assemble and program the node, locating suitable locations to put nodes on and getting permission and electricity from homeowners. With the increasing number of nodes, some home users were asked to "adopt" a node. As so-called "Node Adoption Volunteers", these home users took care of the routine maintenance tasks. The growth of WL thus depended on various forms of alignment work, aimed at including a variety of different types of users in the collective: the sponsor user (individual or organization), the volunteer user, the maintenance user and the home user.

In our analysis of the alignment work involved to create and sustain the innovative user collective of Wireless Leiden, we encountered phenomena that cannot be described adequately by the notion of innovation community (von Hippel 2005a). In the innovation community concept, information exchange between users—that is, primarily lead users—is central, while the Wireless Leiden case illustrates that the innovation community members perform many more activities. Even more central than the exchange of information is the continuous coordination of the heterogeneous. The growth and stabilization of the wireless infrastructure was based on constructing, aligning, tuning and supervising these heterogeneous user groups. Skillfully organized and timed public relations activities contributed to the numerous successful alignments between various social groups and Wireless Leiden. It is especially the heterogeneity of all these activities that contrasts with von Hippel's singular focus on the circulation of information. Next to the heterogeneity of activities, also the incentives for performing all this work are not solely personal user needs or economic in character, as von Hippel focuses on. The political vision of producing an alternative form of socio-material culture—free Internet access for all citizens—was a prominent driver behind the alignment work.

Domestication Work

In the previous section, we focused on the alignment work of a small group of initiators, resulting in a locally entrenched hybrid collective. This group successfully aligned a variety of human as well as material actors to create a local wireless computer network "Wireless Leiden". The central claim of this section is that innovation work does not end once the network is up and running. Extending the local network into new places, namely the residences of home users, is neither straightforward nor obvious. On the contrary, strenuous labor is involved, including not only the work of the initiators and volunteers, but also of the home users themselves. This type of work is often rendered invisible (Star and Strauss 1999) in academic literature. In our study of community innovation, home users' work is also central in understanding the dynamics of these types of innovations.

We have labeled the work of home users as domestication work, using the vocabulary of media studies in which the concept was introduced to describe how the integration of innovations into daily life literally involves a "taming of the wild, and cultivation of the tame" (Silverstone and Haddon 1996, 60) or, as Callon (2004, 3) has described this process: "adopting an innovation means adapting it." This very act of "taming" or adapting a new technological artifact is a process that requires work. In the case of a community innovation, we will argue, this work is rather complex and distributed, as the technology (Wi-Fi network) is rather fluid, flexible and not yet stabilized, and the home user has to domesticate a technology that is inextricably bound up with a community.

We understand domestication as a two-way process in which citizens-turned-into-users shape community-innovation-turned-into-something-usable and *vice versa*. For the analysis of the domestication work, we followed the three dimensions distinguished by Silverstone and Haddon (1996): commodification, appropriation and conversion. Commodification refers to the imaginative work by producers and users involved in transforming novel technologies into "objects of desire" (Silverstone and Haddon 1996, 63). Appropriation involves the "taming" work: here, the new technology has to be given a place in daily life. In this process, both the technology and daily life routines are mutually adapted which involves practical, symbolic and cognitive work. Finally, conversion refers to "the importance of the need to legitimate ones participation in consumer culture in the display of competence, and ownership" (Silverstone and Haddon 1996, 65). Conversion is in essence about the circulation of knowledge from users to other potential users and back to producers.

Commodification

For many pioneering volunteers, WL represented a giant technological playground, a "mini-Internet under direct control." However, the initiators of WL strived for a techno-normative goal: free Internet access for Leiden residents. In order to catch the interest of the common Leiden resident, the initiators performed various strategic activities as a means of translating Wireless Leiden into a more tempting commodity. Lacking any financial budget, they had to find new creative ways with which to market their product. First and most importantly, they aligned a commercial Internet service provider to their network, enabling them to offer free Internet access. Second, they managed to present themselves as a newsworthy item in the media. It was the combination of free Internet access and the charm of an idealistic non-profit organization that aroused the interest and willingness of journalists to write about Wireless Leiden and thus provide free publicity. To quote one journalist: "*Personally I think Wireless Leiden is a very sympathetic organization. It stands for free exchange of information and the supply of cheap Internet access.*"[16] By aligning the press, the initiators not only created publicity, but also endeavored to build on their broader reputation. Media attention was also enlisted on the Wireless Leiden website, functioning as a rhetorical device with which to convey an image of credibility. In addition to humans, non-humans were also aligned to support WL publicities, such as Internet search engines. Initiator Jasper Koolhaas: *"I pushed information about Wireless Leiden really hard into Google."* This work resulted in Google listing Wireless Leiden at the top of its search results.

Much of the strategic work of the initiators in aligning various intermediary actors, like journalists and search engines, resulted in successful public relations and branding of Wireless Leiden. However, the residents too had to perform commodification work to "find" and make Wireless Leiden desirable. First, a number of Leiden residents visited one of the information meetings "Join and Get Connected" as a means of informing themselves. At the meetings, they learned not only about the wireless infrastructure, but also about the community: a friendly bunch of helpful local volunteers trying to build a free infrastructure for the local community. "Getting connected" was thus not restricted to becoming informed about getting access to the wireless infrastructure, but also to becoming connected to the community. Being informed is one thing, but deciding to become a Wireless Leiden user is another. How do people come to value a community innovation such as Wireless Leiden as "desirable"? During our interviews with Wireless Leiden users, we found three different "desirability narratives". The first type of narrative centers on Wireless Leiden as zero-cost Internet, used in particular by residents with low budgets. The second type of narrative constructs Wireless Leiden as an alternative gateway to Internet in sites that were not covered by commercial broadband providers (e.g., summer houses in allotment gardens and some rural areas). In the third desirability narrative, Wireless Leiden was a "toy", a playground for experimenting with and learning about wireless technology. For these users, the possibility to learn about it in a community was one of the primary motives for connecting to Wireless Leiden.

Thousands of Leiden residents have performed these various types of imaginary and informative work in order to turn a community innovation such as Wireless Leiden into an "object of desire" (Forty 1986). Once having arrived at this point, purchasing Wireless Leiden and getting it to work again was not a simple straightforward act, as a special outdoor Wi-Fi antenna was needed to connect to the network. A number of residents chose to build a cheap antenna themselves by buying a cheap kit package (ten euros) at the local electronics shop Kok, but for others, this was far too complex. They could purchase a more expensive so-called Wandy client, a pre-configured plug-and-play outdoor Wi-Fi device that was developed and commercially produced by one of the early Wireless Leiden initiators.

To sum up, the commodification work involved in extending the local Wireless Leiden network into new places, i.e. people's homes, can still be understood as alignment work. Such strategies included aligning intermediary actors, developing black boxed solutions for connecting to the Wi-Fi network, effectively delegating many technicalities to pre-configured devices and offering an infrastructure of support. Interestingly, in the commodification of community innovation, there is a place for both noncommercial build-it-yourself initiatives, as well as for commercially packaged plug-and-play solutions.

Appropriation Work

The extension of the Wireless Leiden network into the homes of Leiden residents not only involved commodification work, but also appropriation work. In order to give the new technology a place in their daily life, Leiden residents and the Wireless Leiden board had to invest quite some time into getting the system at work in their homes. The Wireless Leiden board created a complete infrastructure of support for home users in the form of information meetings, weekly walk-in consultation hours, how-to and "connection debugging" manuals and a mailing list for home users. One could say that Wireless Leiden created an infrastructure enabling domestication by home users themselves by supporting them in building connections. The question, "Can I connect or not?" frequently proved difficult to answer. We found three types of situation in this regard. First, the home was located in the covered area, and the Wi-Fi signals are strong enough. In this situation, home users had to physically and digitally install the Wi-Fi-antenna. Quite often, the location and shape of the antenna were intensely negotiated with families and/or neighbors. For example, one user camouflaged the top roof antenna in a birdhouse, as his wife "did not like the ugly sight of the strange thing on the roof of their house". Another user met the resistance of his neighbors, and he decided to install a big antenna in his living room (as he lived alone, he did not have to negotiate with his family).

A second type of situation was a home covered by one or two nodes, but with connection problems. For these cases, Wireless Leiden offered a so-called "site survey." A volunteer would visit the home and perform various measurements. In some cases, they concluded that the signals were too weak to establish a stable link, leaving disappointed and *de facto* excluded Leiden residents behind. A third type of situation included the homes that were not covered by one of the Wi-Fi nodes. Such situations could induce the complex process of the building of a new node, thus expanding the Wireless Leiden network. Sometimes, the residents themselves performed quite a lot of work to find other potential users in their neighborhood and to collect the money for building a node. In this manner, thousands of Leiden residents managed to connect to Wireless Leiden and used it for various activities.

Conversion Work

Those home users who succeeded in configuring a stable connection were often proud and tended to share this accomplishment and their enthusiasm with friends and families: *"It's real fun showing my connection to visitors. At first I really got a kick out of it."* (interview with home user Marc).

This showcasing of Wireless Leiden is an important element of conversion work. For some home users, their expression as a Wireless Leiden user went beyond regular social relations. They *actively* used their identity as a Wireless Leiden user to demonstrate their skills, knowledge and competences. Sometimes, they explicitly mentioned reputation building as a motive, saying that it could be useful when applying for a new job: *"For me it's a way of showing what you are all capable of, in addition to your work-related experience."* (interview home user Rob). These types of motives are known from open source communities (Ghosh and Glott 2002), and we also found them among the initiators of Wireless Leiden, in addition to the home users.

A third and most interesting form of conversion took place within the collective itself. Home users, to different degrees, became involved as members of the community. This involvement consisted, for example, of assisting other users at home through the users' mailing list, or of giving presentations in public at open information events. In this way, they assisted other potential Wireless Leiden home users in their transition towards becoming actual Wireless Leiden home users. Their activities—in the form of domestication work—allowed home users to contribute "gifts" in return for the "free Internet" offered by the local community innovation. At the same time, the group of Wireless Leiden builders recognized the value of such reciprocal contributions by acknowledging the expertise of the home user.

This process of home users becoming part of the community innovation is what we propose to label as *communification*. We see communification an inherent element in domestication of community innovation. One cannot understand the complete process of the stabilization of use in everyday life by focusing on the community innovation entering home users' houses without also taking into the account the reciprocal and reverse flow of home users into the community innovation. In this way, the experience and expertise as home users became available for wider circulation within the community.

Care Work

As we have seen in the previous sections, innovation is a complicated process and the complexity does not end after alignment and domestication. In effect, due to their structurally open and fluid designs, community innovations are usually in constant need of repair. In order for the hybrid collective as a whole to be able to withstand forces of resistance over time, connections between its constituting elements need to be continuously monitored, maintained and if broken, reconnected. Technology needs to be taken care of. Without care, every technology will fall victim to deterioration. A Wireless Leiden volunteer formulated this insight succinctly: *"Network nodes are just like living beings and require attention from humans once in a while."*[17] Remarkably, the academic literature on the importance of socio-technical care work for innovation is rather scarce. This theme is *"neglected by nearly* *all commentators as somehow beneath their notice"* (Graham and Thrift 2007, 1). A notable exception is Hyysalo (2004, 2010). Therefore, we plea for maintenance to be given a central position in the understanding of the growth and stabilization of community innovations.[18] This section thus focuses on this less heroic but equally important work of maintenance of community innovation. We conceptualize maintenance as *care work* and analyze how this type of work is distributed over the hybrid collective by delegating responsibilities to its various actors, both human and non-human.

Caring for Technologies

Building nodes from scratch is one thing, but actively maintaining the technology is clearly another thing. Usually, the technically motivated initiators lose interest once the challenging technical problems are solved. One Wireless Leiden board member recalls the pioneering volunteers: "*When ninety percent is working, their curiosity is satisfied and they start tinkering with something new. Users are conceived as troublesome and inconvenient, because they only know Microsoft Windows and ask stupid questions.*"[19] As a solution for the lack of resources for this type of work, a strategy for delegating tasks and responsibilities to home users emerged. The central actor in this care arrangement was the so-called node adoption volunteers (NAV), who took care of the proper functioning of one specific network node. This distributed user-artifact entity proved to be central in the shaping of a stable and reliable network.[20]

Remarkably, the origins of the NAV can be traced back to one of the participating home users. Home users, in a way, collectively acted as a distributed system for monitoring failures of the network by registering their complaints on the Wireless Leiden mailing list about nodes that did not work properly. One of these users did not only want to complain, but also to actively help, although the requirement for volunteer vacancies to have high levels of expertise posed a problem: "*When I look at the list of vacancies, I become disheartened by the level of expertise that is required: project leader, people who know the ins and outs of TCP/IP.*" This posting on the mailing list started a discussion, and one contributor put forward the idea that users should be permitted to adopt the specific node they are connected to. This idea received many positive responses, and many home users volunteered for a node adoption. The motivation was reciprocal in character and based on a gift economy: "*I would like to invest some time into this so I can do something in return for the Wireless Leiden network I am using.*" The invention of the "node adoption volunteer" was based on the home user's specific interest in the correct functioning of "their" local node. Their involvement in enacting care work was based on their local attachment to individual pieces of the infrastructure, mirroring maintenance and repair as described in de Laet and Mol (2000). As such, inventing the "node adoption volunteer" can be seen as a pivotal element in the community innovation process.

This specific type of caring activity can best be understood as an act of "caring for technology". In order to capture the affective associations between human and non-human actors involved in and driving this particular type of care work, we introduce the concept of the *"warm user"*. Warm users feel an affective bond to a technology that brings them something positive. With the node adoption volunteers as "warm users", we see similar processes at work as described by Bakardjieva (2005). In her study of the way in which experts help (without cost) people nearby to access the Internet, she introduced the notion of "warm expert" to refer to people who are knowledgeable about the Internet and have a close personal relationship with the novice internet user. Most importantly, Bakardjieva emphasized that the "economy of the warm expert helping a close-by person is not financial but gift-based" (Bakardjieva 2005, 99), an aspect that is characteristic of the Wireless Leiden community. Within a community innovation, the gift economy is a central principle on which maintenance and support work is organized.

Caring About Technology

Some maintenance problems generate complicated technical puzzles. Volunteers thrive on the intellectual challenge of finding a creative solution to tough problems, especially when repair work leads to redesign. In order to fix something, an actor has to think up, design and implement a new solution. Succeeding offers an intellectual reward, and the recognition of competence by peers; this eventually leads to an increase in reputation, sometimes even exceeding the boundaries of the innovation community. This particular type of care work often included creative redesign of the artifacts that had broken down or stopped functioning correctly. In this manner, care work on individual artifacts became part of iterative cycles of improving design, based on the feedback of individual, locally situated solutions into the collective, thus enabling artifacts to become more robust and more resilient to forces of resistance. In order to capture the ingenuity of the actors involved in this innovation by caring, we will refer to this type of user as *"virtuoso volunteers"*.

To provide an example, the scaling up of Wireless Leiden from a few nodes to several dozen caused severe problems in the routing software. The initial dynamic routing software became unstable. The first solution was sought in a less advanced static routing, but this again required a lot of manual work. The network became more error prone, as static routing was not able to handle a local node failure. One of the volunteers, Lodewijk Vöge, decided to write a completely new dynamic routing program that became very successful. For Vöge, solving this complicated technological problem formed a great intellectual challenge; Wireless Leiden functioned for him as a stage that creates visibility for this technical competence. Vöge was just one of the virtuous volunteers. Others too, in various ways, contributed to solving the technological challenges of keeping Wireless Leiden functioning.

This type of care work actor is intrinsically motivated by "tinkering with technology", working intimately with technology as part of a broader identity project.[21] For these actors, community innovations provide a stage for performing technical competencies as part of their masculine identities. In community innovation, care work can be understood as part of identity projects, enacting and maintaining specific images of personal identities. In the process of community innovation, and particularly in the case of Wireless Leiden, it is not only a stage for performing identity work that is provided; those involved integrated the aura of "innovation" of the collective into their personal identities to display their technical competencies.

CONCLUSIONS

In this chapter, we have described a rich variety of different types of work and heterogeneous skills of involved user groups underlying the rise and growth of community-based innovation. This work is, for the most part, performed by the unpaid citizens, like the lead users, the initiators, the technically skilled volunteers and the official board members. Notwithstanding the fact that this type of work is crucial for developing a sustainable and successful community innovation, our study also highlighted the equally important domestication work and care work done by home users and node adoption volunteers. These are actor groups whose work, skills and competences tend to be rendered invisible in the actor-network approach in STS as well as the mainstream user studies in innovation studies. Equally important, we described how non-human actors are active members of such communities. In order to emphasize this point, the notion of a *hybrid collective* offers a better description than *innovation community* because it takes into account the mixed memberships of both humans and non-humans. As we have seen, alignment work and care work in innovation by user collectives is inherently distributed across human and non-human actors.

Summarizing and reflecting on our empirical findings, we present "a convenient vocabulary" (Akrich and Latour 1992) capturing specific characteristics of community innovation that are needed to specify what sets community innovation apart from other types of innovation. The concepts that we found to be central in the understanding of community innovation are diversity, reciprocity and communification, warm users and fluid and open technology.

Diversity

Understanding innovation by hybrid collectives requires not only attention to the different types of non-human actors, but to the diversity of human actors as well. In the analysis of our case, we found a mixture of unpaid volunteers, hobbyists, amateurs and various types of users involved in innovative technology practices. Although many innovation studies accounts give credit to the role of users in innovation, there is a dearth of attention given to the full diversity of actor types. Most studies on user innovation primarily focus on initiators. In current user innovation discourse, the dominant imagery depicts primarily "individual heroes", an "expert elite" consisting of "lead users", "user-innovators" and "user-entrepreneurs". Although these actor types might be the dominant ones representing innovative technology practices rooted in economic values, differently valued technology practices include many more types of actors. It is this diversity of actor types enacting innovative technology practices that characterizes the dynamics of community innovation.[22]

Warm Users

Whereas in many innovation studies, initiators and lead users "steal the show", there is more to community innovation than the involvement of these virtuoso volunteers. While this latter group is usually involved in caring *about* technology, sometimes even reaching levels of fanaticism and fundamentalism, these elite experts are not automatically interested as much in caring *for* technology. Tinkering practices are rooted in the pleasures and powers of "mastering" technology, while technological caring practices are rooted in "nurturing" technology (Hyysalo 2004). Both virtuoso volunteers and warm users can be highly emotionally involved with and attached to certain technologies. Both types of actors share a certain love for technology, in which elements such as intimacy, passion and commitment can be identified. The warm user concept thus helps to make visible those actors engaged in doing community innovation: not only the small group of elite expert "initiators" of community innovation, but also its usually more numerous "user" base. Additionally, the concept of warm users shifts the affective character of the human-technology association to the foreground.

Although care work—in relation to the technology practices usually described as maintenance or repair work—as a label is well known and certainly not new, its inclusion as an intrinsic part of innovation is rather novel. Based on our analysis of the dynamics of community innovations, one can argue that existing notions within the current innovation vocabulary as "learning-by-doing", "learning-by-using" (see Rosenberg 1982) and "learning-by-trying" (Fleck 1994) could be extended with *"learning-by-caring"*.[23]

Reciprocity and Communification

Crucial to understanding the infrastructures of support in the case of Wireless Leiden is the fact that the process of community innovation is not rooted in a market-based economy, but in a gift-based economy. Although there is no money paid for service and support work, other types of reimbursements are expected, although never formally required. Understanding the support arrangements in community innovation requires a broader perspective on economies, not only limited to financial transactions, but gift-based transactions. Such gift-based economies are based on the principle of reciprocity. Examples of reciprocal gifting by users in return for help include writing documentation, answering other users' e-mails and giving presentations. The economy that enables Wireless Leiden to function is one based on gifting based on "warm" relations.

It is interesting to look at how such return gifts are channeled back into the hybrid collective. In the previous section on users who care, the focus was on individual user-object pairs. Warm users as well as virtuoso users often form pairs with specific individual artifacts and technologies. Warm users usually care for the nearby nodes that provide the connection between their homes and the larger wireless infrastructure. Virtuoso users often specialize in a specific element, such as designing and building outdoor node cases or writing and maintaining a specific piece of software. This raises the question of how all this localized individual user-technology bonding is folded back into the hybrid collective. In order to understand this process, we introduced the concept of *communification,* understood as a kind of inverse domestication. Whereas domestication is a process of "taming technology" aimed at aligning artifacts within use practices, communification is a process of "socializing users" (and their practices) into the distributed hybrid collective. Both processes deal with alignment, one of alignment between specific technological devices and users, the other between users and specific technologies resulting from community innovation. Communification is essential for innovative civil collectives that have a political aim of realizing social change through an alternative material culture (Hess 2005), and thus aim to spread their innovation as widely as possible.

Fluid and Open Technologies

What can we conclude about the characteristics of the technologies—the non-human actors—that are part of community-based innovation? Our claim is that technologies of community innovation share two distinctive characteristics: fluidity, and related to it, openness. Both notions deal with the boundaries between technologies and surroundings.[24] More specifically, fluidity concerns the form of these boundaries, while openness relates to their function.

The technologies involved in community innovation can be considered to be fluid technologies (de Laet and Mol 2000).[25] The most relevant, characteristic element of fluid technologies is their lack of solid and sharp boundaries: they draw from and blend with their environment to coexist. Openness points to an underlying mechanism, to how these boundaries have become and remain fluid and permeable. De Laet and Mol already point in this direction, stating that the creation of boundaries that are sharp and solid not only require work, but a specific type of work is also required to create the inverse, namely boundaries lacking sharpness and solidity. Openness relates to "reflective practitioners" explicitly stressing access, explicitly "opening up" technology, by designing a built-in openness, facilitating access to the inner workings of a technology during different types of technology practice.

In the case of Wireless Leiden, openness is an element that is key to its organization. From the outset of the initiative to assemble a Wi-Fi net in Leiden as a cooperative collective, openness was one of its key organizing principles. Technologies can be open in different ways: based on open standards, based on open source software, hardware and org-ware or based on open access. The first form of openness encountered in the case of Wireless Leiden is the openness of the ether. The Wi-Fi technology that ignited the initiation of community wireless networks such as Wireless Leiden lends its very existence to the governmental policy of opening up restricted parts of the ether for anyone to use in the domain of wireless computer networking. Without a commons in the ether for open-air computer communication, community innovation could not have existed, at least not in the various forms, extended scales and high numbers we know today.

In addition, Wireless Leiden is built on open source software. Its infrastructure relies completely on a skillful amalgam of different software, which all provide open access to their source. Source code is invisible during normal interaction, however, when a technology breaks down, access to these inner elements is necessary in order to enable replacement and repair. In the case of software, access to its source code provides its users with the freedom to use it, study and adapt it, improve it and redistribute copies to a wider community.

Consequently, the key to understanding what sets the technologies resulting from market-based innovation apart from those of community-based innovation is the "closedness" of the first versus the "openness" of the latter. The concept of fluid and open technology helps to contrast it with black-boxed technology, which is the usual phenotype of technologies that emerge as products of market-based innovation. Important to note is how the process of innovation, and its degree of openness or closedness, and the strictness of boundaries between different actors, practices and locations are mirrored in the material design of such technologies. Additionally, whereas black-boxed technologies fit in well with a strategy of silencing user values or communality values in order to maximize the economic value, fluid and open technologies resonate better with configurations in which multiple values of technology practices are deemed important.

However, equally important is that during the development of a community innovation, the norm of openly sharing knowledge remains a core value in the community, as only then will innovative technologies of the community itself truly be and remain open and fluid (O'Mahony 2003).[26]

In sum, we conclude that this vocabulary provides adequate heuristic tools to enrich our understanding of the *full* dynamics of collective innovation processes, including the different types of work and actors. The worth of collective innovation can only be assessed by addressing conceptualizations and perspectives that go beyond the "mere" economic value of innovation.

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NOTES

1. For socio-technological perspectives on economic markets, see Callon 1998.
2. See also Chapters 3 and 9 of this volume.
3. Community is a broad notion with many different interpretations. However, we built on the notion of community as a concept to describe a new form of organization (see Amin and Cohendet 2004; Knorr-Cetina 1999; Lave and Wenger 1991; Callon and Law 1995). Because of the interpretative flexibility of the concept of community, and its many different interpretations, such as community of interest, community of practice (Lave and Wenger 1991), geographically bounded community or even "imagined community" (Anderson 1983), in our process we refer to a "hybrid community" (Callon 2004) to stress the inherently mutually intertwined relations between both human as well as non-human actors involved. The crucial notion here is that the innovative agency is distributed over the collective of both human as well non-human actors connected in the network, which then as a whole acts as a "center of innovation".
4. For more information on the Wireless Leiden initiative, we refer to its website presence at http://www.wirelessleiden.nl/en.
5. This is especially the case in extreme or very specific sports communities (e.g., kitesurfing and handicapped sports). In open source communities, information remains in the commons.
6. Looking back, this implicit attention to product design as a variable for user innovation in von Hippel and Finkelstein (1978) resonates with the notion of affordance introduced in order to argue for "a recognition of the constraining, as well as enabling, materiality of artefacts" (Hutchby 2001, 441).
7. For a further analysis of different approaches for representing users, see the chapter by Hyysalo and Johnson in this volume.
8. On "the semiotic turn" in the actor–network theory, see van Lente (1993, 215–19). For a recent overview of the literature on the agency of users in innovation, see the chapter by Hyysalo and Johnson in this volume.
9. For the sake of historical completeness, Ludwik Fleck was the first to introduce the importance of the collective as a unit of analysis for processes of distributed innovation with his notion of "Denkkollektiv" or "thought collective" (Fleck 1979 [1935]).
10. See Oudshoorn and Pinch (2003, 7) for a more detailed discussion of the criticisms of actor–network theory.
11. For a discussion of typologies of users, see Friedman and Cornford (1989, 169–88).

12. Although other large Wi-Fi initiatives exist (e.g., Freifunk in Berlin or DjurslandS.net in Denmark), the completely wireless "backbone" of the Leiden infrastructure was technically unique at the time of inception.
13. A full account of the methodological justification can be found in Verhaegh (2010, 24–26).
14. Verhaegh 2010, 33.
15. A clarification in order to prevent potential analytical confusion: in relation to the Wi-Fi technology as it was commercially available in 2001, Koolhaas can best be analyzed as a lead user. However, in relation to the Wireless Leiden project he initiated in order to address his specific vision for a local wireless community infrastructure, his role can be best understood as a user-innovator.
16. Verhaegh 2010, 55.
17. Verhaegh 2010, 98.
18. Due to the reason of limited space, we focus on caring for the material part of the hybrid collective. Caring for humans in the Wireless Leiden collective and the work in keeping humans aligned to the network have been analyzed as *coordination work* (Verhaegh 2010, Chapter 5).
19. Verhaegh 2010, 101.
20. Michael (2000) introduced the notion of co(a)gent for thinking about distributed entities.
21. For further elaboration on this point, see Freeman (2007) and Ratto (2007).
22. The notion that diversity fosters innovation is not new in STS. For an example within innovation, see Truffer and Dürrenberger (1997), who address the relevance of heterogeneity by emphasizing the role of "outsiders" in creating "innovative milieus". On the importance of the diversity in user studies, see Oudshoorn and Pinch (2003).
23. Hyysalo (2009) argues that there are limits to introducing new types of "learning by" based on Arrow's introduction of learning by doing in 1962. The problem is that not all new types of learning bys have a verifiable referent in a learning process that can be substantiated.
24. In this chapter, we attempt to generalize our findings from this single micro-scale study on community Wi-Fi. For other studies on community Wi-Fi or similar wireless networking technologies, see, for example, Benkler (2002), Medosch (2004a, 2004b, 2004c), Sandvig (2004), Werbach (2004), De Jong (2005), Fuentes-Bautista and Inagaki (2005), Mackenzie (2005), Stoll (2005), Wieringa (2006), Dobusch and Forsterleitner (2007), Dunbar-Hester (2008), Verhaegh (2008), Dunbar-Hester (2009), Hayes and Lemstra (2010), Söderberg (2011). A conceptual discussion of these various cases of community Wi-Fi would be interesting, yet goes beyond the scope of this chapter.
25. Similar notions have been developed by other scholars, for example, boundary objects "that are both plastic and coherent through a collective course of action" (Star 1989, 45) and the "configurational technologies" of Fleck (1988).
26. In his analysis of a similar wireless community in Prague, Söderberg (2011) has shown that this is not always the case. Here, tensions between economic and idealistic incentives lead to a severe split in the community.

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9 User Communities as Multi-Functional Spaces

Innovation, Collective Voice, Demand Articulation, Peer Informing and Professional Identity (and More)

Hajar Mozaffar

INTRODUCTION

In 1984, Oracle Corporation, one of the largest software development companies, formed a user group called "UKOUG" as its unique point of interaction with its wider user base. The UKOUG, consisting of approximately 300 corporate users, was an attempt by the vendor to coordinate the activities of the widespread informal user groups that were formed around UK. As the product range grew, so did the user group, which in 1989 became an independent not-for-profit organization organized and run by volunteers. By the early 1990s, the vendor released its enterprise resource planning (ERP) application. This led to the considerable growth of the UKOUG. The user group, which once consisted of a small number of special interest groups (SIGs) around Oracle technologies, expanded to more than twenty SIGs around technologies and applications. By that time, the user group adopted a not-for-profit membership organization whose events were run by volunteers. By 2013, the user group had over 8,500 member contacts.

In this process what was once a uniform, vendor-governed organization was transformed into numerous settings, joint at top level, but managed and operated significantly differently at various levels of functioning. Almost three decades after its formation, contrary to its primary goal, the configuration point of users by the vendor, the UKOUG had moved beyond a single- entity-managed community to one with a diverse set of roles and Practices directed by different actors, hence facing tensions as well as new achievements.

Although there are various strands of research looking into the dynamics of user communities, there are yet no in-depth studies that offer insights into range of key functionalities of these communities. User innovation studies focus on the outcomes of users' innovative actions to develop products to better fit their needs, and the capacities of the users in communities for doing so (von Hippel 2001, 2005, 2009; Franke and Hippel 2003; Lakhani and Wolf 2003; Füller et al. 2006;). These studies tend to emphasize the free sharing of users' ideas, but neglect the impacts of tensions resulting from the diversity of users as well as presence of other actors, such as intermediaries in the communities (Di Gangi and Wasko 2009). Some scholars, looking into the adoption of user innovation in firms, recently argue that the complexity of innovative ideas and problems in disclosure against competitors make it difficult for firms to employ communities as sources of innovation (Di Gangi, Wasko, and Hooker 2010), and a collective within the community is needed to make innovations that can be valued and applied by adopting firms. Research has also been indifferent to the nature of artifacts to which user communities are attached to—for instance, sports equipment, application software and large, expensive information systems pose very different settings for user community organization (Hyysalo 2010).

In this chapter, I present evidence on how the homogenization of findings from studies on different types of technology is unhelpful, for it not only glosses over significant varieties of actors with significantly different interests and actions, but it also blunts the possible effects of the technology on the community and vice versa. Adapting the Biography of Artifacts (BoA) approach and drawing from a strategic ethnographic study of several user groups functioning around the ERP products of a leading vendor, we begin by briefly exploring the fine-grain details of various user groups and trace the performances and the linkages (between different actors) offered by such communities as they are framed and explained by participants. The findings are presented as a typology of functions of user groups, which represent the performance of community (community as a stage for different acts), their offered linkages between actors and their influence on the artifact. We do not suggest that this study offers a complete list. Instead, it reveals how a variety of acts are performed in different types of user groups to respond to a diversity of needs and interests. We conclude by arguing that user groups should be seen as multi-functional spaces rather than mere innovation communities.

IMPORTANCE OF ENTERPRISE SYSTEMS IN THE STUDY OF USER COMMUNITIES

Generic enterprise applications can be defined as communities of constitutive joint technologies (Koch 2007). They are characterized by their standard nature. In this respect, there is not a considerable difference between them and many other commodities. Producing commodities means carving homogeneity (Kopytoff 1986) to cater to heterogeneous settings. Such commodities can be "configured" (Fleck 1988) by various actors to meet their diverse needs. This standardization is enabled through a strategic social distancing of vendors from users (Johnson et al. 2013). In response to these detachments, users employ various ways of meeting their own needs, such as innovating a solution or assembling into groups or communities (von Hippel 2005) to overcome the "standardization" and "distance" barriers.

These characteristics are seen in a broad class of technologies, such as ERP applications.

Enterprise systems have been widely discussed by academics for the past two decades. Esteves and Pastor (2001) identify 189 studies from 1997 to 2000. Moon (2007) highlights a further 313 articles published around different aspects of ERP between 2000 and 2006. More recently, Eden, Sedera and Tan (2012) conducted a further study of ERP literature between 2006 and 2012 that points to 198 research publications. In their study, Eden, Sedera and Tan (2012) also explored the earlier research on ERP literature and offered a comparison of their findings over the following three periods: 1996–2000, 2001–2005 and 2006–2012. Many of these studies draw attention to the ways in which such systems repeatedly fail to meet vendor's promises and hence leave customers with a large deal of overlooked requirements (Wagner and Newell 2004; Williams and Pollock 2012). Amongst these studies, some point to the existence of complex user communities around these systems, yet without the details of such communities and their role in the development of the products (Williams and Pollock 2012).

Hence, as studies highlight the importance of such communities in helping to conquer some of the difficulties in the development and use of complex commodities, the present chapter contributes a detailed analysis of several user community settings around enterprise systems, which is more broadly useful in understanding how user groups around this particular type of software are shaped and how they, in turn, affect the evolution of this class of artifacts.

TRANSCENDING A PARTIAL PERSPECTIVE ON SOFTWARE USER COMMUNITIES

The importance of user groups has been widely discussed. Von Hippel (2001, 83–84) states that "user innovation communities shouldn't exist, but they do," and argues that the products of such innovations can compete "head-to-head" with manufacturer innovations. Examples of such innovation have been highlighted in the development of many different types of software technologies. For instance, there is a long-standing recognition of the role of such groups in the development of open source software (cf. von Hippel 2005; von Krogh and von Hippel 2006; Roberts et al. 2006; Garriga et al. 2011; von Hippel and von Krogh 2009, 2011). While this view is strongly valid, the notion of the user community covers a much wider range of technologies and products. While for a long time, there have been discussions of involving users in the design of packaged software (Keil and Carmel 1995; Sawyer 2000), recently, the role of online communities in such package developments has been widely acknowledged. In particular, studies on computer games show why and how online user communities overcome many of the challenges caused by the lack of a direct vendor-user link in traditional packaged software development models (Holmstrom 2001; Holmström and Henfridsson 2006; Wiertz and de Ruyter 2007; Hau and Kim 2011). Other scholars such as Füller et al. (2006) point out the importance of community-based innovation in the development of user-preferred product features. There are also studies that go as far as discussing the strategies adopted by firms to generate user innovation and integrate them into the firms' systems (Jeppesen and Molin 2003; Jeppesen and Frederiksen 2006; Antorini and Muñiz 2013). Recent studies investigate the role of communities beyond the development of personal products. For instance, Hyysalo (2010) refers to communities as a source of innovation for vendors around health information technologies. Similarly, in the case of complex workplace technologies such as ERP solutions, Clausen and Koch (1999) state that user groups are essential for conquering the complexity of system implementation, and Pollock and Williams (2009) indicate these user groups as spaces where users' ideas can be fed back to the vendors. Johnson et al. (2013) also identifies user communities around complex infrastructures (both in personal and organizational technologies) to be one of the most important coupling mechanisms between the vendor and its wide range of customers.

The mainstream studies around user innovation share a basic assumption that in response to particular needs which are not fulfilled by vendors, users innovate (von Hippel 2005). Many of these studies ignore the tensions and conflicts that result from the heterogeneity of these communities. The majority of scholarly attention in this field has been given to quantifying users' motivations for taking part in the communities, and showing the successful products as outputs of the process. In this manner, they have focused selectively upon certain aspects and moments.

Firstly, the mainstream research does not offer insight into the detailed processes and outcomes of acting in user communities (see also Verheig et al., this volume). Secondly, there is no unpacking of the wide range of actors and the influence they may wield in shaping the space. Thirdly, the lack of a detailed understanding of user communities has led to a further assumption that user groups are purely "sites of innovation," and neglects the fact that they could have other roles and effects on the shaping of technology that may even supersede their direct innovation outputs (Hyysalo et al. 2013; Johnson et al. 2013; Pollock and Hyysalo 2014). In this manner, there is no inquiry into the detail of functioning, linkages offered between different actors and tensions involved in such communities that may lead to or detract from the innovativeness of such settings.

To overcome the limitations in studies of technology user groups, we will adopt a science and technology studies approach to offer in-depth insights into the fine-grain details of user communities. This approach, adapted from a combination of the Biography of Artifacts (Pollock and Williams 2008) framework and strategic ethnography, investigates the performance and influence of communities around an ERP system in multiple locales. Hence, rather than focusing on a one community, we will look into several user groups in various forms and shapes to offer a multi-spatial perspective on their functions.

RESEARCH STRATEGY AND METHODS

A major critique of traditional interpretive qualitative studies is that they often provide "local narratives" (Carlsson 2003) and focus on immediate actions (Kallinikos 2004) that ignore what could occur in longer timeframes (Karasti et al. 2010, Hyysalo 2010). This leads to a lack of adequate understanding of the evolution of a technology and how it is shaped as its moves over time and space (Pollock and Williams 2008). Pollock and Williams (2008) too criticize single time/space studies by showing that such studies result in a partial and often highly biased image of reality. These issues call for more nuanced ways of designing research around complex workplace technologies.

Thus, concurring with the views of multi-sited ethnography that offer a better understanding of complex situations (Hine 2007), and encountering multiple locales and moments of technological change (Kallinikos 2004, Pollock and Williams 2008), we will adapt the BoA framework, which suggests following the artifact as it evolves over time and space (Kopytoff 1986; Du Gay et al. 1997; Pollock and Williams 2008; Hyysalo 2010; Du Gay et al. 2013). In their BoA framework, (Pollock and Williams 2009) offer "strategic ethnography" as a flexible research approach that is applicable to different contexts through the involvement of multiple spaces, using multiple methods informed by the research questions.

While ethnography as the most "in-depth" or "intensive" research method (Myers 1999) allows the comprehension of settings "from the native point of view" (MacDonald 2001) in a way that is unlikely to be obtained using other research approaches (Liamputtong 2009), the "strategic ethnography" approach emphasizes a "theoretically-informed, multi-site and longitudinal" ethnographic study that underlines the importance of choice of settings and scope of the study to be informed by provisional empirical and theoretical understanding of the locales under investigation. Hence, this study uses the above criteria to collect data from multiple sites and long periods of time. Furthermore, the researcher takes the role of an emic ethnographer (Kottak 1996) to go native in the field, but at the same time to stay focused on the analysis of the order through a theoretically informed perspective.

Data Collection

This study draws on the observation of the events organized by the UKOUG over a period of three years, in all comprising over 150 hours of field observation at key sites and moments of activities of this user group. It

Table 9.1 Data Collection Methods

Method	Data Period	Description	Further Detail
Observations	May 2010 to April 2013	Observation of user group meetings, including special interest groups and customer forums (over 150 hours over a 3-year period)	11 special interest group meetings, 8 customer forum meetings, 2 other types of meetings
		Observation of user conferences	4 conferences
Interviews	May 2010 to April 2013	15 semi-structured interviews (ranging from 30 minutes to 2 hours)	Interviews with community organizers and vendor employees
		Informal short interviews (less than 30 minutes)	Interviews with attendees of meetings, including organizational users, vendor employees, intermediaries[1] and freelance consultants
Access to email discussions	2010–2013	Member of the UKOUG mailing list since July 2010	Also access to 6 years of archived messages in the mailing list

complements these observations with semi-structured interviews and document searching on the Oracle website and the UKOUG document library. Table 9.1 gives an overview of the data sources and modes of data collection used for this chapter.

Data Analysis

Grounded theory was used to categorize the data obtained from the observation of various user community events as well as interviews into detailed groups of "acts by actors." This process was followed by categorizing the codes based on the meanings of the acts, because, as Miles and Huberman (1994, 56) state, "it is not the words themselves but their meaning that matters." In conjunction with the coding process, we noted analytical memos to facilitate the development of theoretical ideas around the identified codes (Corbin and Strauss 1990; Glaser 1992; Urquhart 2001; Charmaz 2006). At this stage, instead of word-by-word or sentence-by-sentence coding, we identified codes after obtaining more complete ideas or concepts within each event. In other words, we analyzed the transcripts on a case-by-case basis to be fully immersed into the context and contents while examining the data. This involved breaking each event into sub-events to be analyzed in detail to produce the codes. Table 9.2 is an example of coding of a short part of one session. Subsequent to the completion of the initial coding, we built the sub-categories and categories, which were represented as typologies of functions. This required the putting back together of the fragmented codes by finding variations in patterns (Glaser 1978), and comparing and finding relation (Urquhart 2013). We continued collecting data and analyzing simultaneously until data saturation was reached. It is worth mentioning

Table 9.2 Part of Initial Coding of OUG Scotland Event—Talk 3

Overview: OUG Scotland—October 6, 2011, Talk 3: jQuery, 45-minute presentation, 15-minute Q&A, presentation by a third-party organization, approximately 20 attendees, mostly from user organizations, but also from Oracle as well as freelancers

“Quotes” [or Observations]	Analysis Codes
“My name is . . . and I have 14 years of experience with Oracle Technology.” [An explanation of jQuery:] – “A layer on top of Java Script” – “Install it in your application” – “Very easy to use” – “Here is a sample:” ‘<!—Document Ready? → <script type = “text /java script”> $ (document).ready(function()) //do some query!)); </script>’ – [Begins with simple codes then moves on to more complex codes, explaining detail on what each part does. This explanation is detailed enough for a technical person having basic knowledge of Java. He further shows sample codes available on the website and how they can be used with detail] – [To emphasize ease, he used jQuery for his presentation instead of Power Point]	Self-induction Affiliation Session opening Technical placement Staging the ease/flexibility Technical detail Technical progression Instructing on use Explaining the updates Introducing innovative ways of doing things Staging the uses of applications
[Throughout the session, detailed questions were asked by participants] – “If from [company name] . . . what if our parameters are coming from an external database?”	Self-induction Affiliation Needs proposed Technical detail Technical placement

that the found themes were reported back to the community in various ways (through publication in their magazine, OracleScene, presentation in a conference and presentation in a customer forum) and refined several times based on written and verbal feedback from the community members followed by detailed (agreeing or opposing) discussions.

THE PERFORMANCE OF THE USER COMMUNITY

"The UK Oracle User Group is one of the largest and most active independent user groups around Oracle products" (Interview, vendor). Oracle is one of the two largest vendors of packaged enterprise systems in the world. It started to release software packages in the early 1980s, with Oracle Financial Package being its first widely used software application. During that time, users from various organizations met informally to discuss the issues surrounding Oracle products. Then, in 1983, as Oracle products were more widely used by UK organizations, Oracle formed a user group to create a unique point of interaction with its wider user base, known as the UKOUG, in an attempt to coordinate the activities of widespread informal user groups. In 1988, as Oracle released its first enterprise integrated application, called the Oracle Accounting System, the user group adopted a membership model, and by 1989, it became an independent not-for-profit organization run and organized by user volunteers. By the early 1990s, the vendor had released the Oracle E-Business Suite (EBS) ERP application, which engendered the considerable growth of the UKOUG. The user group, which once consisted of a small number of SIGs concerned with the technical aspects of Oracle, expanded to more than twenty SIGs concerned with technical and functional issues. By 1993, the number of members grew to 550. Oracle continued the production of new versions of the EBS, and by the year 2000, EBS 11i was released, which is currently the most widely used Oracle ERP application. By this stage, UKOUG had over 1,700 corporate members. Then, by the mid-2010s, the new line of Oracle ERP application, The Fusion, was released. This was after the UKOUG had faced a drop in member numbers (in late 2000s), and had undergone a restructuring of its organization. A few years after the financial crisis, membership in the UKOUG gained momentum again, and by 2013, the number of named members rose to 8,500.

UKOUG afford dispersed actors the opportunity for interactions around Oracle-related products. The community constitutes a wide range of events and resources offered in various types of settings. They include face-to-face meetings in the forms of application module SIGs, technology SIGs, customer forums and conference series, as well as online communities ranging from social networking sites to mailing lists. Users from geographically distanced adopting firms make up the bulk of participants in the user group meetings. These are the key players in the communities around which many of the interactions occur. Vendor employees too attend events on behalf of the vendor corporation. In some SIGs, due to mergers and acquisitions, members from companies acquired by the vendor also participate in events. In addition to the main participants, there may also be those freelance consultants or representatives of third-party organizations that offer tools, products and services to complement Oracle's products. Below, we will demonstrate our exploration into this field.

Community as an Arena of Power

During our fieldwork at UKOUG, we observed the negotiations of power dynamics between users and the vendor. While earlier studies reflect on issues of power in enterprise systems and conceptualize the vendor-user relationship as a technical exercise of vendor power over the adopter organizations (Howcroft and Light 2006), and as a result suggest that users have no or very limited influence on the technology (Keil and Carmel 1995; Regnell et al. 2001; Sawyer 2001; Howcroft and Light 2006), we observed that new power relations and possibilities for wielding of influence were formed through participation in user communities. Participants (from user organizations) were diverse in terms of type of organizational sector as well as roles and duties in the firm. The observations, supported by short interviews with users, revealed that at least one person, and in many cases all interviewees, attended the events in the hope that they could have some type of influence on the vendor's products or strategies (Pollock and Hyysalo 2014). They expressed their wish to "impact" through going beyond the differences and talking through "a common voice" or "a collective word" to have what they termed as "a louder say." In this manner, users urged others to use this space to exercise a collective power with the ultimate aim of mitigating what Howcroft and Light (2006) term as the vendors' "technical exercise of power" in the development of enterprise systems and "structural exercise of power" in defining operating procedures to keep users dependent on their resources.

In our fieldwork, we observed that the user group primarily functions as the key space to connect the wider user community with the vendor. The lack of a direct link between the users and the vendor is said to be one of the main challenges faced by standard applications (Soh, Kien, and Tay-Yap 2000). So such settings, to a certain extent, were used to overcome this issue. The organizational users typically expressed the primary reason for attending community meetings as being a way to create proximity between them and the vendor organizations, leading them to be seen and heard by the vendor and ultimately to get on their radar, so to speak. A user describes this as follows:

> [. . .] *we became a member since 2005. Until then we had no say, we were just one among many and of course Oracle was too busy to notice*

> *us. But since we've become a regular attendee in the meetings we feel much more connected. Not just to the Oracle world* [i.e. other customers] *but also to the vendor* [. . .] *we now have* [an] *impact* [. . .] (Field note, short interview, user)

Secondly, as a consequence of this proximity, participants showed their will for creating a common voice that speaks their needs to the vendor. In this sense, the community was used as a space for users to urge for acceptance of needs by the vendor. In some occasions, this involved primarily promoting the mutual but under-spoken needs among peer users to draw the attention of others to an implicit requirement before it is lobbied to the vendor. This was described by users as "influencing" vendors' products or strategies, which was said to be the ultimate goal of engaging with the community.

Gaining community voice and proximity to vendor have been previously raised as rationales for users to participate in design and promotion of vendor software (Pollock and Hyysalo 2014), and a large user group is clearly a means to potentially amplify users' possibilities for doing so. However, influencing vendor actions was still not always achieved easily. Interviews with users revealed two types of potential barriers: one with respect to user diversities, and second regarding their ability to make an acceptable case for the vendor. In order to overcome these barriers, negotiations in meetings and surveys were a means to initially gather collective views or needs and reach agreements between the variations, and secondly to present them to the vendor in an effective way. As an example, the PSHCM customer forum's Top Ten Priorities List was used first for reaching an agreement, and secondly to exert user community influence on Oracle's human capital management modules. In the PSHCM customer forums, the top requirements of the user organizations were extracted through discussions of the forums committee with the members. The discussions were formed around the requirements negotiated in previous meetings or topics of interest being discussed in the forum's mailing list. Then, on a regular basis, the customer forum called for a survey to identify the "Top Ten Priorities" of user organizations. The list was then updated periodically to identify new priorities and verify that the top three on the list remained the same. The top three priorities were then presented to the vendor for further actions.

A successful case of getting on the vendor's radar to impact the strategies was change on the Oracle EBS 10 license de-support dates. This case, which had turned into a major area of concern for the Oracle users, drove long discussions around the difficulties faced by many users due to termination of the support. This was then put forward to Oracle as a survey showing the need of a large number of users for the extension of the dates. This was explained by an organizing member of the community as follows:

> *Through this common voice, we were finally heard by Oracle. This wouldn't have been possible without the collective action of the*

> *UKOUG. If the user group hadn't done this, every single organization using Oracle 10 would have been affected. So we did this for the larger Oracle family. This is a great achievement by the community, by users, for users.* (Interview, organizer)

Another example of influencing, this time on the product, was the outcome of the PSHCM priority list in 2011. In an e-mail to the mailing list, one of the forum's committee members (a user) announced that the three priorities on the list have been accepted by the vendor organization to be developed in defined time periods.

> *It is anticipated that the first opportunity to target delivery of these features will be the latter half of calendar year 2012* [. . .] *This is obviously very welcome news* [. . .] *It is another sign of how Oracle have come to understand the value of their relationship with the Forum and how we can help play a proactive role in taking forward product development for the benefit of not only the Public Sector but the wider UK customer base. We have already re-stated to Oracle that VDE has to be given top priority* [. . .] (Document analysis, customer forum)

These presented cases, both at high levels of influencing vendors' strategies or fine-grain details of product enhancement, show how the user community may function as an arena of power by imposing "collective pressure" on the vendor. The influence in all observed cases has been a result of collective action by attendees of the user community events. Users naturally also have motivations to influence the outcomes of the community, and as a result, impact other users' choices. For example, during the meetings, we observed some users from a particular organization talking to those from other adopter organizations to convince them to vote for the repositioning of a low-priority issue to the third place on the priority list. This is understandable, as the flip side of prioritization exercises is that such procedure renders all requests specific to smaller groups of user organizations more difficult to put forward.

Through constant interaction amongst user organizations, both within the sub-groups and between the different user groups, user organizations were able to identify common needs and effectively liaise with the vendor regarding an appropriate solution. The actors in the community can thus wield influence over the future development by their "collectively selected solutions," which they may also take an active role in designing (as we detail below). By presenting the above cases, and introducing user communities as spaces for exerting user power, we do not suggest that users have ultimate power over vendors. Rather, we are proposing that what was once mainly discussed as a one-directional wield of power from vendor over user, has reached ways to enable a bi-directional power relationships.

Community as a Place of Innovation

The fieldwork showed that the links developed by the community between users transcended mere knowledge of standard system practice. The intersection of user requirements and ideas in the community brought about incremental changes to the standard products and their perceived uses. So the findings of this study conform with earlier studies on the possibility of user innovation in various technologies (von Hippel 2005; Holmstrom and Henfridsson 2006; Wiertz and de Ruyter 2007; Hau and Kim 2011) by revealing instances of user-generated solutions in enterprise systems user communities. As the users strived to find solutions for their needs, the user group acted as a point for generating and sharing of innovation. Users may take an active role in generating new solutions and disseminating them through the community. Innovative ideas were put forward to the community by some users, and others with relevant expertise and skills developed them further. In this manner, the user groups functioned as a locale where innovative ideas and inventions are collected and turned into operational pieces of functionality which could be taken up by the users or, in more particular cases, could make their way into the product through the link developed by the community between users and the vendor. In the former case, different solutions could end up being used by different organizations, whereas in the latter case, the "dominant designs" (Abernathy and Utterback 1978) were selected to be turned into product features. An example of the sharing of innovations was described by one of the users as follows:

> *It's an opportunity for us to meet face-to face and discuss Oracle's experience* [. . .] *it's also a chance to talk to Oracle and tell them what we want and how we want it* [. . .] *sometimes Oracle has the requirement but does not recognize our need of a specific solution* [. . .] *through these meetings* [. . .] *we examine how we do things and hence inform Oracle about our desired solution* [. . .] *whether Oracle implements it or not is a different issue* [. . .] *I've had a number of open talks with other users which have resulted in using their solutions to solve our problems, and vice versa of course* [. . .] *an example has been in our SCM module. During one of the SCM SIGs, we discussed this Round of Deliveries that we had struggled with for a long time, finally we found a solution that was implemented by one of our peers which we developed further to be used internally* [. . .] (Field note, short interview, user)

On a more effectual but more challenging and less often basis were the innovations and solutions that found their way into the standard application. The UKOUG had produced a number of white papers, which opened up lines of user participatory solution design for long- existing user requirements. An example of this was the financial module white paper written by an offspring group of users and intermediaries. Through data collected from members of the UKOUG, this temporary group highlighted a requirement known as "commitment control," which had been an outstanding issue for years, not only in the UK, but also in other countries. The paper described the problem of the current "commitment control" functionality and suggested possible solution to be incorporated in a later version of the system. The vendor responded by offering an approximate time for the incorporation of changes.

> *In strategy we received the UKOUG Fusion Council Financials/Projects—analysis and interpretation of survey results in April 2006* [. . .] *We noticed that the Commitment Control functionality was deemed weak for both the Oracle EBS and PeopleSoft Enterprise products* [. . .] *We'd like to ask your user community about the reasons behind the Commitment Control response* [. . .] *It is anticipated that the first opportunity to target delivery of these features will be the latter half of calendar year 2012* [. . .] *Oracle have asked for feedback on the priority order of these solutions* [. . .] (Document analysis, e-mails)

More often, this type of collaborative action was seen within the customer forums, which aimed at finding solutions for industry- or sector-specific requirements. The collaborative actions of users and the vendor in designing and developing a functionality known as "volume data entry" (VDE) in the PSHCM customer forum is an example of such user-initiated innovations. Due to the nature of the standard applications for processing variable pay data, forum members reported using various bespoke solutions developed internally by each organization to handle this requirement. The solutions tended to be labor-intensive and complex to handle. This involved transforming the use of an electronic template for entry of variable pay data (e.g. as overtime, premium payments and expenses) with appropriate system validations and approvals. To design a solution, a VDE sub-group (consisting of members from five user sites) was formed to gather the business requirements and collaboratively design a solution for the need. The solution went through several iterations until a system functionality was achieved after two years.

The user group was a space for the initiation of ideas and the stabilization of solutions. When a common need was expressed, a brainstorming session could lead to the generation of new thoughts to be examined and developed into solutions. Such solutions were then tested by users within the group. The vendor also checked the viability and feasibility of the work in progress by keeping regular contact with the users. Sometimes, this could mean the modification of the design. Additionally, the group was used as a point to reach a consensus on diverse needs. In this respect, when different users asked for multiple solutions, the vendor used the group as a space to arrive at an agreement between different organizations.

Solution development and diffusion did not occur evenly in all the groups. They were more common in cases where the sense of collaboration was superior to competition (discussed further below in tensions). Typically, in groups with users, intermediaries and vendors, the innovative ideas discussed within the community could go through different routes. Therefore, apart from the diffusion of innovation amongst the user organizations or into the vendor product, some solutions could be taken up by intermediaries and developed into complementary products. This led to the development of new third-party products, which were then sold as complements to the vendor's existing products. Although this was sometimes welcomed by users, there were many cases where this was seen as a key problem. In this respect, we observed a growing body of complaints surrounding certain third-party organizations attending the meetings. In numerous cases, user organizations objected (in formal meetings as well as informal chats) about the attendance of particular third-party organizations at the events in which users presented their innovative solutions to common problems.

> [. . .] *they* [third parties] *come and listen and in the next meeting present to us what we already gave as a solution and want to sell that back to us* [. . .] *we don't want to be sold our own ideas* [. . .] *I don't want to be told by consultants that we can do it better* [. . .] (Field note, comment by user)

Such voices could only be heard in groups with higher user collaborations, and in some cases, went as far as stopping some third parties from attending user group meetings. However, in communities with less collaborative acts from users, third-party product marketing took over the majority of the events.

A further tension in the way of the innovation and sharing of user-generated solutions was due to existence of competitor user organizations in the groups. For example, the financial SIG served a wide range of companies, some of which were competitors in the business market. Hence, participants expressed concerns about presenting solutions to "competitors" or "other players in the market" with the fear that it would "threaten organizational competitiveness." This was evident in some groups more than in others. For instance, the sense of competition was less evident in groups dedicated to public sector organizations than in private sector groups.

Community as an Up-to-Date Informant

In the observation of the events and interviews with users, gaining knowledge about the new products, tools, technologies and future plans and strategies of the vendor was amongst the motives of users for attending the events. Learning about related partner products and services offered by partners (one type of intermediaries) to complement the vendor's product was also expressed a further attraction for the users to take part in the event. Often, users referred to this as "keeping up to date," "finding out about the hottest offers," "knowing what's on the horizon" and "identifying where the technology is moving."

In this respect, the community functioned as a source of the latest information about the vendor's products and strategies as well as the third-party products and services offered to complement the vendor's solutions. The UKOUG acted as a disseminator of this information to its wider audience. The information presented for this purpose included new features, new modules, process updates, licensing and support strategies, patch updates, future products and future roadmaps.

Users referred to this as a productive way to assist them in making better decisions. Their main discourse on this surrounded three main factors, primarily learning about what the road ahead will be for vendors products:

> *We are informed about the most recent news ahead of the crowd, thus we have time to take in what's necessary and process it as it is happening* [. . .] *this leads to improved decisions.* (Field note, short interview, user)

Secondly, getting updates about other user organizations and their plans:

> [. . .] *last week [in a community event] everyone was talking about release 12, but we have no plans* [. . .]*we attend the meetings to find out whether we should really be thinking of moving to R12 and if so, being able to convince top management about it* [. . .] (Field note, short interview, user)

Finally, to inform the vendor about their own future path and plans and future expectations:

> *We told Oracle about the new teacher pension reforms coming up for the coming year. We let them know well in advance and we let them know if this means a new requirement* [. . .] (Field note, short interview, user)

Indigenizing the future directions through vendor-user dialogue and particularly the final aspect in which users informed vendors about their own future path was a very important aspect of the community. Through this channel, users informed the vendor about their future needs and priorities and as a result, they could have an influence on vendors' future strategies.

As the vendor updated users with its future plans and products, it also tested the viability and acceptance rate of its products. In such meetings, apart from the main speaker(s), there were always other participants from the vendor who took note of the reactions, questions asked and new needs expressed by users. For instance, in one of the financial SIGs, as one of the vendor employees was demonstrating the new version of the general ledger functionality, a user asked a question about transfers between different operating units. This opened up a line of discussion between the vendor and user organizations about their exact needs. While this discussion was going on, one other member from the vendor organization was taking note of all the conversations.

Another key aspect of this function was that as the groups functioned as up-to-date informants, the audience were attracted to hear from "local experts" (Stewart 2007), who were the individuals who were known to solve the tricky problems. Although some of these individuals were identified in groups with user-user exchange practices, they were mainly known to the experts from the vendor organization.

On a different note, this function of the community involved a marketing and sales aspect, which was not welcomed by some of the users. This was typically the case when a partner organization introduced a new product to the users, particularly if the requirement had not previously been identified in the user community. In such cases, we observed direct marketing and stories tainted by obvious commercials from some of these firms. For instance, a session on a new product that was said to improve use of the User Productivity Kit (UPK) for training purposes was not well received by many of the audience, as it was said to be "just a sales pitch" for "making [their] own profit."

A further concern expressed by some of the actors (and particularly the users) was the "complementary" nature of these events. Many users referred to these events as being "beneficial," but only beside other "user-driven" events. So while the community organizers called for the contributions of different actors to the events, some contributions were not positively received by user organizations.

> [. . .] *you know, these sessions are good, but they are not what bring me to the events* [. . .] *too much of them, and I will lose interest* [. . .] *I want to network and find real solutions* [. . .] (Field note, short interview, user)

This was again mainly the case in presentations given by certain third-party organizations on complementary products. While the user organizations insisted on having the key functions of user-user exchange, and vendor updates on future products, the third-party products were of less interest to the majority of the audience.

Community as a Peer-to-Peer Exchange and a Networking Site

Our fieldwork also showed that the user communities not only formed and maintained user-vendor links in packaged applications, but also importantly, that they developed user-user bonds. These user-user relationships drove information and knowledge exchange, which were amongst the highest motivations for attending the meetings. In this respect, users explained their interest in the user group as a locale for "sharing the story," "hearing other's experiences" or as more commonly stated, "exchanging knowledge." In this capacity, the community functioned as a medium for peer-to-peer knowledge and information sharing. The type of exchange in the user group ranged from knowledge and experience about already existing functionalities and configurations of systems to user-designed solutions. There were also a large amount of discussions about the processes employed by users in response to the requirements of systems in their pre-implementation, implementation and post-implementation phases. The main topics of discussions included "roadmaps to success," "things to do/ not to do in the pre-implementation/implementation/post-implementation phase" and "the steps in re-implementation/ upgrade."

The UKOUG financial SIG was one of the leading user groups that functioned as a peer-to-peer exchange medium. At the time of the study, the SIG had been operating for over twenty years, with more than fifty participants attending each event. The events were very lively, both during the presentation times and the breaks. The observations of the meetings in 2010 showed that users were enthusiastic about sharing their ideas, and as they described it as "our reasons for going to SIGs is more about sharing." In this manner, the financial events mainly had an interactive form.

By functioning as a peer-to-peer exchange medium, the user group acted as a space for users to freely discuss their concerns, such as their views and feelings about certain aspects of products and the vendor. They also disclosed their stance and experience about the intermediaries' products and services. Such sharing of experience could also involve driving a sense of sympathetic understanding about the challenges and difficulties of dealing with the application or other actors.

However, the research suggests that this function could be problematic in what the users termed as the "participation" versus "contribution" problem. "Participators" were "silent actors" whose main acts were "taking away" from the group. The prime intentions of those actors were to acquire some type of knowledge from others without any devotion to contributing back to the community. Participants in this mode were more attracted to the group by the element of "take" (Hall and Graham 2004). In contrast, "contributors" played the role of "giver" as much as a "taker." In this manner, actors either shared their knowledge through giving full presentations or, in less intense cases, by offering input to discussions.

This tension is often expressed as a concern for contributors as their ideas being subject to "free riding" (Raymond 1999, Baldwin and Clark 2006). For example, in several observations of SIGs, we observed limited user-user knowledge exchange, as contributors who dedicated substantial portions of their time to presenting their knowledge to the group had a feeling that their knowledge was being taken without them receiving what they expected.

> *I used to meet wonderful people, we shared experiences . . . I even presented in a number of SIGs . . . but you know, it's time consuming . . . you know, if it's only you, while others don't bother to even give you*

> *feedback, you get this feeling, why should I do it?* [. . .] *you see it should be a matter of mutual benefit* [. . .] *not a one-way effort . . .*

As a result of such challenges, the user groups' committee members, who were also volunteers, had to dedicate considerable time in persuading contribution. In the fieldwork, we observed significant time and effort spent during the event and afterwards to convince users to present their knowledge. As a committee member puts it:

> [. . .] *the success of these communities relies on a balance of actors in their committee, those who drive the community. Too often we have a user need but not the right volunteers to step up* [. . .] *in some SIGs we sometimes struggle to get them [the users] to contribute . . .* (Interview, organizer)

Further to peer-to-peer knowledge exchange, many users stated networking activities and making new connections for future exchanges to be amongst the reasons they attend the meetings. As a result, the UKOUG functioned as a site for networking primarily amongst users and secondly between users and other actors in the Oracle world and beyond. The events provided an arena for different actors to meet up and interact on any subject of interest. These sessions involved exchanging information and business cards, and finding similarities and differences in using the application. This function was used by many of the actors as a place to be recognized for developing future reputation plans. In this respect, the UKOUG acted as a space for building "professional identity and position" (Pollock and Hyysalo 2014), in which actors made their knowledge and skills visible to others and produced highly "tradable" expertise (Fleck 1998). Typically, the presenter attached his or her identity to the presentation by giving an introduction to his or her experience with Oracle or ERP applications in general. This was then followed by showcasing the real-time experience of the presenter and publicizing the knowledge that he or she acquired through the journey of working with the system. In this way, presenters made themselves known to others, so as to build a reputation. In such cases, the UKOUG acts as a stepping stone for these actors. This was described by users and intermediaries through terms such as "presenting for professional development" and "a springboard to build [a] future reputation." In doing so, users (and sometimes intermediaries) who assisted and perhaps "cajole" other actors (particularly the vendor) could achieve praise and enhanced organizational independence (McLaughlin et al. 1999, Pollock and Hyysalo 2014) by trading their knowledge and skills in a potential job market.

DISCUSSION

The role of the user within the packaged enterprise system is highly noted by the existing literature (Swan et al. 1999; Light 2001; Verville and Halingten

2003; Howcroft and Light 2006). Our study goes beyond this singular view of "users" and discusses and theorizes the role of "user communities," where association exists between diverse users as well as between them and other actors in the field of enterprise applications. Our findings suggest that user communities are formally organized spaces where relations are structured to achieve the longevity and growth of complex packaged applications.

We have attempted to describe and analyze this setting through a biographical lens that spans beyond a single locale. We develop the empirical understanding of the user community through examining its various activities and their aims, which indicates the complicated couplings that exist between its diverse actors. Hence, the primary contribution of this study is to empirically demonstrate a fine-grain study of activities that occur in different user group settings. Table 9.3 shows the possible performances of different user communities.

Table 9.3 Typical Performance of User Communities

	Performances of User Communities
Community as an arena of power	• Create proximity between users and the vendor organizations • Users develop a common voice to speak to vendor • Users promote needs within the community to develop top priority list of needs to be presented to the vendor • Users influence vendors' products and strategies
Community as a place of innovation	• Users offer knowledge and solutions to each other • Users and vendors contribute and cooperate to generate solution • Users disseminate new solutions (including configuration and customization) amongst other users • Enable user-led incremental developments to be added to vendors' package • Identify common user needs
Community as an up-to-date informant	• Vendors are informed about the future plans and needs of users • Users are informed about future vendor products and strategies • Users are informed about plans of other users with respect to the technology • Vendors test the viability of their future plans • Local experts are identified • Vendors and partners market their products and services
Community as a peer-to-peer exchange and networking site	• Users share experiences, including success and failure stories, procurement and implementation experiences, relationship with particular partners, etc. • Different actors interact to trade knowledge and expertise • Different actors present their skills to build reputation

This multi-spatial view, derived from the BoA approach, extends the current understanding of user communities in showing that only some user communities can be referred to as "innovation communities" (Lakhani and Wolf 2003; von Hippel 2005, 2009; Baldwin and von Hippel 2011; Oliveira and von Hippel 2011), and even those that are spaces for collective innovation do not merely reside in this aspect. Instead, they offer a multi-functional space of information and knowledge exchange between various actors in which only a fraction of activities involve user or community innovation. Hence, we can refer to these communities as *user-centered multi-performance* arenas, which serve the diverse needs of various actors. In this way, we argue that the main activities and functions of one group differ from another. While some of these spaces offer very effective support environments or spaces of collective influence by users, others may only provide points of contact for receiving information from vendors of different products. Hence, this study reveals a wider range of activities by different actors involved in user communities, central to which is the coordination of the heterogeneous interests of different actors from different actor spaces.

Furthermore, in using the BoA approach, we have attempted to shift the lens from a singular view to one that understands packaged enterprise system as a community of vendors, existing and potential users and others (Koch 2005) having complex multi-directional influences on one another. So this study contributes to recent discussions of packaged information systems by acknowledging the coexistence of different types of actors and the cooperation of users and vendors in shaping future technologies. In this way, we contribute to the extant literature by showing that, in contrast to earlier discussions of limited user influence in shaping of packaged information systems (cf. Keil and Carmel 1995; Regnell et al. 2001; Howcroft and Light 2006), user communities can be seen as locales where vendor-user relationships are restructured and power dynamics are changed in a way that users have an increased role in the futures of technologies. So rather than fueling "hold-up" behaviors (Lacity and Willcocks 1998; Sarker et al. 2012), user communities promote a synergetic mode of functioning to raise users' authority in influencing the future pathways of technology. By no means have we suggested that such relations are without tensions. Instead, we acknowledge the existence of difficulties, but at the same time, we show how they are managed to achieve a higher goal. We show that vendors and users "invest in the relationship" rather than merely look for individual gains (Madhok and Tallman 1998; Sarker and Sahay 2003), so they work together in "mutually reinforcing manners" (Sarker et al. 2012) and give up some of their own autonomy. Thus, while vendors use communities as a strategic tool to manage their customers (Jeppesen and Molin 2003; Jeppesen and Frederiksen 2006; Pollock and Williams 2008; Antorini and Muñiz 2013; Pollock and Hyysalo 2014), users likewise can deploy communities to push through their needs.

User communities play a major role in obtaining help in finding solutions for users' needs, transfer of knowledge and information, identifying common user requirements and finding ways to fulfil them and enabling the creation of solutions through the contribution and co-provision of resources and competencies. This conforms with the findings of Pollock and Hyysalo (2014) in showing that different actors manage the complex tensions that exist between the generic offerings of the vendor and the localized needs of users and how new coupling mechanisms generate new developments. Our findings shift this understanding further by showing how this act is performed by a collective performance of different actors. In doing so, primarily we show that users go beyond conflicting needs to form a *combined* priority of their requirements and present this as a generic need to the vendors. Then, various actors collaborate to develop solutions.

Unlike many of the earlier studies, where users are merely seen as individual actors who innovate and "freely" share their innovations within a community, our findings show innovation to be a "collective" act at the same time. Moreover, earlier studies have disregarded the diversity of actors in communities (or have focused on communities of "end users" only). Hence, in those studies, there is no mention of the surrounding environment and possible other actors, such as third-party intermediaries, that accentuate conflicts, collaboration and competition, confrontation and agreement, nor is there mention of the numerous attempts in balancing the power and aligning the interests of different actors all taking place in user communities. In this respect, we believe that communities are domains of various competencies (Hyysalo, Juntunen, and Freeman 2013), and it is through this diversion and possibilities of learning and transfer that the products are evolved.

Furthermore, studies show that vendors benefit from vendor-user relationships to capture user requirements (Royce 1970; Robertson and Robertson 2012), to develop or improve solutions (McLaughlin et al. 1999; Holmstrom and Henfridsson 2006; Buscher et al. 2009; Hau and Kim 2011; Johnson et al. 2013) and to find out about the benefits of their products (Voss 1985; Pollock and Hyysalo 2014). We show that suppliers of packaged enterprise applications also associate with users in user communities to find out about the long-term plans and strategies of adopters to be able to inform their own strategies in good time.

CONCLUSION

User communities do not equal innovation communities (Heiskanen et al. 2010; Hyysalo et al. 2013), and the relationship is not only one of deficit in innovating. User communities can have a range of other functions that can be more important to peers and vendors than user innovation. Communities offer a wide range of actions upon which the innovation was built. This study is the first to admit that the user communities are multi-performance spaces of different actors with diverse needs and interests. Participants recognize these groups in different ways, and they offer a different act in each of these settings.

The BoA approach and particularly, the consideration of several community spaces enabled us to gain a better understanding of the dynamics of user communities. This means going beyond a "singular" view of user communities both in terms of just examining the single space and time of their existence, as well as the idea that user communities are spaces where users act individualistically. In this way, we suggest that when studying such spaces, one needs to acknowledge (1) the existence and effects of "users" rather than "user" on one another; (2) the existence and influence of other actors and surrounding spaces of the performance of such communities; (3) to pay attention to other inputs rather than direct design inputs, but to understand how they affect solutions in different stages of innovation, from ideation to voicing demand to testing and further improvement; (4) the importance of the technology in question, as without it, distinguishing between moments of new solution generation, configuration and existing knowledge exchange will not be possible.

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NOTE

1. There are a wide range of intermediaries around complex technologies; refer to STEWART, J. and HYYSALO, S. 2008. Intermediaries, users and social learning in technological innovation. *International Journal of Innovation Management,* 12, 295–325. for common types of intermediaries. By intermediaries, in this chapter, we refer to third-party organizations and consultants who develop complementary products or offer additional services such as the implementation, maintenance and performance management of the system.

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Appendix

Constitution of UKOUG

The UKOUG organizes its events in various forms. The most common forms are SIGs, which are shaped and function around a particular Oracle product. Participation in these SIGs is voluntary and is open to all members of the UKOUG. These SIGs are generally theme (product) specific, e.g. financial SIG and SCM SIG; there are also SIGs that focus on technical aspects such as the development SIG, and there are a number of location-based SIGs around some of the products.

"Customer forums" are another type of setting for user community meetings. The main difference in their structure compared to SIGs is that forums are closed groups and attendance in the forums takes place by invitation only, e.g. the public sector human capital management (PSHCM) customer forum. In the case of customer forums, interested users need to contact the forum committee to be "approved" before joining the group.

Apart from these events, which run on a regular basis, the UKOUG has organized a number of special events over the years that focus on a particular topic of interest. These sessions are also open to all members of the UKOUG. In addition to these, the vendor also organizes some ad hoc events throughout the year, which are presented by Oracle in collaboration with other user organizations. These events are on special topics, such as the Oracle Business Analytics Summit. User "conferences" are yet another type of setting organized and run by the UKOUG with particular aims. Finally, the community maintains a number of online mailing lists in particular areas.

The organizing structure of the UKOUG has undergone numerous changes, with the most recent one happening in 2011. The group is managed through having three pillars for its business model: governance, influence and commercial. To support these three pillars, the management of the UKOUG is conducted by three bodies: (1) council; (2) board of directors, also known as "the board"; (3) executive. The main responsibility of the council is to recognize and balance the needs of every sub-community. The council represents the members of the community and is in charge of influencing and communicating with Oracle. The objectives of the council are to make available a multi-directional communication and influence channel between Oracle and the user group. The council is also responsible for fulfilling the needs of existing members and attracting new ones. Moreover, it encourages the sharing of knowledge and experience by its members. As a result, the council identifies the needs of the members and feeds these into the products and services offered by the community. Council members work on a voluntary basis (restricted to one per company) and are elected by members for three-year terms. The council is led by a president and a vice president who are elected by the council members: the president is accountable for the external relationships of the group, and will be known as the leader of the UKOUG by the members and Oracle; the vice president takes on internal roles, focusing on interrelations and chairing the council. The second body, the board, is the ultimate authority for UKOUG matters. It is the legal entity with accountability for the governance of the company. The composition of the board is confirmed by the council, and is made up of three council and three executive members. Finally, the executive body is responsible for ensuring the effectiveness of the UKOUG business, including planning, budgeting and delivery. The executive directors are appointed by the council from a list of candidates prepared by a nominations panel. All the three executive directors are on the board, and should be prepared to commit one day per week to UKOUG business. Despite the formal structures of the user communities, each community had its own way of functioning. Hence, apart from some basic rules, such as having to be a member before attending the meetings, there were no hard and fast rules on the management and operating of the groups. Each sub-community has its own chair and sub-chairs (member of the council) who organized the events in various ways. The main element of organizing the events was negotiating with potential speakers to step forward and give talks in the future program. However, what made this difficult was establishing a balance between the demands of the audience (particularly those from user organizations) and the subject of talks. The complexity was that it was typically challenging to convince speakers with topics of high interest to present their experiences and findings (details of these will be explained in the next few sections). While some communities were spaces mainly formed of user organization members, with very few invited attendees from non-user organizations, others were spaces were a complete mix of users, the vendor, and other third-party and intermediary organizations.

Part IV

Unwanted Innovation and Non-Users

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10 "We walk straight past the screens"

The Power of the Non-Users of a Hospital Information System

Line Melby and Pieter Toussaint

INTRODUCTION

Within science and technology studies (STS), a wide range of studies has looked at how technologies are used in new, innovative ways. Many studies give us detailed analyses of how users are creative, and how they appropriate, domesticate and reconfigure technologies in unexpected ways, thus bringing forward new practices both in work and leisure (Oudshoorn and Pinch 2003a). STS studies have also investigated the pre-use phase (the development and design phase of technologies), studying, for example, how future users play central roles in the development of technologies (Hyysalo 2006; Elgaard Jensen 2012). When involving users in the development phase of a technology, the objective is to align and connect the visions of designers and users, and through this, to increase the chance for developing a "successful" technology. Extending on the study of future users' input in design, there are studies that look at the role of the researcher in the design phase (Elgaard Jensen 2012). Researchers are often assigned the role of mediator, balancing the requirements and needs of designers and the hopes and visions of users (Elgaard Jensen 2012). A similar attention to users can be seen in methodologies for information system development (ISD). The involvement of users, through various techniques, in the development and implementation of large information systems has become *a sine qua non*. The user is taking part in the design process and is seen as being the main prerequisite for creating a system that will be successfully used in its application context.

Regardless of heavy user involvement in technology development, the fate of a technology is difficult to foresee. The technology can turn out to be less of a success and more of a failure than expected. It can even provoke resistance and opposition. In this chapter, we will tell the story of the implementation of a pilot hospital information system in Norway, and observe how health care workers resisted its use. It is, therefore, a story about non-use and non-users. With today's strong emphasis on user-involvement and user-engagement in technology development and innovation in the back of our minds, we think it is also necessary to remember that not all users are equally engaged, and not all technologies are wanted. This story can be seen as an attempt to focus on these issues from the premises that non-users are also important in shaping a technology's fate.

The system in question is AwareMedia, a hospital information and communication system, a so-called "awareness system." By displaying information about colleagues' and patients' whereabouts (e.g., progress in an operating room) on computer screens, health care workers should be better informed when it comes to making decisions, planning their work and subsequently providing better care for patients. The system has four main functionalities: (1) patient update through a status bar (i.e., the patient's position in the planned trajectory); (2) patient overview; (3) instant messaging; (4) video feed from operating rooms (ORs). The information displayed would have to be manually entered by health care workers in the different wards. The system was piloted in the domain of acute surgery in a Norwegian university hospital, and six wards were included in the pilot. The pilot took place between January and July of 2011, but the system was never put into regular service. The authors were part of a larger interdisciplinary R&D project, called COSTT (Cooperation Support Through Transparency). The project studied coordination and collaboration among hospital workers in the surgical domain, which also involved creating design solutions for supporting such activities. In addition, COSTT took part in the implementation of AwareMedia and was responsible for evaluation of the system. The development and implementation of AwareMedia will be described in more detail later.

Our aim in this chapter is twofold. First, we want to address the question of how users oppose a new technology and become non-users or even anti-users. How is non-use performed and organized? Use of an information system is clearly organized by the proponents of the system, that is, the designers, implementers, managers and so on. But what about non-use? Who is in the lead here, and how is the "movement" of non-users established? Second, we want to discuss the powers that non-users have. Paradoxically, they can have a huge impact on the outcome of the process of designing and appropriating an information system without ever having been formally involved. The question becomes, how do non-users matter?

THEORETICAL PERSPECTIVES

The implementation of technologies, hereunder use and non-use of the technologies in question, have been addressed from different disciplines and from different theoretical traditions. In this chapter, we draw on theoretical insights from the STS literature, in particular the material- semiotic perspective. In addition, we use empirical insights from research on user involvement in design and resistance to technology as found in the information science and management literature, as well as within medical sociology.

Before turning to our theoretical perspective, we briefly summarize research in the area of the use/non-use of health care information technologies. Overall, we can say that the aim of these studies is to provide research-based advice for making the implementation processes successful (Edmondson et al. 2001; Cresswell et al. 2013), to discuss why implementations go wrong (Karsh et al. 2010) and/or to identify factors that promote or inhibit the adoption, acceptance and diffusion of health information technology (Dexter et al. 2003) (Jeyaraj and Sabherwal 2008; Eckhardt et al. 2009; Greenhalgh et al. 2010). The studies are often targeted towards health care management, policymakers and implementers of technology. Theoretically, popular approaches are the Technology Acceptance Model, the Diffusion of Innovation Theory, the Theory of Planned Behavior, the Theory of Reasoned Action, and Self-Efficacy (Williams et al. 2009).

The scope of these studies is quite broad, from small-scale, confined studies (like Arning et al. 2013) to Roberts et al.'s (2009) systematic review of organizational factors influencing the adoption and assimilation of technologies in the British National Health Service. There is also quite a range with regard to how deep they dig into the complexities of use and non-use of technology. Some (in our opinion) scratch the surface by exclusively focusing on, for example, cognitive or behavioral aspects of use, while others embrace the whole context and seek to address factors on both the micro (individual) and on the meso and macro levels (e.g., Greenhalgh et al. 2010). However, in line with Oudshoorn (2011, 27), we argue that resistance to technologies may be related to other aspects. Actors may, for example, be unwilling or unable to perform the tasks or take on the new responsibilities delegated to them by the technology.

Technology in the Making

As a point of departure for addressing the non-use of technologies, we turn to a material-semiotic approach to the user-technology relationship (Akrich 1992; Latour 1992; Nelly Oudshoorn and Trevor Pinch 2003a; Law 2009). In such an approach, technologies work when they are embedded in a heterogeneous network in which people, organizations, knowledge, skills and technological artifacts interact to produce a specific practice of work (Latour 2005; Oudshoorn 2011). A key idea is that technologies do not have any intrinsic qualities that are defined once and for all, but through their place in the network, they acquire characteristics related to other parts in the network (Latour 2005; Oudshoorn 2011). In this unstable network, there is an ongoing, mutual constitution of technologies, actors and practices. Taking this perspective means that there is no deterministic—or direct causal—connection between the introduction of a particular technology and the effect it produces on its surroundings (Latour 2005; Oudshoorn 2011). Taking such a perspective for technology developers and designers is challenging and problematic because control over future users and practices are impossible per se. However, developers apply different strategies to try to increase control over use and consequently, effects. We turn to some of these strategies in the next section.

Representing Users in Technology Development

Methods for ISD apply as a strategy for increasing control over use the active involvement of users in the design and implementation process. Two conceptualizations of users are in play. First, users are conceptualized in a social sense, that is, as individuals participating in the design and development activity (Oudshoorn et al. 2004). Another perspective, going back to Akrich (1992), conceptualizes users in a semiotic sense. Users are inscribed into the technology. Designers define users with specific tastes, competences, motives, aspirations, etc., and these traits are inscribed into the technology. This means that each new technology comes with a "script" that encourages specific types of use and constrains other possible forms of use. The concept of a "use case," as used in many ISD approaches, can be seen as an example of explicit scripting, in that typical interaction patterns between user and system are inscribed in the design. Another example of using scripts is the use of so-called "personas" in methods for user interface design (Pruitt and Grudin 2003). These are more or less detailed descriptions of archetypical users. Therefore, ISD approaches incorporate the idea expressed by Akrich that the creation of successful technologies depends on the ability of innovators to generate user representations and integrate them into their designs. Different strategies can be used for aligning the various user positions and the technology, like market surveys, consumer testing and feedback on experience (Akrich 1995, 169).

The material-semiotic approach has been criticized for reinforcing "the view that technological innovation and diffusion is successful only if designers are able to control the future actions of users" (Oudshoorn and Pinch 2003a, 15). A more fruitful approach sees the inscriptions in the system not as a means to discipline the user, but as an opportunity for users to become co-designers of the technology. As Oudshoorn et al. (2004, 54) note, *"Users may slightly modify the scripts, they may drastically transform them, or they may even completely reject them and create new meanings and uses of the objects or become nonusers."*

Elgaard Jensen (2012) discusses three conceptions of the user that shed light on the actual role a user plays in the process of scripting, re-scripting and co-design. The first role is a rather passive one, and is designated as the "the user with unacknowledged needs." In this role, the user is an object of study. Innovations are based on a systematic investigation of the user's needs by means of attaining a deep understanding of the workplace. A more active user role is coined "the lead user." In this case, users themselves take care of their unacknowledged needs by designing and implementing systems to support their work. The health care domain has seen many examples of databases or small applications that have been developed by individual users to cater their own needs using available tools. For example, in the hospital where we conducted the pilot study, a system for planning operations was used that was originally initiated by an operation nurse. The third type of user represents, according to Elgaard Jensen, the most active role. He coins it "the participating user." This conception of the user "builds on a normative political idea that users should be involved in the development of technologies that will change their workplaces, combined with the belief that collaborative design processes will lead to better technologies that are more easily adopted" (Elgaard Jensen 2012, 18).

One could argue that many modern information system development methodologies attempt to combine the social and the semiotic perspectives, with a focus on the participating user. Explicit descriptions of user types and uses (for example, by means of use cases in unified modeling language (UML)), are refined and adapted in negotiations with users involved in the different design and development cycles.

Resistance Against Technology

Users always have the option of becoming non-users, and workers have the option to resist use in the face of what they consider to be poorly functioning technologies. In this section, we draw together research on resistance and non-use.

According to Kline (2003, 51), resistance in general has been interpreted in a variety of ways in the literature, ranging from an irrational opposition to progress to a heroic act of defiance against oppression. In line with Bauer (1995), we dissociate ourselves from the idea that resistance is a personal deficit, irrational and morally bad, argued from managerial and technocratic points of view. Instead, we understand resistance to be based in the interface between system design, culture and practice (cf. Timmons 2003, 267). Phrased differently, resistance helps shaping the network of people and technology that realizes the potential in the technology. Resistance can be understood in terms of active or passive resistance (picked up by many later authors), and in terms of individual action or collective action. The level of intensity with which the resistance occurs may also vary (Bauer 1995, 16, 18).

The number of studies regarding user resistance to technologies within the health care domain is limited. One example though, is Lapointe and Rivard's (2005) study of physicians' resistance behavior with regard to information systems in three different hospitals. The authors map physicians' behavior towards the systems along an axis, progressing from neutrality, apathy and passive resistance to active resistance and aggressive resistance. Thus, they take both the level of activity and intensity of resistance into consideration in their categorization. In their discussion, they differentiate between the system itself, system significance and system advocates as the object of resistance (Lapointe and Rivard 2005). Aggressive resistance is, we think, not so common in clinical settings, but we will show that such behavior actually took place in the hospital we studied. However, probably more common, but less spectacular, are the different forms of passive resistance. As Selander and Henfridsson (2012, 290) point out, user resistance literature has privileged active resistance over passive resistance. Passive resistance is understood as a form of routine resistance that influences the appropriation of an IT system in daily practice (Selander and Henfridsson 2012). One form of passive resistance, cynicism, is elaborated in their paper (see also Fleming and Sewell 2002, 867–868). For these researchers, cynicism refers to "cognitively distanced resistance that constitutes negative affects towards the IT implementation and manifests a perception of seeing through the espoused goals of the implementers" (Selander and Henfridsson 2012, 290). The authors show that the negative effect among cynical users may be transferred to other users in the same workplace, creating a ripple effect.

Timmons's (2003) study of nurses' use of a computer system is another example of an attempt to understand resistance and non-use in the workplace. He shows that the system was resisted variably and in a variety of forms. Timmons divides the users (or non-users) into three groups: one not-so-common group that completely refused to use the system, one group that tried to minimize the use of the system and the most common group, who was using the system, but criticized it heavily. Summing up, he coins the term "resistive compliance," denoting a sort of "soft" resistance where staff complained, but yet used the system.

Furthermore, Oudshoorn (2011) investigated resistance against telecare technologies. The so-called Cardiophone, a mobile phone that recorded, stored and transmitted patients' ECGs to a telemedical center, was resisted for various reasons both by patients and physicians. The developers redesigned the technology, and instead of targeting the patient in the consumer market, they targeted physicians in the professional market. As a result of resistance, both the Cardiophone and the users were completely reconfigured. Another example of resistance discussed by Oudshoorn was found during a telecenter (call center for heart patients) trial. Here also, the service was resisted for several reasons by the involved actors. However, one of the main reasons for resistance was that the new service disturbed the existing order of care by challenging who was in control of the organization of work. Thus, it is not necessarily the technology itself that provokes resistance, but the object of resistance can be the consequences the technology brings about.

Turning to studies on resistance outside the workplace, and outside the health care domain, a well-known example from the STS field is Wyatt et al.'s (Wyatt, Thomas, and Terranova 2002; Wyatt 2003) study of Internet users. Their study is among few studies within STS that explicitly focuses on non-users. Investigating users and non-users of the Internet, they identify four types of non-users: *resisters* (who have never used the technology because they do not want to), *rejecters* (who have used the technology, but have voluntarily stopped), *the excluded* (who have never used the technology because they do not have access) and *the expelled* (who have used it, but have stopped involuntarily) (Wyatt 2003).

Summing up, the studies referred to above have addressed several points related to resistance and non-use. Resistance can take various forms, from withdrawal to aggressive behavior. It can spring from various reasons, and consequently, it can be directed to different objects, or to a combination of objects (e.g., management or the technology itself). Lastly, rejecting a technology can be a voluntarily act, or actors can be non-voluntarily marginalized from use. It is also important to stress that, in our opinion, people are seldom completely supportive or completely resistive of a technology, but may hold contradictory positions.

METHODOLOGY

In our (evaluation) study of the AwareMedia system, we made use of various methods, including a pre- and post-pilot questionnaire, participant observation of health care workers in the pilot wards and interviews with involved actors. In addition, we participated in meetings, including information meetings arranged by the vendor and project group meetings. Overall, our research team had close relations to the field, since members of the research project also were members of the implementation team, meaning that many of us were repeatedly in and out of the hospital. However, none of the research team members had a responsible role in the implementation. Furthermore, while some of the research project members took an active role in supporting user instruction during the implementation, the two authors were only involved in the data gathering for the evaluation study. In the following, we exemplify our results with descriptions of events where we were present and with quotes from interviews. However, the analysis builds on knowledge gained through our research in the hospital for a three-year period. In the following, we briefly describe how the observations and the interviews were conducted before discussing some methodological challenges and how we approached the analysis.

The observations we draw on in this chapter are twofold. Firstly, there are a number of "unplanned" observations during meetings and seminars, as well as during interactions with the hospital staff during the implementation process. One important event was a "theme day" for all operation nurses. This event took place in late October 2010, some months before the implementation was intended to begin. The background for the theme day was a discernible feeling of reluctance towards AwareMedia among, in particular, nurses working in the operating room. The implementation team saw this as a potential threat to a successful implementation and released all operation nurses (approximately eighty) from surgical duties and called for a training day. The first part consisted of a presentation from the researcher who was the operational manager of the implementation process. In the presentation, the advantages of AwareMedia were stressed. After the presentation, the audience was encouraged to ask questions. Following this, nurses were divided in groups and received tutoring from researchers who were (more or less) familiar with the system. It was felt that if the nurses learned to use the system, they would be more positive towards it, and consequently, would use it when it was implemented in the hospital.

Secondly, we conducted "planned" observations. The aim was to closely follow the technology in use and study how health care workers appropriated and reconfigured the technology, an approach widely applied within STS. The observations were conducted by a PhD student and a master's student over a period of two weeks in the spring of 2011, about two months after implementation of the system. Ten days of observations were conducted. Half of the observations were conducted with the approach of following a patient's trajectory through the different pilot wards, thus encountering several places where AwareMedia was installed. The other was bound to a physical place, thus following, in detail, how actors in the particular ward used the system.

To obtain people's reflections on their experiences with AwareMedia, interviews were conducted. The intention was to clarify use and assess the meaning actors gave to the system. In total, twenty-five persons were interviewed. The aim was to learn from personnel in all the pilot wards, and interviewees from all but one of the pilot wards were recruited. This gave the following distribution of interviewees: operation nurses (7), anaesthesia department: anesthesia nurses (3), anesthesiologist (1), observation post at the Post Anesthesia Care Unit (PACU: intensive care nurses (5), coordinators (nurses) (2), and in-patient ward nurses (7). The interviews were conducted by various members of the project team, and in total, eight persons conducted interviews.

Since many people were involved in the interviewing, a semi-structured interview guide was developed. The main themes covered in the interview guide were: how the coordination of information/resources took place, how a predictable working environment was created, perceptions of AwareMedia (including the implantation process and training) and the use, usefulness and usability of the system. All interviewers minimally covered the issues raised in the interview guide, but since the interviews were conducted more like conversations than strictly structured questioning, the interviews vary in terms of length and themes discussed. The interviews were conducted in the hospital wards where the interviewees worked and lasted between thirty and forty-five minutes. All interviews were taped. Of the twenty-five interviews, a majority (19) were transcribed verbatim by researchers. The remaining are in audio form, and have been listened to.

One can discuss how to best approach the study of non-use, given that most non-users are invisible. Our study didn't start out as a study investigating non-use. On the contrary, it began as a study of the use of a system, and our research strategy was designed thereafter. In our study, the non-users were highly visible and often very vocal. In the observations, we encountered them in various forms. In the interviews, the main challenge was to make health care workers understand why we wanted them to talk about our "evaluation of AwareMedia," even though, as they explained, they had hardly used the system. It is also a challenge to access people's real feelings and attitudes through interviews, and it is always a risk for people to be politically correct (Dingwall 1997). In our interactions with the health care workers, for example in interviews, we were highly aware of our position as researchers and members of the implementation team, and how this could affect what they wanted to share with us. Both authors tried to be clear and open about that we were more interested in conducting research and understanding how the implementation process evolved than if the implementation of AwareMedia was successful. Our experience was that health care workers seemed quite frank and open in the interviews, revealing both positive and negative emotions. Most interviewees were also highly reflective and able to explain their feelings.

The four categories of non-users that we present in the results section were developed through a "dialogue" between our intuitive understanding of non-use based on experiences from the pilot period and on previous research of non-use and resistance to technologies. We began developing the categories while discussing the pilot and reading through the interview transcripts. We wanted to reflect the sense of activity, engagement and emotional intensity that we experienced in the non-user group, adding something beyond simply providing explanations for non-use. Later, after a more thorough reading of the existing literature, we revised the categories somewhat to reflect what we consider to be the important dimensions of non-use. The categories are not mutually exclusive, and one health care worker could be a combination of different types.

System Development "By the Book"

The development of AwareMedia was initiated in the spring of 2005 by a research group from the University in Aarhus, Denmark (Bardram, Hansen, and Soegaard 2006). Field studies of surgical departments they had been involved with and research reports had convinced them that there was a need for an information system that supported the coordination of tasks in the context of surgical work. A central idea behind the system was to provide clinicians with a sense of awareness about the progress of work and the activities of their colleagues in an undisruptive manner (Bardram et al. 2006). In developing the system, the design team aimed to maintain the most desirable functionality of whiteboards while improving them with computer technology.

The development process started with design workshops in which future users (surgeons, nurses, anesthesiologists, etc.) and system designers participated in "idea-generating" with respect to the system's main features. The outcome was that the system had to support four groups of functions: (1) users should be able to find out the current status and whereabouts of each other from, e.g., large public displays; (2) users should be able to keep track of past, present and future activities, such as operations; (3) users should be informed about the activities taking place in a specific room, e.g., an operation theater; (4) communication with each other in both synchronous and asynchronous ways should be facilitated (Bardram et al. 2006).

During the design and implementation phase, the implemented features were verified with the users. For example, with respect to temporal awareness, the visualization of delays, acute operations and cancellations were checked with the users to see whether they were informative enough (Bardram et al. 2006). The scripts of designers and users were then aligned.

By the end of 2005, the system was deployed in a Danish hospital, and a pilot was used in a select number of departments. After the study was finished, in the summer of 2006, the system was commercialized and implemented in other Danish hospitals. At the time of this writing, the company claims that installations of the product run in most Danish hospitals.

Piloting AwareMedia

The company that commercialized AwareMedia became a partner in the COSTT project in January of 2009, shortly after the start of the project, primarily because AwareMedia fit very well with the research objectives of the COSTT project. It offered the type of clinical process support that we wanted to evaluate. In March 2009, there was a meeting between the vendor and the COSTT project in which a plan for collaboration was agreed upon that included the integration of AwareMedia with indoor positioning technology (for tracking people and equipment) before the summer. This integrated system would first be tested in a controlled laboratory environment. After the summer, we would set up an implementation in the Norwegian hospital that was a partner in the COSTT project in order to evaluate it in a real practice.

However, in that same period, the spring of 2009, a group of decision makers from the Norwegian hospital made a study trip to Denmark visiting the Danish hospital using AwareMedia. The system was well received, and interest was aroused. Suddenly, we were in a situation where three partners were interested in a pilot of AwareMedia in the Norwegian hospital: the researchers in the COSTT project who wanted to conduct an evaluation study in real practice, the hospital that wanted to try out the system in order to see whether they wanted to acquire it and the vendor who was interested in having an installation in Norway as a first step towards expanding their market abroad.

After the summer of 2009, a pilot implementation in a part of the hospital was decided upon. AwareMedia screens would be installed in the Emergency

Centre (three operation rooms, the coordinator's office, the hallway of the operation center, the "24-hour observation unit," PACU and the sterilization unit, three bed courts in the orthopedics ward and two bed courts in the gastric ward). The objective with this installation was to cover as much of the peri-operative patient trajectory for emergency patients as possible. It is relevant to note that the emergency center is staffed by personnel from other surgical centers in the hospital who work there on rotation. So, staff from, for example, the orthopedics surgical center works shifts at the Emergency Centre every now and then. This means that there is a frequent change of staff on a day-to-day basis. People who work together are often not familiar with each other, and one can expect much communication to be needed in order to coordinate the work properly.

The division of labor in the pilot was as follows: the hospital would provide a project manager and members to a project work group, finance hours for training staff and in general support and facilitate the implementation process. The COSTT project would acquire the necessary computer hardware and help with the deployment of the system. The vendor would provide the software free of charge and take responsibility for configuring the system in order to adapt it to the Norwegian work environment. This meant, for example, translating the texts on the screens from Danish to Norwegian and presenting information in a way that was preferred by the Norwegian users.

A project group was formed consisting of 16 people who were responsible for the execution of the pilot project. Fourteen of the project group members were working in different roles in the hospital departments that were involved in the pilot: four were physicians, and eight were nurses. The other two project group members represented the ICT organization responsible for the IT infrastructure in the hospital and the COSTT project. The project team worked together with the vendor on defining the configuration of the AwareMedia system that would be deployed in the pilot. The establishment of the project team was a clear attempt to introduce the participating user into the pilot project. However, we encountered the same problem that Elgaard Jensen noted, that only a few of the hospital employees actually participated in the meetings (cf. Elgaard Jensen 2012, 25). The participative role was clearly not a priority.

Several workshops were held in which the project group gave feedback on system features. This resulted in a configuration document that was finalized in May 2010, which gave a detailed description on the installation that was planned. The plan included the installation of fifteen touch screens. This plan was presented to a large group of people from the departments involved and hospital management on May 21, 2010, when it was announced that the pilot would start after the Emergency Centre had moved to the new hospital building, which was planned in the second part of the fall of 2010.

In October 2010, all the staff that would use AwareMedia participated in an education session (the previously mentioned "theme day") in which they received instructions on how to use the system and were offered the opportunity to practice. Due to delays in getting everything up and running, AwareMedia was not in use until January 25, 2011. The Emergency Centre had just moved to its new location, and the staff still had to settle into in the new working environment. During the first three weeks, people from the COSTT project were available to help with problems in using the system. The video stream from the operation rooms was not available until February 21st, and for privacy reasons, was only broadcast within the Emergency Centre (and not to the in-patient wards). In April, a new version of the software was installed in order to overcome some problems that had been encountered. The pilot ended on June 15th, although the system remained operational for a few months after that.

The intervention that was embedded in the pilot was an example of what Elgaard Jensen (2012) denotes as "intervention-as-composition." The COSTT researchers were not only invited to the site in order to study the workplace, they also took part in the discussions around the design and the implementation of AwareMedia at the site; they influenced the decisions regarding the configuration of the screens, hardware placement, education of users, etc.

RESULTS: NON-USERS IN THE HOSPITAL

It is unfair to say that no one liked or used AwareMedia. Some saw a potential for instant messaging (the chat function) replacing telephone conversations, making communication more efficient and the work environment less noisy (fewer telephone calls). Staff in the in-patient wards saw a potential for being better prepared for when their patient would have surgery and could follow the activity in the OR on the AwareMedia screens. Others had more vague ideas about how the system might contribute to improved coordination and more efficient information exchange, but found it difficult to specify how and didn't have enough experience to be certain. Some people had used the system, though not extensively. The whole implementation process was in fact a "downward spiral." Because AwareMedia is a system where one's use depends on other people using it (e.g., displaying the status of a patient), little use led to even less use, which in turn implied almost total non-use. Summing up, we can say many people tried AwareMedia, some saw potential in the system, a big group of people were more or less indifferent to it and some were strongly against it. Common for all was that use was minimal.

Next, we will focus on our development of different non-uses categories and provide examples from our empirical material. Most of the examples are taken from our interview data. They often provide a very good and direct illustration of the point we want to make. The observation data is used in a more implicit way. It backs up the description of, for example, behavior at meetings or the use of the system in the workplace, without references to concrete observations.

Non-users of the system are divided into four categories based on two dimensions. The first is the active-passive dimension, referring to whether or not the actor takes active measures in expressing resistance (cf. Lapointe and Rivard 2005; Selander and Henfridsson 2012). The second dimension divides non-users on the basis of their overall attitude towards the system, including the implementation process and actual use, and is related to the aspect of system significance as identified by Lapointe and Rivard (2005) System significance relates to how potential users perceive the system's usefulness and can, according to Lapointe and Rivard, be one of the objectives of resistance. Our dimension distinguishes between constructive-destructive. Non-users with a constructive attitude are in principle positive to the system, and they express its potential usefulness, but are of the opinion that the system has the wrong features or is implemented in a wrong way. Non-users with a destructive attitude are negative towards the system. They question its usefulness and the explicitly expressed intentions with its implementation. Their (implicit or explicit aim) is to get rid of the system. All the non-users can be seen as a refinement of Wyatt et al.'s (2002) "rejecter" category, that is, a person who has used a technology, but has voluntarily stopped. However, we followed the implementation process prior to installation of AwareMedia in the hospital, and different user categories were visible even before staff had even laid hands on the system. In this respect in particular, one of our categories ("the activist") resembles Elgaard Jensen's (2012) "participating user." The four categories can be depicted in a two-by-two table where we find the constructive anti-users in an active mode (the activist) and in a passive mode (the avoider), and correspondingly, the destructive anti-users in an active form (the saboteur) and in a passive form (the skeptic). These are outlined in detail below.

The Activist

The activist is an active and constructive actor who has knowledge enough about the system to provide constructive criticism. Thus, being an activist presupposes knowledge about the technology and/or (at least somewhat) the use of it. The activist expresses her opinion, for example, in meetings. In principle, she is not against the system, but argues that before she uses it, the system must be improved.

Table 10.1 Categories of Non-Users

	Constructive	**Destructive**
Active	The activist	The saboteur
Passive	The avoider	The skeptic

Vignette 1. Theme Day: Questioning the System

The theme day started out with an information meeting before the training session began. The information meeting was held in a large auditorium at the university. A member of the project group and spokesperson for the vendor informed the group about the system. Afterwards, the floor was opened for questions. One of the operation coordinators, who was also a participant in the project work group, made several critical remarks based on her knowledge with the system so far. She was in particular concerned about the fact that coordinators would have to enter the same patient information twice, since the Operation Planner system is not integrated in AwareMedia.

This wasn't the first time questions were raised regarding the functionality and the usefulness of AwareMedia. In particular, one nurse in the vignette asked critical questions about the system. This was observed in other meetings as well. We can say that she acted as spokesperson (cf. Latour 1987) for the clinical staff, but she was also a mediator with the aim of aligning objectives in the clinical world of the hospital with goals of the implementers and the vendor. She is a good example of a "participating user" (Elgaard Jensen 2012). The major part of the theme day consisted of training to use AwareMedia. During the training, researchers collected feedback from the nurses, and in the end, it was suggested that twenty-eight features in the system be improved before implementation. In this respect, all operation nurses had the chance to be participating users, and some seized the opportunity.

After implementation, when staff gained some experience using the system, it became clear that not having AwareMedia and the Operation Planner integrated was a major drawback for use:

> *You have to economize with time, and we already have the Operation Planner, and we have to relate to it. That's mainly the reason now. It's not bad, but because we have to use the Operation Planner, it turns out that unless you need something exactly at the moment you're next to an AwareMedia screen, you won't seek it out.* (Interview 6, anesthetist)

Besides the lack of integration of AwareMedia and the Operation Planner, several other concrete suggestions for why the implementation was failing and how the implementation and the system could have been improved were suggested in the interviews:

> [The pilot period] *was too short . . . I feel that the system was ineffective, or inoperable, for quite some time. It started up, but fell out again. So it became hectic, and it didn't really work . . . People didn't get familiar enough with it.* (Interview 1, anesthesia nurse)
>
> *AwareMedia has to be up and running the whole day and night, if it's any point of using it . . . And it must be established routines to*

> *make sure that someone checks what is being said there* [in the system]. *Over at PACU, it is located on the desk, so they can see it, but I don't know how it is placed in other departments.* (Interview 3, intensive care nurse)

A number of areas for improvements were talked about in the interviews. The pilot period was too short, AwareMedia was never really integrated into existing work practice, routines for use were not properly developed, people lacked training, the system did not work due to the update midway in the pilot period, there were technical problems and the placement of the system (the screens) was not always functional. Here, we won't go in detail into *causes* for non-use,[1] since our interest lies in how non-use is enacted by health care workers.

The activist is a category that was visible even before the system was configured for use in the hospital, and it is valuable for developers because it can provide constructive feedback. The activist is a participating user and will interact with developers and the system, trying to co-design the script of the technology. During regular workdays in a hospital, it can be difficult to be an activist; there are few arenas for continuous interaction and negotiations around the system. The activist is, therefore, the most visible in meetings were she also could act as a spokesperson for her coworkers.

The Avoider

The avoider was the actor most often encountered in our study of AwareMedia. She is rational in the sense that, when asked, she has many arguments for why she is not using the system without questioning the need of it. However, contrary to the activist, she applies a passive strategy. She is not engaged in meetings and does not speak up in order to influence the implementation process or the technology. She wants to interact and engage as little as possible with the system, and does not take responsibility for integrating it into her work practice. Her main strategy is to ignore the system and keep up with old routines and practices, what she considers to be her "real work." Her rational arguments can take the form of blaming: the failure of the system is due to the management's poor decisions or how work is organized and the needs of staff, etc. She considers herself situated outside of what is going on.

In the interviews, the avoider would typically say, *"I don't know why you want to talk to me, because I have hardly tried the system."* Interviewees also pointed out that AwareMedia was not a top topic of conversation for staff:

> *There are not many people who talk about it* [AwareMedia]. *It isn't much of a topic. Because there are so many other things that have much higher priority.* (Interview 8, coordinator)

Furthermore, some interviewees were aware that their attitude towards the system was not the most positive, and tried to explain that by pointing out flaws in the implementation process:

> *I do think we in surgery look at it in a slightly negative way . . . because we didn't receive proper. . .* [training] *. . . I miss training. I think that* [it] *worked pretty well in the orthopedics. I think they had much more training than we had after it was installed, and benefit from it. Consequently, we haven't been as engaged as we should have been.* (Interview 9, OR nurse 8)

Or, she felt that AwareMedia was not for her:

> [The system is probably user friendly], *but given that the screens in the ORs are located next to the OR nurses, I reckon we in anesthesia feel that it isn't really . . . it is something that belongs to them . . . For example, I imagine that they prefer to push on the 'half an hour left' button themselves. I think they would like to do it themselves. It is kind of their intervention . . . But then again . . . maybe it's just something that we in anesthesia imagine.* (Interview 2, anesthesia nurse)

In addition to the reasons for non-use mentioned in the previous section, many of the avoiders also explained their non-use by how old habits are hard to break and that they had not really "got that reflex to look at the screen." Also, the fact that the implementation of AwareMedia was only one of many new things that happened simultaneously in the hospital made it difficult to get the staff's attention and energy.

The avoider is a person with no power intentions, and she doesn't try to enroll people in her "non-use network." Her influence stems from the fact that she belongs to a large group. She focuses mostly on herself and her immediate work situation and just wants "to do her job." Her resistance to the new technology takes a passive form, and she can be seen as a version of Timmons's (Timmons 2003) users, who minimized their uses of the system. The avoider is not often reached by traditional user involvement attempts, and she is also not interested in being an activist. Because this group is large in size, the avoider represents an interesting paradox: she has no power intentions, but she can make or break a system.

The Saboteur

The saboteur is not the most common character in the story, but she exists nevertheless. She can be difficult to detect via interviews, but stories about her circulate among her coworkers, and she can be observed in the field. She is emotionally engaged in the subject, and she takes an active approach and shows how she feels about the system. However, we do not rule out that her actions towards the system may represent an underlying feeling of discontent with the working environment in general and with management in particular. She is the most extreme character and the most negatively outspoken regarding the system. She sabotages and misuses the system and demonstratively shows her attitude towards it (e.g., in training).

Vignette 2. Theme Day: Learning to Use AwareMedia
The operation nurses were divided into groups of ten to twelve persons. The groups were divided into different rooms and had access to several computers. The nurses were instructed to execute some tasks in the system, and they were encouraged to tinker and play with the system (e.g., sending instant messages to each other). Two or three instructors from the COSTT project were present in each room to provide help if needed. During the sessions in one of the rooms, two of the nurses refused to participate in the training. They sat next to each other with their arms folded over their chests, looking uninterested in the others.

The behavior of these two nurses may be seen as an example of sabotaging. By refusing to participate in the instruction needed to get going with the system, they actively sought to "destroy" the network that has to be in place for successful system use. In this case, the focus is on the immaterial part. Focus on the material part of the network is illustrated in the behavior of some of the staff towards the use of video cameras for recording events happening in the operating rooms. These video recordings triggered strong reactions:

> *I heard that they* [in the OR] *pulled out the cables one weekend.* (Interview 2, anesthesia nurse)
>
> *It was met with such strong resistance and aggression; they actually pulled the cameras from the cables. I would never have thought. How people can be so agitated over such a small thing, that it became this massive commotion! I had never imagined; it came as somewhat of a surprise. But I think there were strong voices that set up each other. (Interview 8, coordinator)*

In her attempt to disintegrate the network that keeps the technology up and running, the saboteur is actively seeking power over the fate of the system. But where the activist is seeking power with positive intentions (e.g., in order to improve the system), the saboteur has negative intentions related to the system, and she wants to get rid of it.

The Skeptic

The sceptic can be characterized first of all by her ability to see through—what she considers to be—the espoused goals of the implementers (cf.

Selander and Henfridsson 2012). She suspects a hidden agenda from management, that the system is implemented in order to rationalize work and as a means for surveillance.

> *Most resistance came up against the pictures from the ORs . . . I guess people felt that they were seen—that it was misinterpreted to be about looking at what they did, and that they did not want this. In a way, surveillance . . . It was a lot of resistance and aggression. But after we changed what the cameras captured, people's attitude changes.* (Interview 8, coordinator)
>
> *I don't know if we need it. First of all, you can perhaps feel a bit surveilled. On my own behalf, I think, does the coordinator need to see what I do and don't do? When I . . . write messages back and forth, or move the status bar.* (Interview 9, OR nurse)

However, skepticism is not only directed towards the intentions of the implementers and management, but also towards the system itself. The skeptic questions both the trustworthiness of the information that is provided and the overall usefulness and value of the system.

> *Because it* [AwareMedia] *was this tool 'on-the-side,' it hasn't been fully trusted. And such a tool has no real value . . . If you are uncertain*

Table 10.2 Examples of How Non-Use Was Motivated and Enacted by the Four Non-User Groups

	Constructive	Destructive
Active	**The activist:** • 28 system related items were identified as problems • Pilot period too short • Must economize with time • Need of integration with existing OpPlan • Routines must be established to ensure, e.g., that messages are read • Lack of training	**The saboteur:** • Refusal to participate in training • Pulling out cables from cameras
Passive	**The avoider:** • AwareMedia is not a big topic of discussion or interest • AwareMedia is a low-priority issue, competing with a number of other new things • Habitual users/old habits stick	**The skeptic:** • Feelings of being surveilled • Distrust of the system itself • Questioning the need for the system

whether it [the information] *is correct, you won't look at it, right.* (Interview 6, anesthetist)

I haven't used AwareMedia very much. No. I feel that it is not very certain/safe to send an instant message to the ward about premedication through AwareMedia. I would rather talk to them. In particular, when it comes to the surgical patients. There are certain things you need to communicate verbally, like if they have any questions that need to be answered. (Interview 10, OR nurse)

No, I have never missed it. If there is an operation in OR 3, then I know that he/she is there, because they are not going anywhere. If there is an operation in a particular OR, they are there. (Interview 10, OR nurse)

The skeptic keeps a low profile. Her position is mostly communicated by means of gossiping and spreading rumors. The opposition against the system seems to be mostly driven by emotional resistance. She has a negative attitude towards the system and also tries to disintegrate the network, but she is not engaged in direct actions other than talking.

DISCUSSION

As Wyatt (2003) phrased it, "non-users also matter." Non-users are an important force in the process of shaping a network of technology and people necessary for an information system to work. In this respect, they are the complement of the active, engaged user who is a supposition for user-involvement. The latter users matter because they are an important source of information when it comes down to configuring the technology in order to integrate it into the network. But how do non-users matter? Is non-use informative in the same way that use is to understand a technology? The power of non-users may seem paradoxical, since non-use per se is void. There is no (or little) interaction between the user and the technology. One approach to solving this problem is to investigate reasons for non-use and list them, much like we see in the management and implementation literature (e.g., Lapointe and Rivard 2005). We have chosen not to take this approach because reasons for non-use could be mere excuses for not wanting to participate in the design or the implementation process, and they are highly contingent. Instead of asking people who refused to use the system or to come to work-group meetings, we studied their behavior towards the system's implementation, and we talked to them, trying to grasp their motivation for not using the system. That, we think, gives insight into how non-users actually matter.

To resist a technology—to become a non-user—means, by definition, that a person can decide his/her own actions and exercise some influence on his/her surroundings. Or, to use the words of Timmons (2003), "resistance presupposes power." However, a user's influence and power varies between different technologies. We can, for example, decide not to use Facebook, but we cannot expect that decision to have any impact on the Facebook system and its place in society. However, in our case study, non-use did imply influence, even if it was not always intended. In order to function as a coordination supporting awareness system, AwareMedia must be used by most staff in the workplace. If, for example, one coordinator refuses to enter patient information in the operation schedule, the schedule is incomplete and, in fact, useless. Likewise, non-users cannot be reached by means of the chat function. As our descriptions of non-user categories have shown, few of the interviewees had an explicit agenda to break the system. The largest group, the avoiders, would probably say they were powerless if asked about their ability to influence their work situation. Some were more conscious that their non-use was powerful vis-à-vis the fate of AwareMedia, and the experience of power may have been further increased by the character of the implementation project, namely that it was a pilot with the objective of assessing the usefulness of the system in the new environment. Future users became testers. They felt they had something to say about the value of the system.

If we agree that non-users do matter from an implementation/management point of view, it is still a question how they can be reached or get involved. The possibilities here depend on the mode in which the non-use is enacted. We identified two modes: a constructive mode (the activist and the avoider), and a destructive mode (the saboteur and the skeptic). In the constructive mode, the non-user attacks the system, but she does this by identifying features that would make the system acceptable. Even though the activist opposes the system by not using it, she is willing to become a user if her "demands" are met. So, in a way, the activist can be characterized as a participating non-user. That cannot be said of the non-users who act in the destructive mode. They are hard to engage in a discussion where they rationalize their resistance. Their behavior expresses an unwillingness to become users, irrespective of possible changes in the system, because they question the need for it. Of course, something can be learned from the aggressive opposition of the saboteur if we try to find out where this aggression is directed. In our case study, the use of cameras lead to aggressive resistance, indicating that the perception of AwareMedia as an instrument for surveillance made it unacceptable for part of the envisaged user group. But more undirected resistance, such as that displayed by the two nurses refusing to participate in the education session or people switching off screens, is harder to interpret.

Probably the most interesting group of non-users is the group of the avoiders. First of all, they represent the majority of non-users in our case study, and because of this alone, they have the greatest impact on the system's ill fate. Interestingly enough, it can be argued that they act in a constructive mode, and to bring the system to a close does not seem to be their objective. They express a more or less positive openness towards the system, and based on their statements in interviews, they are willing to become users if a number of contextual things are different (e.g., if only they have more time, have more experience, receive more training or are able to get rid of old habits). But power over the system's design or implementation seems of little interest to them, which indicates that it can be hard to engage them in discussion.

So, where the activists is probably the group of non-users that is most easy to engage by using the traditional instruments of system development and implementation methodologies, such as workshops and focus group interviews, it is more difficult to get feedback from the three other groups. Even though some feedback was given in the interview fragments we presented, the essence of their non-use seems to be displayed in their behaviour towards the system. As stated above, the avoider "presses" the system out of her work practice by sticking to old practices and finding work arounds. The skeptic uses gossiping and negative small talk over the coffee table as a means of enacting non-use, and the saboteur takes offensive action towards the system. Instead of involving these three groups in a dialogue, a better option here seems to be to use in-depth observations of the workplace. This could provide valuable input to the decision to change the system or even to abandon it.

CONCLUSION

In the study of AwareMedia, we witnessed a health information system failing in its pilot phase. Even though the system was carefully developed, putting future users' needs center stage, and was a success in Denmark, it did not succeed in Norway. Resistance towards the system was enacted in four different categories of non-users. These non-users have power and are important players in the heterogeneous relations of technologies, persons, spatial arrangements, cultures and ideas that, in the end, produce a hospital information system.

We think that our discussion and reflections on non-use and non-users may also be relevant for understanding non-use outside the clinical domain, and for other types of technologies, as we have tried not to be too context-bound in our descriptions of the enactment of non-use and resistance. In order to understand the development of technologies and the practices related to them, we would like to see more studies of how non-users influence the design and development of technologies.

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NOTE

1. In her master's thesis, Lund (Lund 2011) goes into more detail regarding the reasons for the non-use of the chat function of the system.

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11 Users, Non-Users and "Resistance" to Pharmaceuticals

Kate Weiner and Catherine Will

INTRODUCTION

In this chapter, we wish to explore conceptual frameworks for thinking about use and non-use, drawing on the case of pharmaceuticals and specifically prescribed statins for cardiovascular disease prevention. We bring medical sociology concerning "resistance" to pharmaceuticals into conversation with the more explicit discussions of non-use within science and technology studies (STS), and aim to contribute to the study of unwanted innovations by suggesting an analytic shift from a focus on the non-user as an identity to non-use as a practice.

Recent discussions of pharmaceuticals within medical sociology have run along two rather distinct courses. On the one hand, a new phenomenon, pharmaceuticalisation, has been identified, denoting the overall expansion of pharmaceutical use (Abraham 2010a; Williams et al. 2011). Like discussions of medicalisation and biomedicalisation (Clarke et al. 2003; Conrad 2005), this pharmaceutical expansion has been partly attributed to users through references to lay activism and consumer demand for both prescribed medicines and those more readily available. The second, more long-standing, area for scholarship has focused on individual "patients'" experiences of, views on or practices with medicines prescribed by doctors or available through pharmacies. In their comprehensive review of work concerning treatments for symptomatic conditions, Pound and colleagues (2005) suggest that while some people accept medicine use unproblematically, lay responses to pharmaceuticals are best characterised by the concept of resistance.

As with other work in medical sociology, Pound et al.'s (2005) insistence on the agency of lay medicine users and the rationality of their thoughts and practices is intended as a corrective to professional concerns about "compliance with" or "adherence to" medical regimes. Such thinking, they argue, assumes that medicines are beneficial and provide the proper and only response to illness. An alternative agenda would not rely on initiatives to encourage people to use medicines as directed, but focus on improving the safety of medicines and on identifying and evaluating patients' preferred treatments. In this model, we are encouraged to see technologies rather than human actors as deficient and requiring modification.

While these scholars do not refer to literature on the uses and non-uses of technologies, much sociological discussion of medicine use can be seen through an STS lens, and there are strong parallels with scholarship on other technologies. Here it is recognised that technology developers and promoters (for example, regulators, policy makers, trialists and clinicians) may have very particular types of users and uses in mind which are configured (Woolgar 1991) or scripted (Akrich 1992) into the technology (e.g., through testing, licensing, prescribing and packaging of pharmaceuticals; see Oudshoorn 2003). Yet, users may have a great deal of agency to de-scribe these scripts by finding other ways of using the technologies. This is recognised through the ideas of user anti-programmes (Akrich and Latour 1992) and of appropriation and domestication (Silverstone et al. 1992). Scholars have documented important examples of technologies being used in radically different ways than those imagined or intended by their designers and producers (see Kline and Pinch 1996), thus highlighting the potentially creative role of users in shaping innovation trajectories.

In work on the uses and non-uses of the Internet, Wyatt and colleagues (Wyatt et al. 2002, 2005; Wyatt 2003) and Selwyn (2003) foreground "non-users" as important but neglected actors. In a critique reminiscent of that concerning medical "compliance", these scholars argue that non-use of the Internet is attributed within policy to material or cognitive deficits to be remedied by better access, education and training; recognising non-use as a rational and viable category might lead to policy that included alternatives to the Internet. Again, the technologies rather than the human actors are drawn into question by this analysis. In order to better characterise issues around Internet access and use, Wyatt (2003) suggests a four-part "preliminary taxonomy of non-use": *resisters*—never used because do not want to, *rejecters*—stopped using voluntarily because adequate alternatives, *excluded*—cannot get access, socially and technically excluded and *expelled*—stopped use involuntarily due to cost or loss of access. This separates the "want nots" (resisters and rejecters) from the "have nots" (excluded and expelled).

TOWARDS AN UNDERSTANDING OF MEDICINE NON-USE IN PRACTICE

Wyatt's (2003) taxonomy offers an important reminder of the possible range of practices that may be linked to "resistance" to medication in the sense that Pound et al. (2005) introduce. Yet, only limited use has been made of the framework to identify different forms of non-use of medical technologies that struggled to find a market (for an example, see Siegel Watkins 2011). In fact, the framework has wider applications: while primarily concerned with non-use, it also incorporates an understanding of use. It is the move between use and non-use that creates the categories of "rejecters" and "expelled". Wyatt and colleagues (Wyatt 2003, Wyatt et al. 2002) acknowledge that there may also be flows in the opposite direction, where former users become active users again, suggesting that use and non-use of the Internet must be identified within particular temporal and social trajectories, including, for example, the process of aging and changes in locality.

In offering a more sustained application of the framework to pharmaceuticals, one aspect that may be important is the household, for medicines are usually stored and used in domestic settings. In their study of the Internet, Wyatt et al. (2005) demonstrate the mediation of technology use through household members and wider social networks. Family members may help others get online, but they also observe that Internet access, in principle, at a household level, does not necessarily equate with use by all members of the household. Similarly, in discussing telecare and telemedicine, Greenhalgh et al. (2013) identify the importance of family members or professionals getting monitoring technologies set up appropriately, and argue that until this is achieved, technologies may occupy a "liminal" position in the domestic space. In the case of pharmaceuticals, we know that women often take responsibility for helping their partners or children adhere to their prescribed medical or dietary regimens (Oudshoorn 2011; Weiner 2011; Will and Weiner 2014), and adult offspring have been shown to contribute to their parents' adherence to medication through their emplacement of medicines in the home (Hodgetts et al. 2011). This underscores the potentially shared or distributed nature of medicine use, an aspect well recognised in relation to other technologies (e.g., Silverstone and Hirch 1992; Miles and Thomas 1995).

Further, in the case of prescription medicines, other important actors beyond the domestic sphere also mediate use and indeed non-use. Close to the consumer, this occurs through the need for a prescription from a certified health professional (in the UK, this may be a doctor or a nurse prescriber), or a discussion with a pharmacist in the case of over-the-counter medication. However, access to many medicines is also mediated by the organisations providing or paying for health services, which seek to control costs and regulate use in the name of safety and efficacy. Such policies may well stimulate coordinated campaigns for access by those who feel "excluded"—for example, groups representing Alzheimer's patients (Moreira 2010) or individuals looking for access to expensive chemotherapy (Hughes and Doheny 2011). Similar campaigns, or more individual strategies, may be pursued by the "expelled", for example, people who wish to continue on a drug started on a trial, or to have additional rounds of something like in-vitro fertilisation. Even if health care payers are willing to support a technology, and patients are offered it, as noted above, having access to prescription medicines does not dictate whether or how they will be used once offered. "Resistance" and "rejection" (in Wyatt's sense) may both occur at different points in time. In this chapter, we seek to explore whether the concept of "resistance", developed in medical sociology, can help support or develop the non-use framework proposed by Wyatt. Before we look at our data to investigate this in more detail, we turn to a closer comparison of the ways in which "resistance" is understood in different literatures.

THE MEANINGS OF RESISTANCE

Across medical sociology and STS, the concept of "resistance" appears to play an important role, cutting across the idea of use and non-use in different ways. In this section, we explore the concept in more detail, once again drawing on both literatures. In STS, Kline (2003) enumerates three forms of resistance including both users and non-users: opposing the introduction of a technology, not purchasing it ("consumer resistance") and not using in the prescribed manner. Thinking about the first two categories in particular, we are reminded that one might make a further distinction between collective or coordinated resistance and individual or uncoordinated resistance (the central interest of Pound and colleagues, Wyatt and the current chapter). As described above, Wyatt's "resisters" are people who have never used a technology and do not want to—perhaps closest to Kline's consumer resistance. In contrast, for Pound et al. (2005), resistance is most closely identified with people who use technologies but not in the prescribed manner, but may also include people who stop using them, Wyatt's "rejecters". Because of these overlaps, we propose taking "resistance" as an overarching term, and looking for alternative language for those Wyatt calls "resisters". We suggest that the term "avoiders" may help. On the other hand, Wyatt's term "rejecters" adds clarity within the overall category of "resistance". These are people who tried a technology and stopped using it. As Pound et al. acknowledge, this is not a significant theme in their review, which analyses published work on medicine "use" but may well be important for further understanding of "non-use" for these technologies.

Beyond the categories of use and non-use, we further suggest that "resistance" has its own complexity. For example, Armstrong and Murphy (2012) propose that a distinction can be made between conceptual and behavioural resistance. For these authors, conceptual resistance means "rejection of the discourse within which a particular procedure is embedded" (Armstrong and Murphy 2012, 318), whereas behavioural resistance means "refusal to accept a particular recommended procedure". Relating this to Pound et al. (2005), we might suggest that "conceptual resistance" covers people expressing a general reluctance to take medicines, for example, because of a fear of side effects, dependency or the potentially disruptive aspects of regimens to daily routine, or because of a preference for more natural or less harmful therapies, the symbolic association of medicines with illness and thus an illness identity, as well as potential stigma associated with taking medicines. At a behavioural level, the review points to the way people reportedly modify regimens to minimise harms, for example, by lowering the dose or taking "drug holidays", as well as outright rejection. For them, the term resistance also "carries the suggestion of something hidden" (Pound et al. 2005, 152), which they propose is apposite, since practices of modification/rejection are likely to be instituted without the knowledge or agreement of medical prescribers, in anticipation of their disapproval.

A final layer may then be added to the characterisation of resistance, for in the case of both conceptual and behavioural resistance to medicine use, there is a question about whether they are acknowledged to prescribers. Again, medical sociology provides a term for this. Writing about "aversion" to medicine, Britten et al. (2004) distinguish between "voiced" and "silent" aversion, referring to whether people told their doctors about their resistance to medication. Though the situation for such "voicing" or "silence" may change for different technologies, this may have analytical value in other settings, and is certainly important when medical sociology seeks to inform clinical understanding of patient experiences. When people do decline to use a product in practice, or modify or abandon their regimen, they may or may not "voice" this (Pound et al. 2005). Equally, it is possible to express antipathy to a medicine (either during an interaction with a clinician, in a research interview or elsewhere) without necessarily declining to use it. Indeed, we note that talk about disliking medicine use is common in research interviews (Britten et al. 2004; Will and Eborall 2011). A summary of these concepts and their overlaps, as they relate to individual or uncoordinated resistance, is provided in Figure 11.1 before we introduce our own empirical case, offered here as a way of testing this conceptual framework.

In the rest of this chapter, we will explore the value of this framework in understanding the uses and non-uses of prescription statins. This is a class of drugs that reduces cholesterol levels and has been available by prescription in the UK since the early 1990s. Here, as elsewhere, in the last decades, these drugs have become a major part of cardiovascular disease prevention strategies, constituting a significant class of prophylactic medication (Greene 2007). Indeed, they have been cited as a textbook case of pharmaceuticalisation, representing a rapidly expanding market of drugs for people who do not see themselves as ill (Abraham 2010b). Current health policy has moved towards systematic screening for cardiovascular risk in primary care and mandates that those at relatively high risk of cardiovascular disease (twenty per cent over ten years) should be offered a statin (NICE 2008a). This means that large proportions of adults, and particularly older adults, should have been offered a prescription for statins (perhaps more than thirty per cent of people aged seventy and older, NICE 2008b). In a move that turned out to be unique globally, in 2004, a low-dose statin (10 mg simvastatin) was licensed for sale over the counter (OTC), that is, without a prescription, in the UK. The product, Zocor Heart Pro, was licensed for sale to people at "moderate risk" of coronary heart disease, classed as ten to fifteen

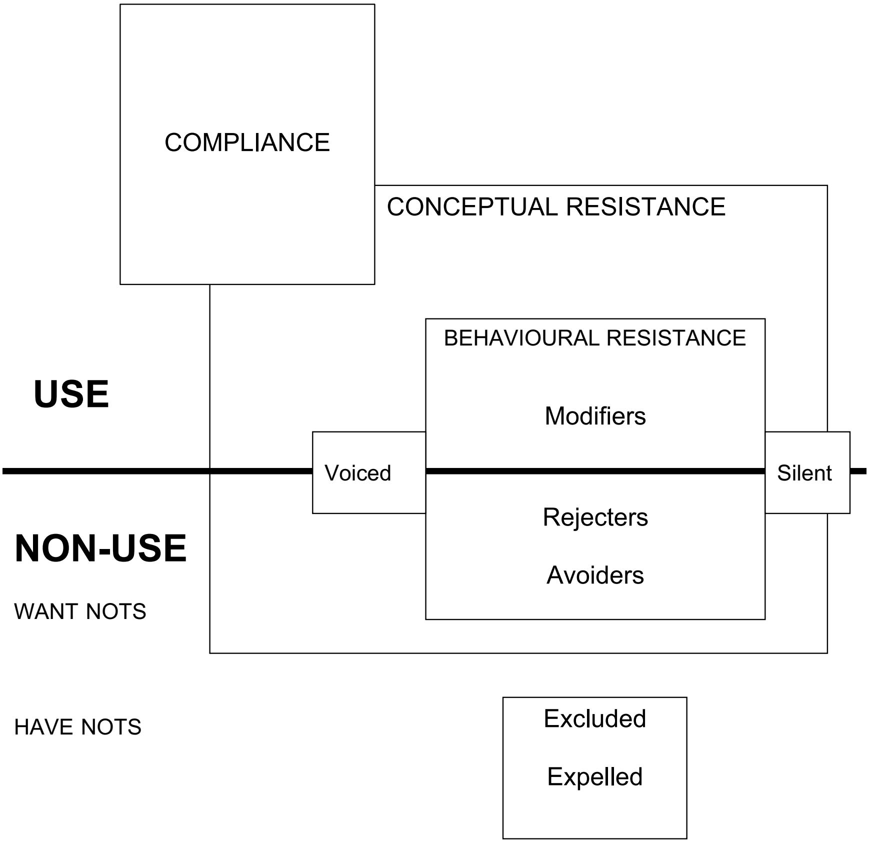

Figure 11.1 Use, non-use and resistance to pharmaceuticals: a summary of the categories and overlaps suggested in the literature.

per cent risk in ten years. This includes a fairly broad group, most notably *all* men aged fifty-five to seventy regardless of cholesterol level or other criteria. In combination, then, the two sets of risk criteria (for prescription and OTC statins) circumscribe a fairly extensive group of potential users. Yet, as with other prescription medicines (Britten 2008), evidence suggests that "adherence" to prescription statins is low, perhaps lower than fifty per cent (Benner et al. 2002; Mantel-Teeuwisse 2004). Furthermore, sales of the over-the-counter preparation apparently proved so low that Zocor Heart Pro was quietly withdrawn in 2010 (see Will and Weiner 2015 for further discussion).

This is a technology that, on the basis of clinical and commercial risk assessments, has a very wide pool of potential users, but we suggest that the category of non-use is highly relevant, as evidenced by the adherence data and the failure of the OTC statins. As a preventative drug, the issue of symptom management that is critical in the uses of other medicines is not pertinent, and suggests potential for even greater non-use or "resistance" than described in previous studies of medication. In short, statins in the UK appear to offer a particularly interesting case for the study of non-users of pharmaceuticals.

HOW MAY WE STUDY USE AND NON-USE?

The chapter draws on data from two related interview projects with people who self-identified as having bought or used different products for heart health. The first was a study of "users" of functional foods such as spreads, drinks and yoghurts containing phytosterols for cholesterol reduction, and was undertaken between 2008 and 2010. The second recruited people who had purchased OTC statins or been offered prescription statins for cardiovascular risk reduction. This was carried out between 2009 and 2011. The projects were conceived and designed as comparative cases. In this chapter, we use data from the first project, on functional foods, to give examples of "non-users" of prescription statins, for the foods were, in some cases, viewed as alternatives to medication. The statin sample, however, also includes many examples of non-use, as well as attempts to modify regimens as part of "behavioural resistance".

Relatively large proportions of the British population are reported to use foods containing plant sterols or to have been prescribed a statin and the majority of these are middle aged or older (TNS 2006; NICE 2008b). We surmised that potential participants were numerous and would not be very difficult to find. In contrast to much of the extant research on medicine use, we were keen to avoid recruiting via the doctor's surgery in an effort to distance our interest in health and health practices from clinical interest in "compliance" (see also Henwood et al. 2011). Following institutional ethical approval gained from our respective institutions,[1] we therefore recruited from a number of sites on a pragmatic basis and selected among potential respondents for maximum diversity regarding age, gender and socio-economic background.

Users/former users of phytosterol products and prescription statins were recruited through advertisements in our own universities and the newsletters of elder's forums and councils in three localities in England. Users/former users of statins purchased over the counter were recruited at a national level, using an ad appearing with a Google search for "Heart pro" or "Zocor". In the first study, where recruitment occurred on the basis of the use of functional foods, we interviewed forty-five people, of whom twenty-two said they were current (14) or avoiders or former users of statins (8). In the second study, we recruited forty-four people on the basis that they had bought or been prescribed statins. A total of sixty-six people across the two studies therefore identified themselves as having experiences of using and/

or not using statins. The interviewees included forty-seven men and forty-two women, with a range of ages from 24–90, while most were over forty (mean = 64). They had a variety of occupational backgrounds, including all eight groups in the National Statistics Socio-Economic Classification, although there was a higher proportion with professional and managerial backgrounds.

We asked participants about how they came to purchase or use (or not use) different heart health products, and about how they used these products, including statins and other medications, supplements or foods, as well as about conversations with primary care practitioners, pharmacists and others. We undertook an iterative thematic analysis in the way proposed by Hammersley and Atkinson (1995), which involved going backwards and forwards between the datasets. The analysis we present here is based on the 66 self-identified users and non-users of statins. Respondents are identified according to the project from which they originate—Phyt indicates phytosterol project; Stat indicates statin project.

Studying the use and non-use of pharmaceuticals raises a number of methodological challenges. As Wyatt (2003) acknowledges, non-users may be difficult to locate. In the case of relatively ubiquitous technologies such as cars, televisions and telephones, social infrastructures are organised around an assumption of use, and non-use may involve effort or at least a degree of reflexivity. For less ubiquitous technologies, it is more difficult to identify people who have avoided use and to differentiate them from other potential users who may be largely ignorant of the technology in question. In the case of statins, our work suggests that people are often not aware of cholesterol as a health issue unless alerted to it by health care practitioners (Weiner 2011; Will and Weiner 2013). It is methodologically challenging, therefore, to identify people who are actively avoiding statins rather than simply not attuned to the issue. Studying users and former users of functional foods containing plant sterols proved fruitful in identifying some such people who were aware of cholesterol and engaged with its management to some degree, but were avoiding statins. The OTC statin group included some people who felt they had been excluded from prescription statins. These groups thus provided a way into exploring non-use of the prescription drug.

Even having identified relevant individuals, it is not straightforward to research the use and non-use of pharmaceuticals. As technologies that are prescribed in the clinic but largely used in domestic settings, their "use" may take place in a variety of sites, including private spaces, and potentially over a long time frame. Relevant actions are, therefore, not readily amenable to observation (Bryman 2001; Murphy and Dingwall 2003). In contrast to other interview-based studies concerning the uses of pharmaceuticals, which interview people at specific time intervals after a clinical encounter, the recruitment strategy we adopted meant that people had not necessarily been newly prescribed statins, and we were able to elicit accounts of use over long time periods, sometimes several decades. We are, however, cognisant of the issues inherent in the interpretation of interview data, which can be read as both narrative presentations of the self and accounts of practices, that is, as both topic and resource (Hammersley and Atkinson 1995; Dingwall 1997; see also Murdoch et al. 2013). In the current chapter, we have tended to treat the interviews more often as a resource and have bracketed interactional aspects, for example, treating the interview data as evidence that particular conversations or events happened, rather than focusing our analysis on the way these are talked about within the research interview. In light of scholarship on doctor-patient interactions, which finds that people tend to portray themselves as much more active in these encounters than observational studies suggest (Stimson and Webb 1975; Baruch 1981), we are reluctant to make too much of our participants' talk on these interactions. Yet we see no reason to doubt that while some of the "action" concerning statins takes place in the doctor's surgery, much also happens away from the doctor's surgery.

FINDINGS

Conceptual Resistance

People in our interviews rehearsed many familiar reasons for being reluctant to take statins, including a general dislike of pill-taking, concern about or experience of side effects, a reluctance to take multiple medications, a desire to try something more natural and the symbolic association between taking pills, illness and aging. People also expressed a reluctance to take pills on a long-term basis, an aspect perhaps particularly salient to preventative medicines. As interviewees described it: *"I just didn't want to take something that you kind of took all the while"* (stat 12), *"I thought oh God have I got to do this for the rest of my life"* (stat 26). Beyond these personal reasons, there were also occasional reflections on the wider systems of pharmaceutical provision, including scepticism about current clinical orthodoxy, doctors' prescribing habits and the pharmaceutical industry. As with previous studies (Lumme-Sandt et al. 2000; Pound et al. 2005; Britten 2008), we observe that these narratives were rehearsed both by people who reported having taken action to modify or halt regimens of prescription statins and those apparently taking the drugs as prescribed. Notably, even some of the people who had elected to buy statins over the counter reproduced these concerns.

Behavioural Resistance: Avoiding (or Delaying)

Once cholesterol has been discussed or tested in a medical consultation and statins had been mentioned, interviewees often narrated taking steps to avoid statin use. Those who currently or used to take statins talked of delaying medication over quite long time frames (a year or more), and several plant sterol users accounted for their consumption of these foods as a way to help them avoid statins.

The following example illustrates many of the points made so far, showing both why and how people avoid or delay medication. This interviewee, a sixty-six-year-old building society manager, tells how he was first alerted to raised cholesterol by a hospital consultant while being monitored for a separate condition. He then narrates his reluctance to take medicines to lower his cholesterol because of the long-term nature of such treatments and a preference for managing cholesterol himself "through diet alone" and other non-pharmacological responses (homeopathy), in the context of implicit concerns about safety. His account suggests that he avoided cholesterol-lowering medications for many years despite several overtures by his general practitioner (GP).

> STAT34: *. . . and at the end of it he* [consultant] *said, 'Do you realise you've got high cholesterol? You really ought to see your GP and have it sorted because it's over eight'. So I then saw my GP obviously about that . . . So I initially said, 'Well we'll do it by diet', and we got it down to about six or seven or so on the diet alone.*
>
> INTERVIEWER: *Oh right, how long were you trying the diet?*
>
> STAT34: *This probably must've been, I've been taking statins for two years and, probably getting on for twenty-odd years ago. And when the doctor then said of course there's statin, well he said you could lower it with medication, and I said, 'I'd rather not, initially, don't want to be in the long term thinking of taking a tablet every day for no purpose.' And then after a while when it went up again the doctor referred me for a second time and this time he said, 'They're a lot safer now', as if to say well they weren't particularly safe when I suggested it the first occasion. I thought hmm yeah I'm not sure. So again I tried on diet, a friend of mine is a homeopath and she gave me a book on lowering, and there was some homeopathic remedy she said to try . . . And then when it went back up again . . . and this time he said, 'Well you know I really do think you ought go on a statin a day', and this time I gave in.*

In a second example, a sixty-two-year-old teacher explained how she had so far avoided statins through dietary changes, including incorporating plant sterols. She accounted for her reluctance to take statins in terms of their symbolic association with ill health and aging, their potential toxicity and her knowledge of the potential side effects of statins. The interviewee recounted the various efforts she had made and encounters with her GP over a three-year period. Embedded within this account is the sense that this will delay statins, but that she will eventually have to take them. The interviewee speaks to this on three separate occasions within the interview, saying, for example:

> PHYT8: *You see, I try to get all the right things, but yeah. I mean I have the feeling that I'm going to end up on statins you know, I've just put it off for a while . . .*

In this way, we suggest, non-use may sometimes be seen by the actors involved as a phase.

Elsewhere in the interview, the interviewee recounted somewhat as an afterthought a memory that her GP had actually given her a prescription for statins on one of the previous occasions:

> PHYT8: *And actually she gave me a prescription and I didn't ever buy it, I didn't ever cash the prescription in because she seemed so keen to make me have it I thought, oh you know, maybe I should and then when I came home I just, I don't know what I did with it, the prescription.*

It is now clear that the interviewee has avoided statins both in negotiation with her GP and away from the consultation. From our analysts' view, we might class this as both voiced and silent resistance, and we found some other examples of silent avoidance where people either did not cash prescriptions or avoided further contact with their doctor in order to avoid statins. Yet this particular example is interesting for the way the interviewee presented the decision as relatively insignificant. The participant had been very complimentary about her GP and their relationship, saying, for example, "she's really good" and "she's not dictatorial". There is a sense that the prescription was accepted as a way to please or perhaps appease the GP and the prescription was then quietly forgotten. Her attitude, then, is not presented as particularly militant, which draws into question the attribution of this example of avoidance as a form of "resistance".

Behavioural Resistance: Unscripted Uses, Modifying Regimens and Rejection

In comparison with the previous work we have described on prescription medicines, we found relatively few examples of people who used statins in unscripted ways, for example, taking smaller amounts than prescribed or not taking them on particular days in an effort to minimise side effects or fit them around other aspects of their daily lives. Yet, we found many examples of people stopping taking the pills for periods of time, either with or without their doctors' knowledge, experimenting with stopping and possibly restarting to confirm suspected side effects and negotiating with doctors to receive either lower doses or a different statin. All of this was connected to a desire to mitigate suspected or avoid potential side effects. This perhaps relates to the fact that the need for the drugs was not always clear, for example, to control symptoms.

A retired teacher in her late seventies explained how she came to associate a bout of diarrhoea with taking statins, and her reaction to this. This excerpt illustrates both how she set about checking her hunch about the statins and the way her decisions were taken independently and only communicated to her doctor at a later date:

> PHYT36: *I was found to have pretty high cholesterol and my doctor put me on statins, which is the normal sort of thing that they do. And I did take these for a couple of months maybe until I got very severe diarrhoea, which I didn't immediately connect with it. And then because they made me so uncomfortable I stopped taking them and that made me realise, because of course the diarrhoea cleared up straight away, that there was a connection between the two things. However, just to make sure of this, I did take them again for a few days and back we got with the diarrhoea, so I thought well, I'm not going to persevere with this, it's not worth it. And I didn't do anything about it for quite some time and then the doctor persuaded me to have another go with a different statin, which I did . . . I still did not enjoy taking it and gave it up, I didn't even finish the first lot of pills, you know, in the packet . . .*
>
> INTERVIEWER: *At what point did your GP become aware that you'd stopped taking the* [first] *statins?*
>
> PHYT 36: *Oh well not straight away, because I didn't bother going back. Yes, quite some time later I think. . . . I don't think I mentioned that I wasn't on them until I saw her again for something else and then she gave me these others to try.*

In this case, the interviewee might be classed as a serial rejecter. This example also suggests that voiced and silent resistance may also have a temporal element: actions taken independently of a doctor may become voiced at a later, perhaps more convenient, date. Again, these practices do not have the oppositional and purposive sense implied by the notion of resistance.

In another interview, a sixty-five-year-old woman talks of the concerted negotiation with her doctors in order to maintain a relatively low dose of statin. This could be classed as a more explicit case of voiced resistance. Notably, the interviewee had earlier recounted that she had willingly gone onto statins and indeed signalled her commitment to *doing something* because of her family history. Here, the form of use (the regimen) rather than fact of use is in dispute, and the interviewee's reluctance to change her dose relates to her knowledge of the potential side effects of the drug:

> STAT 28: *I started on a ten-milligram dose. And that continued for another two to three years and then I had to change doctors because she retired and the new doctor suddenly said out of the blue, 'We'd like to put your dose up from ten to forty.' . . . I told him I didn't really want to because I'd always had from childhood quite bad rheumatism, I said, 'and one of the side effects is quite a lot of legs cramps'. I said, 'I'm really not, you know not into taking a sudden you know four times the dose'. So we agreed to compromise and I started taking twenty but for one reason or another I actually changed my doctor. And he then again discussed the fact that I was on twenty but I have said to him the same as I said to the previous doctor that I wasn't happy in putting up the dose . . . I said, 'I would prefer to stay on the twenty-milligram'.*

In some cases, people might stop taking their current prescription and intentionally return to their doctors within a relatively short period (of days or weeks) in order to instigate a change of pill (modify use). In others, as in a previous example, interviewees reported unilaterally rejecting their pills unnoticed by the doctor for months or even years. Once noticed, this might lead to restarting the same or a different regimen. For example a seventy-seven-year-old woman, a former administrative worker in local government, suggests that she was first prescribed 40 mg simvastatin in 2002, but "came off them myself" in 2008 because she suspected that they made her lightheaded. She told her doctor about this at a subsequent appointment, and continued to have annual blood tests. In 2010, her doctor persuaded her to try 20 mg pravastatin. Here, there was a period of rejection and silent resistance before concerns were voiced to a doctor, and this was latterly followed by modification.

Many accounts suggested periods of rejection, however brief, making it difficult to separate modifying and rejecting in our data. Of the people we interviewed, a small proportion could be classified as rejecters at the time of interview. Yet, looking at the trajectories of others over time periods which might be measured in weeks, months or years, use and non-use emerge as sometimes transient and provisional; potential users may make efforts to avoid statins whilst acknowledging the likely impermanence of this position, current users might hope to reduce or come off statins and current rejecters might be persuaded to take statins again in the future.

Throughout these accounts of the uses and non-uses of statins, interactions and relationships with doctors figure a great deal. The analysis so far suggests that people might enter into sporadic conversations with their doctors about taking or not taking statins and the precise regimens. Use, modification and rejection might be punctuated by a visit to the doctor to discuss statins or (as far as the interviewee was concerned) some other issue, or prompted by a change of doctor (for example, through moving house or a doctor retiring). As illustrated in a previous example, changes in doctors were reported as moments when the prescription might be opened up again and where differences between doctors' prescribing practices became clear. In one very vivid illustration of this, an interviewee described his displeasure at being prescribed a higher- dose statin by a hospital consultant than the prescription from his GP, and how this lead to his GP "tearing up" the consultant's prescription:

> STAT 27: *I said, 'He's* [consultant] *upped them statins to forty', and I'd actually got the tablets . . . And I said, 'What am I going to do with these things', I said, 'because quite frankly I've got this problem with the memory situation and to put it up to forty milligrams is not going to ease the condition, it'll make it worse probably'. So he* [GP] *said, 'You've got a choice whether you can have a potential heart attack or you can go into Alzheimer's, which do you prefer?' So I said, 'Well I think I'll go for the heart attack'. So at that stage, I just stopped them and I've been off them since.*
>
> WIFE: *He tore up the prescription, didn't he?*
>
> STAT27: *Mm, he not only tore the prescription, he said, 'Give me those tablets', so I gave them to him and he bunged them in his drawer, he said, 'You don't need those any more'.*

In this case, the GP appears to be instrumental in sanctioning the rejection of statins.

Family and friends were also implicated in accounts of modification and rejection, as a source of information and support. Conversations, for example with siblings, offspring, neighbours, friends or colleagues, made people aware of potential side effects, and helped them to identify shared symptoms and potential responses, such as asking to change to a different statin. As we have already stressed, statins are widely prescribed across the population so that such conversations might occur relatively easily. These were sometimes portrayed as casual encounters:

> STAT 37: *I was talking to a friend of mine and we were laughing about it, 'I don't know I can never seem to find the right word, and I just feel weird.' So she said, 'Have you started those statins? I was on those and I was [unclear], found sort of odd things'. She said, 'Go and take the ones that I'm taking', and then that's why I went back to the doctors and said, 'I don't want to take these, I want to take these'.*

In other instances, they seemed to be part of sharing responsibility for the decision. In the following example, an interviewee's sister had apparently sent relevant newspaper articles on several occasions, providing support for her view that simvastatin was causing her problems:

> STAT 26: *. . .oh my sister sent me an article from the Daily Telegraph about simvastatin, how it had slowed somebody up . . . And I thought, this is me . . . I thought I'm convinced, that's it. And then I had another one from her with a pink label [post-it note] on it saying, 'Here you are Mary, more grist to the mill'.*

In these accounts, then, doctors, family and friends were all important figures in mediating the uses of non-uses of statins. Family and friends might provide support for a change of regimen or rejection of statins, and doctors appear to have instigated or at least sanctioned such actions in some cases.

Exclusion and Expulsion

While the above discussion largely deals with Wyatt's "want-nots" (or perhaps want-less's), our interviews did identify some "have nots". These were mostly users of over-the-counter statins, who described hoping for, but being excluded or expelled from, prescription statins by different doctors. Indeed, some of these interviewees felt excluded twice over, first by their doctors and then by the withdrawal of the over-the-counter statin, as one sixty-two-year-old businessman described. In his case, raised cholesterol had been identified. The interviewee talks of his failure to get his doctor to prescribe a statin on repeated occasions and shows that he is aggrieved by the apparent inequity of this through his comparison to his friend in "the next village":

> STAT24: *Then I went to the doctor, had the test and came away with nothing prescribed at all, looked into it, I think maybe I contacted the doctors again and they wouldn't help at all, and that's when I tried to see what was out there . . . So I spoke to her* [GP] *then and she went through this sort of computer programme, inputting the things and she said, 'We can't justify giving you statins'. . . . I have another friend whose cholesterol has never been as high as mine, lives in* [village], *which is the next village along. His doctor prescribes him no problem. He's very much the same as me, you know pretty fit, same age group, it's just my particular surgery won't give, I'm going to go back and see them now I can't buy them.*

However, two interviewees currently on prescription statins also produced stories of apparent exclusion, where they suggested they had been excluded from particular (more expensive) classes of statins to the detriment of their health. In both cases, the interviewees had experienced side effects with simvastatin and knew that other classes of statins were reported to cause fewer problems. Their accounts suggested a sense of entitlement to these other, better statins, which was produced through comparisons with known people who were prescribed the preferred drug. We note that family members (an aunt and a sister) appear as quite central to these accounts of negotiating over exclusion, as supporters and providers of information about alternative preparations of statins. We illustrate this with the case of a sixty-five-year-old woman who is a retired catering assistant:

> STAT16: *Well just the first lot of tablets were the cheap ones, the cheap statins. And it was just, I had to take them at the night time before I went to bed and I used to get really bad cramp in my legs, it was painful . . . I thought no, I was only on them I would say six weeks, and I went to the doctor's and I says, 'I want taking off them'. So I just told him I was absolutely ill with them, I says, 'My auntie has read in the Times and she's on these tablets', I says, 'and I believe you are on them as well because you told her you were on them', and he says, 'They're ten time dearer than them ones'. I says, 'I don't care,' I says, 'I paid National Insurance all my life, I think I'm entitled to them'. So he put us on them ones.*

In this case, the interviewee's intervention appears to have led to a modification to the desired regimen. In the other, the interviewee remained excluded from the statin she wanted.

These accounts help to think about Wyatt's category of exclusion. Just as there are different types of use (Miles and Thomas 1995; Crang et al. 2006), there may also be different levels or types of exclusion, in this case from a whole class of drugs, from a particular preparation or a particular dose.

DISCUSSION

In undertaking this analysis, using statins as an example, we have complicated the categories of non-use and resistance proposed by Wyatt (2003) and Pound et al. (2005). Like the previous literature, we found limits to "compliance" with medically expected use, categorised here with the STS concepts of "script" or "programme". We found that people might attempt to avoid taking statins over quite long time frames, for example, through instituting dietary changes, not attending for subsequent screening or not cashing a prescription. We also report that once people have started to take statins, they may move between periods of use and rejection over many years. This may involve experimentation, that is stopping and starting to try to gather evidence about putative side effects, and interactions with doctors. Interactions about statins, which, from the interviewee's perspective, might have been intentional or happenstance, could lead to modifications of regimen, perhaps a lowering of dose or a change to different preparation. Rather than give too much weight to the boundary between "use" and "non-use", we find that Wyatt's categories offer a valuable starting point for a more nuanced analysis of practice. Our analysis thus draws particular attention to the potential transience of use and non-use over time and the social relations through which use and non-use might be mediated, as well as the vicissitudes of silent and voiced resistance. This is summarised in a revised framework of concepts in Figure 11.2, which we now discuss in detail.

Different Temporalities of Use and Non-Use

In the case of statins, as other technologies, people might oscillate between periods of use and non-use that may be calibrated in days, months or even years. Avoiding statins might also appear in our interviews as a phase, that is

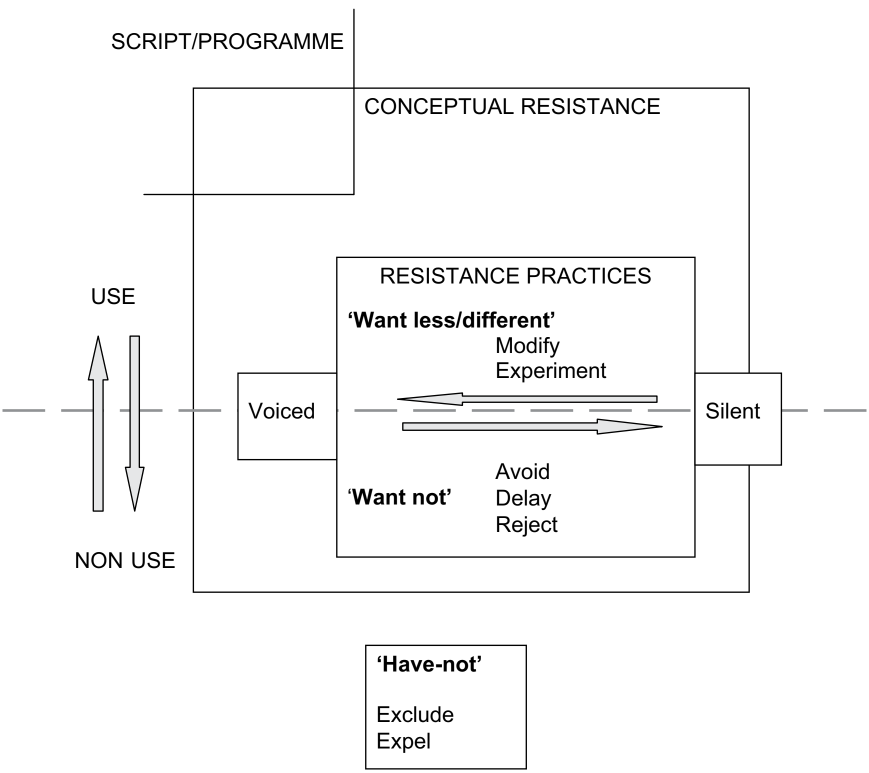

Figure 11.2 Use, non-use and resistance to pharmaceuticals: revised framework.

delaying rather than absolutely avoiding. Such trajectories may be punctuated by particular events, such as doctors' appointments, a worsening or recognition of side effects or interactions with family and friends. The periodisation of use and non-use seem different in character to that described both by Pound et al. and Wyatt and colleagues.

Pound et al.'s review of studies on medicine focuses on prescription medicines for symptomatic conditions. They found that a preponderance of studies were concerned with the experiences of people not taking their medicines as prescribed with little treatment of outright rejection. Their analysis therefore focuses on modifications to regimens that constitute a process of balancing between ameliorating symptoms and managing the ill-effects (physical, social and symbolic) of the medicines themselves. This might be achieved by reducing the dose, taking less frequently than prescribed or taking drug "holidays". In this case, use and non-use are more likely to be calibrated in hours or days, and the longer periods of non-use we describe are not considered.

In Wyatt and colleagues' discussions of the Internet, use and non-use are identified in connection with specific events in the life course, such as changing jobs, moving house or retiring. Some of these punctuation points were also relevant to the interviewees in the current study in their wider accounts of their experiences of cholesterol monitoring and management. For example, moving house might mean registering with a new GP, bringing a set of health checks that lead to the initiation of prescribed statins or potentially a change of prescribed regimen. Yet, these major events were overlaid in the current study with less eventful periods where people might act independently, negotiate with doctors, experience physiological changes or competing preoccupations or come across new information. Use and non-use thus appear more dynamic in this study than suggested through reference to major events in the life course. Other studies may need to account for the particular temporalities that matter for other technologies, and attend to this in settling on methodology. These considerations also have theoretical implications, for the dynamism we found created a degree of analytical difficulty in distinguishing between users, modifiers and rejecters.

How (Non-)Use Is Mediated

Our analysis also suggests that both the uses and non-uses of prescription statins are mediated through a mesh of social relations and interactions. STS scholars have often focused on the "scripts" or "programmes" encoded in the technology by designers. In the case of prescription drugs, we observe the on-going mediation of use and non-use by different human actors. Beyond the bald fact that doctors remain the ultimate gatekeepers to prescribed medicines, we have suggested that wider social networks, including family, friends and colleagues, could be important allies and supporters in the non-use of medicine, providing information about side effects and encouraging interviewees to press for a change of regimen. This is hinted at by Pound et al., who report that people may look to see how others fare on a particular medication or draw on information from peers before deciding whether to accept a medicine, although this does not do justice to the on-going relations that contribute to maintaining or disrupting use. Thus, while scholars such as Oudshoorn (2011) and Hodgetts et al. (2011) have suggested the ways in which *uses* of pharmaceuticals may be mediated in domestic settings, our analysis draws attention to the role of family and friends in "non-use" or the ways in which non-use may also be shared or distributed. This observation recalls work by Siegel Watkins (2011) on implantable contraceptives, which identifies both avoidance (in our terminology) and rejection coming out of exchanges with friends and family.

We note that in relation to pharmaceuticals, health care professionals also play a particular and perhaps statutory mediating role, and we identified both "voiced" and "silent" resistance to clinical scripts. Avoiding, experimenting with or rejecting statins may be discussed with doctors (voiced), or quietly undertaken independently for a period of time (silent). Where Pound et al. (2005) imply that much modification is in fact silent resistance according to this scheme, we found evidence of extensive negotiations with doctors across the long periods in our interviews. Once again,

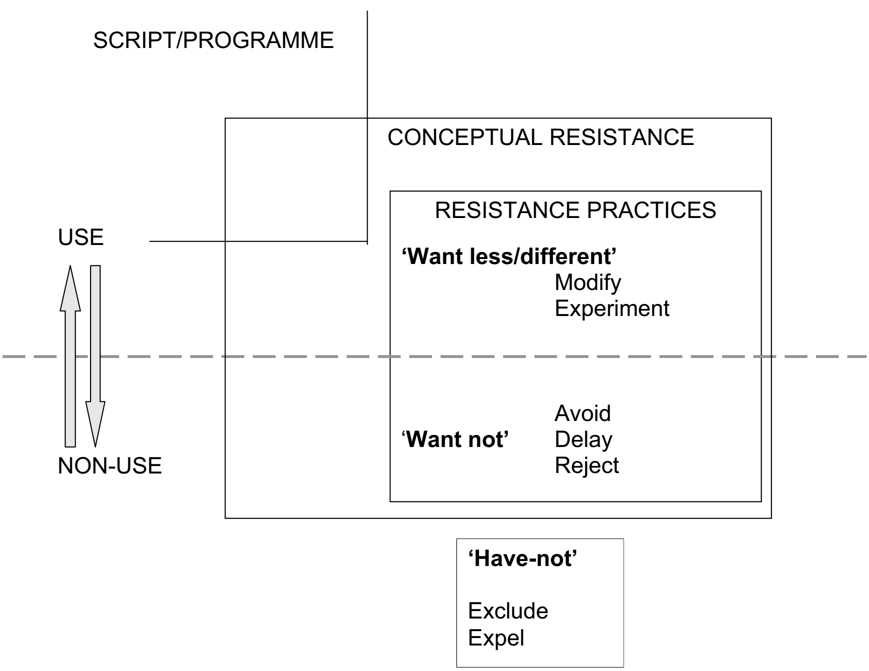

Figure 11.3 Use, non-use and resistance to technology.

it is possible that this difference lies in the cases considered. Doctors may be more ambivalent themselves about statins than other drugs (Gale et al. 2011), and less insistent on prescribing than they might be for symptomatic conditions, especially mental illness, studies of which were influential in the Pound and colleagues review. Our data certainly suggests that doctors may act not only as promoters of prescription drugs, but may also sanction rejections or reductions and instigate changes of preparation. In other words, they were mediators not only of use, but also of modification and non-use. This may look very different for other technologies, which have other intermediaries. For this reason, we have provided versions of the conceptual framework with and without the boxes for "voiced" and "silent" resistance, for times when no equivalent interactions appear relevant—although we have not found it possible to depict such intermediaries and interactions as specific elements in the figures.[2]

Practices of Resistance or Non-Use

We noted above that individuals moved relatively easily between "use" and "non-use", so that this distinction alone did not say enough about how a technology was received. This might be one reason to retain the additional broad category of "resistance", which encompasses a broader orientation to the technology which may be expressed purely at a conceptual level or spill over into modification as well as avoidance and rejection. We have debated whether "resistance" is the appropriate language, given our finding that non-use or the threat of non-use is not necessarily hidden from doctors (c.f. Pound et al. 2005). We do not know whether the participants in our study would recognise their practices as resistance, and we have become increasingly reluctant to attribute motive beyond the conceptual resistance that was widely articulated. We also feel that resistance implies an oppositional stance that is not apparent in the current study. These reflections speak to on-going debates about the meaning and attribution of resistance as either an analysts' or actors' category (see, for example, Bauer 1995; Kline 2003). For example, we note that resistance as an academic theme has been critiqued for obscuring the analysts' own normative commitments—resistance may be implicitly romanticised or celebrated (for further discussion, see Armstrong and Murphy 2012). However, we have retained the term in our schema because it does capture a sense of people's reticence around drugs that straddles use and non-use.

Because of these concerns, we find that the addition of new layers of both use and non-use from Wyatt is helpful, both for our case and perhaps for scholars of other technologies. We have made minor modifications to Wyatt's categories, suggesting the term "avoidance" rather than "resistance" to allow us to retain resistance as a broader and potentially conceptual category. In addition, we have proposed that we add "modification" and "experimentation", allowing us to highlight attempts to limit or alter the script offered by the health professional, while stopping short of rejection. Finally, and importantly, we have shifted the language from types of users to actions. As discussed above in relation to temporalities, modification and rejection are phases that people may move between several times over. This suggests these may be better understood as aspects of practice rather than identity. Similarly, in discussing mediation, we noted that use and non-use emerged out of discussions and interactions with relevant others, including friends, families and health professionals. Again, rather than label people individually as avoiders, users, modifiers and rejecters, we therefore suggest it makes sense to think about practices (of avoiding, using, modifying or rejecting), which may be shared or distributed. Thus, this analytical shift to practice incorporates both the temporalities and the mediation of non-use. In suggesting this turn from identity to practice, we draw on a notion of practice understood as fluid, contextual, contingent and distributed. We also prefer this term to "behaviour", which is increasingly critiqued in medical sociology (and seen as individual, fixed and discrete) (Cohn 2014). We therefore suggest one final modification to the original schema we sketched out, replacing Armstrong and Murphy's (2012) idea of behavioural resistance with "resistance practices". This completes our conceptual shift to practice and is reflected in our final figures.

ACKNOWLEDGEMENTS

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NOTES

1. Universities of Nottingham and Manchester, where Weiner was based during this research and the University of Sussex, where Will is based.
2. We note that an account starting from the types of STS informed by Actor–Network Theory would have attended to this issue more explicitly, but we have chosen here to orient our figure around practices rather than actants.

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12 DIY Research in the Psychonaut Subculture

A Case of Unwanted User Innovation

Johan Söderberg

STS ON DRUGS

The involvement of unauthorised practitioners in scientific research and technical development has received much attention from science and technology studies (STS) scholars over the years. The conflictual aspects of this trend have often been emphasised: user and/or patient involvement blurs professional boundaries and challenges epistemological hierarchies, while opening the door to marginal perspectives on science and technology. Some of the terms employed to capture this phenomenon and the conflicts it entails are "lay expertise" (Wynne 1992), "scientific citizenship" (Irwin 2001; Elam and Bertilsson 2003) and "technology-and-product-oriented social movements" (cf. Oudshoorn and Pinch 2003; Hess 2005). These studies are paralleled by writings on free and open source software development as a model of open innovation, practices that have recently expanded to include open hardware development and open biology. A culture of DIY research, emerging from the margins of natural science, is transforming the way officially sanctioned research is financed and conducted (Delfanti 2013). Furthermore, the introduction of a physical infrastructure to enable such initiatives, ranging from the creation of hackerspaces (Kostakis et al. 2014) to the development of user-friendly "open" tools (Söderberg 2014), suggests that this trend will continue to grow in importance and scope. Indeed, this process is backed by an improbably wide range of actors, from EU policy-makers and corporate executives to hackers and anarchist militants. Any one of these would readily subscribe to the following statement:

> *This kind of kitchen chemistry is definitely something that should be maintained. It is a dying art and if the only people who are able to actually do these kind of manipulations in the future are the people that have been to the university and have the appropriate licenses, if that is how it becomes, then we lose a large part of our potential as humans.* (Interview person B)

Except that the "kitchen chemistry" referred to here is the extraction of dimethyltryptamine (DMT), a Schedule I drug under the *UN Convention on*

Psychotropic Substances. Home manufacture of this substance is punishable by long prison sentences in most jurisdictions in the world. My case study of user innovation in the methods of extracting from hallucinogenic plants is presented as a corrective to the often consensual and celebratory talk about the benevolent and emancipatory potential of DIY practices. Kitchen chemistry on controlled substances reminds us of the need to think about state regulation of the growing conflicts that can be expected to follow from greater user participation in scientific research and innovation.

Ten years ago, taking the pulse of existing literature on users, Dale Rose and Stuart Blume lamented that the role of the state had largely been overlooked (2003, 107). They pondered the possibility that this omission was embedded in the very subject matter under discussion. The notion of the "user" implies a person located outside (state) institutions and the symbolic chain of authority for which the state is the guarantor of last resort, in particular, the university. Indeed, the emancipatory promise sometimes attached to user innovation largely stems from this purported "outsider" position. One ambition of this chapter is to reconnect with Rose's and Blume's musings on the relation between the state and its citizen in the case of user engagement with technology. The authors' argument revolved around the ability of the state to exercise its authority over citizens by obliging them to participate in vaccination programmes. The officially stated goal of such obligations is to reduce the risk of epidemics, an objective that even those who, for various reasons, refuse to participate in vaccination programmes, are likely to support. In order to put my argument in terms as unambiguous as possible, I have chosen a case—drug control—where the goal of state intervention is instead hotly contested, at least by those subject to its enforcement regime, i.e. users doing research and product development on controlled psychedelic substances.

It could be argued that drugs offer the quintessential example of a core STS insight, namely, that an object can be two diametrically opposed things depending on the context. As Paracelsus famously put it, the dosage makes the poison. For this reason alone, drug use offers a compelling field of empirical investigation when reflecting on user engagement with technology (Gomart and Hennion 1999; Westhaver 2011). The difference between a poison and a remedy is a matter of degree, not of kind. The ambiguity of the drug itself is transferred to the act of its administration, which can be framed alternately as a medical act or as an act of intoxication and recreation. There is therefore relevant in extending STS discussions on patient advocacy to the sphere of illegal drugs (cf. Epstein 1995, 2008). It has been shown, for instance, that self-medication with controlled substances is highly prevalent among patients diagnosed with schizophrenia (Addington and Duchak 1997). From the other end of the telescope, much substance abuse has been attributed to the consumption of prescription medicines in non-prescribed contexts or quantities (Thoer et al. 2012). In sum, drug user groups and patient groups exist on a continuum.

One controlled substance that stands out in this respect is cannabis. The effectiveness of cannabis in the treatment of medical conditions such as multiple sclerosis, attention deficit hyperactivity disorder and rheumatism is attested to by large groups of patients. Some of them claim to choose cannabis over prescription medicines because they find the prospect of becoming addicted to the latter more frightening (Pedersen and Sandberg 2013). The difficulty of distinguishing between the medical and recreational use of cannabis is reflected in a contradiction in US legislation. Since 2010, the medical use of cannabis has been permitted in 14 US states, while continuing to be regulated at the federal level as a Schedule I substance. The criterion applied in giving a substance a Schedule 1 classification is that it has no currently accepted medical use (Hoffmann and Weber 2010). Cannabis has won cultural acceptance in the general public that has not been granted to most other controlled substances. But much the same message holds true for more controversial, psychoactive drugs. One example is cluster headache, a chronic, periodically recurring and very painful medical condition. In a forum dedicated to this illness, a member suggested that the symptoms could be relieved with psilocybin, the active substance in "magic mushrooms". Many forum members were outraged by a claim that, in their eyes, sought to legitimise a controlled substance by associating it with their clinical condition. However, some tried psilocybin and felt that the mushroom alleviated their suffering. They launched their own patient group, called "clusterbuster", dedicated to this particular treatment. Following this, cluster headache became a celebrity cause in the underground, psychedelic press (Sewell 2008). In STS literature, it is old news that the label "patient" itself is charged with meanings which, in some cases, presuppose the very assumption that demands scrutiny. In other words, the act of ascribing sickness or health is highly political in a society that has become medicalised through and through (Brown and Zavestoski 2004; Zavestoski et al. 2004). The case with controlled substances allows us to examine ongoing STS discussions concerning the epistemological authority of a medical diagnosis in the light of punitive legislation and law enforcement.

This connects this chapter with another fruitful field for STS inquiries, namely the study of science in the judicial system. It has provided a testbed for recurrent questions about epistemology and truth claims in relation to expert witnesses and forensic laboratory work (Jasanoff 1995). Applying these questions to illegal drugs, Nancy Campbell has examined the controversy surrounding drug-testing equipment. Despite concerns about the reliability of such equipment, the test result is made to bear a heavy epistemological burden when courts take decisions on parole and on the enforced removal of children from parents (Campbell 2005). Here, I propose to angle the discussion in the direction of user involvement in science and product innovation. A case in point, to be discussed later, is the appropriation of drug-testing equipment by users for the purpose of determining whether or not a compound offered for sale is correctly labelled. The central argument that I make in this chapter is as follows: although users seem to stand outside state institutions, the state cannot be left out from reflections over how users matter.

AN OUTLINE OF PSYCHONAUT SUBCULTURE

Defining the "drug user" is fraught with as many ambiguities as defining the "patient group". It could be said that the psychoactive substance of choice plays the same central role in the identity formation for the former as does the medical condition for the latter (Beard 2004). Telling are the multifarious distinctions made by the users of various controlled substances, drawing boundaries between hard drugs and soft drugs, individualistic drugs and social drugs, chemical drugs and natural drugs and so on. Needless to say, these classifications relate only partly to the pharmaceutical properties of the substance in question. Equally important is the desire among groups of users to distance themselves from more disreputable drugs and drug users in order to gain legitimacy for their particular drug of choice. A case in point is the push for the decriminalisation of cannabis use, which goes hand in hand with a strong emphasis on the therapeutic properties of the herb. The medicalised language transforms a subculture of drug users which for decades justified their practices in more political and confrontational terms (Pedersen and Sandberg 2013).

With regard to the arguments that I intend to advance here, I have chosen to look exclusively at a group of drug users who have forged a strong collective identity in opposition to medical expertise and legal authorities. As a byproduct of this confrontational stance, they have developed a counter-expertise around the drugs they use. The group I have in mind gravitates around substances that are variously labelled "psychedelic" or "hallucinogenic", the best-known being LSD, dimethyltrypamine (DMT) and psilocybin (i.e. "magic mushrooms"). Experimentation with lesser-known compounds with psychoactive effects falls into the same category, and will be referred to here as "legal highs". Users dedicated to this constellation of drugs often refer to themselves as "psychonauts", a composite term coined by the German futurist Ernst Jünger from the words "psyche", meaning the mind, and "nautes", meaning a voyager. It gives a sense of the cultural sensibilities of the people who adopt this name. Most drug users are found on the margins of the psychonaut community and have only a fleeting interest in psychedelic experiences. They would be more accurately described as belonging to club culture. My interest is with the core-set who identify themselves as psychonauts, share the values of this group and regularly contribute to the common project.

One advantage of focusing on psychonauts, in comparison with many other groups of drug users, is that they self-organise in forums in which they collectively reflect on and give meaning to their own practices. Besides discussions on web forums dedicated to psychedelic drugs, they regularly hold festivals and conferences on both sides of the Atlantic. The observations and interviews that underpin this study were collected during four psychonaut conferences held between 2011 and 2013 in Milan, Amsterdam, Berlin and London. My experiences are limited to the European psychonaut scene, but the subculture is global in its outlook. The psychonauts share a sense of common history rooted in 1960s American counterculture, and many of its gurus are still held in high regard. Besides Timothy Leary, we find in the Parnassus of this subculture the novelist Aldous Huxley, the inventor of lysergic acid diethylamide Albert Hofmann and Alexander Shulgin, another legendary chemist who synthesised and made publicly available 200 novel psychoactive substances. The output of books and fanzines is prolific and helps to constitute a reading public. It covers trip reports, how-to-do manuals, arguments in favour of decriminalisation and spiritual and/or neuroscientific interpretations of drug experiences. The intake of psychedelic drugs is framed as an intellectual and/or spiritual pursuit.

This rationale distinguishes psychonauts from the mainstream of "recreational" drug users who take drugs chiefly in connection with parties and festivals. Embedded in this narrative is a negative judgment of the reckless and uninformed manner in which inexperienced users take drugs. That judgment carries force, because medical emergencies are put down to *uninformed* substance use, as opposed to being attributed to the inherent pharmaceutical properties of the substance itself. This case is typically made by stressing the importance of "set and setting". The first refers to the state of mind of the user when a drug is taken, and the second to the physical environment and other precautions taken by the users. Set and setting resonates with the priority given in STS research to the situational rather than the essential properties of an object. The stress on informed drug use reallocates responsibility, as the uninformed drug users not only puts themselves at risk, but jeopardizes the psychonaut community as a whole. Emergencies attract the attention of the media and politicians, accelerating the rate at which a novel substance is scheduled and thus imposing restrictions on the whole psychonaut subculture. There is consequently an esoteric and elitist strain in the psychonaut community—bordering on the paternalistic—alongside the exoteric, libertarian outlook, according to which psychedelic drugs should be kept out of hands of ordinary partygoers. It is this circle of lay experts that interests me, rather than the recreational users with only a passing or instrumental attachment to the drugs they take.

A final word is in order on how I have demarcated the drug users in my study. I have chosen not to consider substances associated with severe addiction problems and forced treatment programmes, even though methamphetamine cooking in the rural US is tangential to my arguments here (Sexton et al. 2006; Reding 2009). The mere mention of it casts a shadow over the buzz around do-it-yourself research and "user innovation". Unsurprisingly, psychonauts are as anxious as are DIY biologists to disassociate themselves from the methamphetamine cook. This is well illustrated by the introduction of vaporisers, an electrical device that has become popular for administering cannabis or DMT. They are preferred over the ordinary glass pipe, where the compound is placed inside the glass bowl and a heat source is applied under the bowl. Vaporisers are designed to bear as little resemblance as possible to the glass pipe, for reasons that psychonauts are quite lucid about: the glass pipe, better known as a crack pipe, is associated with crack cocaine, crime and social misery. Of course, these are precisely the kind of boundaries erected by practitioners that an STS researcher ought to question when setting the parameters of his or her inquiry. The reason I have excluded problematic drug users from my discussion of clandestine drug innovation is because psychonauts tend to be highly articulate and assertive about what they are doing, in a way that better fits the intent of this chapter.

Psychonaut subculture contests the epistemological authority claimed by government agencies, the medical profession and pharmaceutical companies, paralleling much of what has been said before about patient group activism (Akrich and Rabeharisoa 2012). The implications of commanding epistemological authority in this context are suggested by in the validity ascribed to diagnosis. It is the diagnosis that separates medical from non-medical (thus recreational) substance use. In the same breath as this expertise is assigned to a doctor—the holder of a title certified by a state-sanctioned educational institution—patients are deprived of the authority to self-diagnose their conditions, and, subsequently, to claim their drug consumption to be medically motivated (Illich 1976). The epistemological challenge posed by psychonauts goes beyond questioning the authority invested in medical doctors and law enforcement. A thematic core in collective psychonaut identity formation is the claim that psychedelic drugs give them access to an altered state of consciousness, opening doors of perception that remain closed to the state, indeed, to the scientific rationality of modernity as a whole (Doyle 2011). The metaphysical ramifications of these claims play out more mundanely in a widespread mistrust of government-backed information sources. Trust reached a low point in the psychonaut community in 2009 with the dismissal of David Nutt from his position as the UK government's adviser on the misuse of drugs after he had compared the statistics on horse-riding accidents unfavourably with emergencies arising from the use of Ecstasy (Nutt 2009). Psychonauts seized on the opportunity to call for an "evidence-based" approach to drug information and harm reduction, as opposed to existing drug policies, which they contended to be ideologically driven. Here one can detect a tension in the various arguments advanced by the psychonauts, similar to the difficulties encountered by various alternative medicine movements. One side renounces *in toto* the hegemony of "Western" rationalism and science, while another seeks to lay claim to some of that legitimacy for its own oppositional practices (Goldner 2004). Be that as it may, over the years, drug users have built up a counter-expertise in pharmaceutics, to the point that some have acquired both interactional and contributory expertise (Collins and Evans 2002). Indeed, because of the low level of confidence in government information about drugs among target groups, health personnel and law officers often have access to these people only through the information channels that have been set up by legalisation activists. This gives the activists a lever for institutionalising their agenda inside government-sponsored organisations that promote drug education and health issues and monitor the drug market. Unsurprisingly, attempts to institutionalise a counter-discourse on drugs are met with strong resistance from within these institutions. Again, the situation can be compared with the resistance that advocates of complementary and alternative medicine encounter within hospitals and clinics (Goldner 2004).

As well as contesting the content of drug education and drug prevention programmes, psychonauts champion medical research on psychoactive and controlled substances. Such research is hampered in most countries by a general lack of public funding, the strictures of ethical committees and the requirement for special licences and security routines. Once a substance has been listed as a Schedule 1 substance, which is to say, once it has been classified as lacking any legitimate therapeutic effects, it is likely to stay in that category, because pharmaceutical companies avoid taking the risk of investigating any potential medical uses. One of the oldest activist organisations in the field, the Multidisciplinary Association for Psychedelic Studies (MAPS), was conceived as a "non-profit pharmaceutical company", according to its president, Rick Doblin, with the aim of filling this gap in research on psychedelics. MAPS organises conferences and funds research on psychoactive substances. It can be said to represent one strand within psychonaut subculture, struggling to win public recognition for psychoactive substances as a legitimate field of research, to be conducted within established, official channels of science and clinical medicine. The other strand upholds the right of the layperson to do research without being accredited by a university department. In the newsletter Erowid, a key reference in psychonaut subculture, which publishes trip reports, reviews of new drugs and updates on changes in the law, the chief editors summed up this idea as follows:

> *[. . .] there are no hard lines between researchers and the subculture. Members of the psychedelic subculture have access to the same scientific understandings about psychedelics that researchers do, such as mechanisms of harms like MDMA neurotoxicity, or spiritual benefits of psilocybin documented by the Griffiths group at Johns Hopkins. The distinction between scientific researchers, pharmaceutical researchers, subculture researchers, and that chemistry geek in the college dorm are more blurry than they have been since before the explosion of psychedelics into the culture, and the backlash against them, in the mid-1960s.*
> (Erowid 2010, 18)

Indeed, the expertise in chemistry and pharmaceutical science on some web forums dedicated to controlled substances is at times of a professional standard. One token of this is that, during my research for this chapter, I could access pay-walled academic journals through a link posted on a forum dedicated to DMT extraction techniques. Forum participants used the link to consult medical journals in order to keep abreast of recent developments in the pharmaceutical field.

Users of controlled substances differ in at least one all-important respect from most other unruly, uncooperative users and patients. In their case, the epistemological authority invested in the medical profession and in the pharmaceutical industry is backed up by the court system. The unauthorised user who self-medicates or engages in DIY research on drugs runs the risk of being subjected to law enforcement and criminal sanctions. The fact that psychonaut subculture as a whole occupies a legal grey zone profoundly affects their practices, their self-understanding and their interaction with the wider society. This makes it rewarding to consider them in relation to existing STS literature on users and patients, where the epistemological challenge of users typically stays within legally established boundaries. In consequence, those boundaries have not received much attention, whether from unruly practitioners or from scholars. The example of drug users puts the spotlight on the state as the lawgiver, which sets the baseline for user innovation and lay expertise. This holds as true for cases that fall well within the margins of the lawful as it does for illegal ones. The meaning of user innovation changes drastically, however, when it takes place within a legal grey area. Here, the state plays the role of a hothouse in driving innovation among users. This is remarkable in that controlled substances are one of few policy areas where today's regulators try hard to prevent innovation and entrepreneurship. Both in its presence as a hostile external force, and in its absence as a benevolent regulator, the state contributes to fostering and channelling user innovation of controlled substances. In respect of the former, innovation works to make law enforcement harder. In respect of the latter, innovation works to compensate for the lack of consumer protection afforded to or imposed on market actors. In the next two sections, I discuss first the hostile-punitive aspect and then the benevolent-regulatory aspect of state intervention in relation to user innovation in controlled substances.

USER INNOVATION TO CIRCUMVENT LEGISLATION AND LAW ENFORCEMENT

A major incentive for members of the psychonaut subculture to engage in innovation is to avoid detection by law enforcement agencies, and/or to circumvent existing legal definitions of controlled substances. Broadly speaking, two strategies for neutralising the law can be identified. First, users try to stay ahead of the game by finding as-yet unclassified plants and compounds.

Second, methods for growing and manufacturing drugs are developed to spread their use to ever-larger numbers of people. The first strategy has made it into the headlines with expressions such as “designer drugs”, “legal highs” or “novel psychoactive substances”, depending on who is doing the talking. According to the European Monitoring Centre for Drugs and Drug Addiction, seventy-three novel psychoactive substances were identified on the European market in 2012 alone, and the trend is upward every year (EMCDDA 2012). The pace of innovation is driven by the involvement of for-profit entities, which may invest substantially in research and development. The design and production of new psychoactive molecules have been systematised and integrated into a global value chain in which Chinese laboratories play a prominent role.

Confirming an observation well established in the literature of innovation studies, private companies enter this market segment as late adopters of innovations that originate with users (Interview person K). The chief innovation is not the discovery of any single plant or psychoactive substance, but the realisation that novelty is a loophole in the controlled substance act. Though it is impossible to say exactly when this realisation was first made, the practice spread to a segment of the 1960s counterculture with the criminalisation of lysergic acid diethylamide. The LSD ban was first introduced in 1966 in California state law; it was written into US federal law four years later and then implemented internationally the year after with the UN convention on psychotropic substances. Overnight, it had become unlawful to manufacture and to possess the emblematic drug of the hippie identity. The often idealistic and eccentric milieu in which LSD had been consumed and manufactured gave way to more criminal and self-serving elements (Schou 2010). Nevertheless, some of the LSD manufactured today is still produced for political-ideological motives. When such chemists are caught by law enforcement, they regard themselves, and are recognised by the psychedelic community, not as criminals, but as political prisoners (Fielding 2011). The most recent example is Casey Hardison, who was released in 2013 after serving a nine-year sentence for manufacturing LSD and dimethyltryptamine. In court and throughout his time in prison, the chemist refused a lawyer and contested the legitimacy of the law under which he was convicted (Hardison 2007). Few are willing to pay such a high price for their convictions, no matter what the political cause. Another sign of this commitment is that, since the day LSD was outlawed, users have gone to great lengths to find as-yet legal substitutes. Of the many analogues invented or rediscovered at this time, the most popular was MDMA, better known as Ecstasy, which remained unclassified in the US until 1985 (Collin 2009). The clampdown on Ecstasy and its corollary, the rave movement, in the late 1980s and early 1990s, unleashed a new wave of discoveries and innovation amongst drug users, especially a renewed interest in psilocybin-containing “magic mushrooms”.

The second way in which innovation is mobilised against the controlled substance act is through the development of methods that lower the threshold for growing and processing scheduled drugs. With wider dissemination of the practice amongst users, it becomes harder for the police to intervene and press charges. This points to another contradictory outcome of law enforcement. Not only does the law quicken the pace of an innovation process that it was intended to suppress, but it may also give users incentives to acquire the know-how and skills to manufacture drugs. A telling example of this dynamic is a thread on an important forum in the psychonaut community, Drugs-Forum.com. The discussion concerned a vendor of designer drugs in United States who faced criminal charges. He was recorded on a Drug Enforcement Agency wiretap admitting to a Chinese supplier that the chemicals he was enquiring about were intended for human consumption. One of the commentators on the forum drew the following lesson:

> *Maybe the next person who gets the bright idea to get rich quick will take a chemistry class instead and learn how to cut China out of the picture all together.* (2012-04-20)

The willingness of participants in a community to learn about and engage in shared practices is a precondition for the continued existence of that community. In this sense, then, the law also plays a role in preserving the identity and cohesion of the psychonaut community. One way of testing the plausibility of this postulate is to compare psychonauts with users who stay within the bounds of the law and whose innovations circulate on white markets. Here, it is a recurrent finding that the community is swept away by the commercial success of the innovation that it helped foster. The core developers fall out with each other over alleged betrayals of ideals or conflicting intellectual property claims. Concurrently, ordinary users lose interest in the service provided by the community as their needs are catered to by the regular market (Söderberg 2011). The dynamic is somewhat different in markets in controlled substances. In a study of the Norwegian cannabis market, Sveinung Sandberg notes that cultivation takes place in a two tier-system that has proven remarkably stable over the years. A proportion of the drug circulates in extended friendship networks governed by a moral economy distinct from the main cannabis market. Sandberg's explanation for this is that legal risks increase with the scaling-up of operations. This leaves a niche for users who engage in small-scale drug manufacturing for personal use and occasional sales (Sandberg 2012). This observation is confirmed by at least a small minority in the psychonaut community who opposes the decriminalisation of psychedelic drugs. According to this line of argument, criminal law is what protects the community from being co-opted by dominant institutions (Bey 2000).

The backbone of the drug-using community is the information channels where discussions are held, new products advertised or recommended and methods shared. In the 1980s, these channels were provided by fanzines and printed newsletters. Later, they were hosted on bulletin board systems, before everything moved out onto the Internet. Instructions on how to cultivate illegal plants such as cannabis or how to process controlled substances from accessible precursors are now easy to come by. To follow these instructions and actually synthesise a drug is a more demanding task. Besides the tacit knowledge presupposed for laboratory work and the associated safety measures, synthesis might require laboratory conditions and secondary reagents that are closely monitored by law enforcement agencies (Interview person A). More within reach of what ordinary users can do in their homes is the extraction of psychoactive alkaloids from plants. At this point in the argument, it should be stressed that the difference between synthesising a chemical compound and extracting it from plant material is a matter of degree, not of kind. Indeed, most drugs said to be "chemical" have their origin in the plant kingdom. For instance, amphetamine has a sibling in the ephedra plant, which contains a chemically related alkaloid, ephedrine. LSD is made from lycergic acid, which can be isolated from an ergot that grows on rye. A precursor for Ecstasy is safrole oil, obtained from the bark of the sassafras tree. Small amounts of safrole are also present in nutmeg, and the prospect of making pure Ecstasy from this widely available nut is a recurrent, though elusive, "holy grail" for psychonauts. The field that has generated the most systematically organised, collaborative research project is the extraction of dimethyltryptamine, or DMT.

As DMT remains relatively little known outside psychonaut culture, a brief description is in order. The drug is usually administered by heating DMT crystals in a glass/crack pipe. When the fumes are inhaled, the substance is delivered to the brain, giving an intense but short-lived psychedelic effect. The drug does not enhance mood or increase stamina, which may partly explain why it has so far had limited appeal for recreational users. DMT users belong to a tight-knit community that tends to emphasise the drug's role as a vehicle for mystical experience. This claim seeks support in the ethnographically rich history of the DMT molecule. It is the active compound in many brews taken in shamanic and ritual practices, the best-known being Ayahuasca, a brew originating with tribal peoples of South America. The appetite for discussions and writings on the deeper meanings of the DMT experience testifies to the intellectual culture that has grown up around this drug. This is also apparent in the community efforts put into improving the methods employed for its extraction. Before returning to the processes of innovation that arise in this setting, I will give a brief technical description of the most popular method among the several possible extraction techniques.

The ingredients required include plant material containing DMT alkaloids, a basifier, usually sodium hydroxide, and a widely available petroleum-based solvent such as lighter fuel. The plant material is ground to a fine powder and soaked in water. The basifying ingredient is placed in the water to raise the pH level, shifting the polarity of the DMT alkaloids. This makes the alkaloid susceptible to a non-polar solvent, so that when the petroleum is stirred into the mixture, it sucks up the alkaloid. The water, which has now turned into a greenish-brown vegetable goo, and the transparent petrol form two superimposed layers. The next step is to separate out the solvent, which contains the DMT, from the spent water-goo. Ideally, this is done with specialised glassware. Thanks to the recent popularity of molecular gastronomy, users at least have "plausible deniability" when requesting specialised equipment of this kind. This seems to happen often enough that when one of my respondents approached a glassblower, he was warned that another customer had been caught by the police (Interview person A). It is easier to obtain a metal syringe, which is almost as effective for the job. In England, at least, supermarkets sell them around Christmas as turkey "basters" (Interview person B). Once the two liquids have separated, more of the solvent is added to the water-goo and the same process is repeated several times to ensure that all the alkaloids have been extracted. The petroleum solvent is then poured onto a flat tray. One incremental improvement in the extraction process that has been made through collective learning and information sharing in the community is that a higher yield can be obtained by temperature changes. In the past, the tray was simply left in the open till the petroleum had vaporised, but nowadays, it is common practice to place it in a fridge. The solvent holds less DMT at lower temperatures and this forces the DMT out of the liquid. The end result is a fine white powder and, if the user is lucky, crystals of DMT left on the bottom of the tray.

The extraction process is not without hazard. Sodium hydroxide is highly corrosive and can, for instance, cause damage to the eyes. There is a small risk of this, because a heat reaction can cause splashing when the sodium hydroxide is introduced into the water. Likewise, it is an ongoing discussion on Internet forums whether vaporisation removes all of the petroleum solvent. It seems plausible that traces of it remain in the end product, the DMT crystals. Alternatives to the above extraction process are under development, where potentially hazardous chemical substances have been replaced with food-grade materials such as vinegar and limonene oil, a derivative of oranges. These and many other improvements to the extraction process are driven by health concerns, aesthetic factors or curiosity, and do not differ in kind from user innovations that take place in legally recognised white markets.

However, there is another class of user innovations specific to the psychonaut subculture, arising from the illegal status of DMT extraction, in other words, innovations made in direct response to or in anticipation of law enforcement activities. Although DMT is a Schedule 1 substance under *1971 UN Convention on Psychotropic Substances*, enforcement agencies have given a low priority to this drug. By contrast with Ecstasy, DMT has not attracted a mass consumer market of recreational users and, unlike some experimental designer drugs in recent years, DMT has not set off an avalanche of emergency cases. Perhaps this will change in the next few years. The community continues to devise a steady stream of new methods for administering the drug. One is to saturate dried herbs with the extracted crystals and roll them into cigarettes. Another is a crack pipe that uses steel wool to conduct the heat more evenly, thus making the drug easier to administrate. The reward for deskilling is a bigger market, but it also attracts media and political attention and increases the pressure on law enforcement agencies to uphold the law in this area. For now, it remains relatively easy to find plant material containing DMT on sale on the Internet and to have it shipped internationally, without seizure by customs authorities. The two most popular plant sources for DMT extraction are *Mimosa tenuiflora*, imported from Brazil, and a subset of the acacia family native to Australia. Although the bulk of the trade in these plants is unquestionably driven by the demand for psychoactive alkaloids, they have other uses as well. *Mimosa tenuiflora*, for example, can be used to dye cloth. The legal status of this plant is currently under review in many countries. Since 2005, possession of the raw plant material has been banned in France, subject to the same control measures as the DMT substance itself. As for England, the possession and sale of *Mimosa tenuiflora* is permitted on the condition that it is not intended for human consumption. Selling *Mimosa tenuiflora* in powdered form is banned on the assumption that it has been prepared for extraction. The user can easily overcome this obstacle by grinding the bark in an ordinary food mixer. The law has been effective, however, in that the additional preparation step reduces the quantities of plant material that can be extracted from a single batch, simply because of the limited capacity of food processors (Interview person B). Besides new legislation, there are signs that higher priority is being placed on the enforcement of existing laws. In the US, the supply of *Mimosa tenuiflora* dried up after the September 2012 clampdown on major importers and retailers.

This development was anticipated by the psychedelic subculture, spurring it to scan for alternative plants and fungi native to European and North American flora from which DMT can be extracted. It happens that florae containing the prized alkaloid are prevalent in the plant kingdom (Shulgin and Shulgin 1997, 247). As far back as 1992, the fanzine *The Entheogen Review* published instructions on how to extract DMT from grass of the phalaris genus, which were soon followed by more meticulously executed studies (Appleseed 1992). The advantage of phalaris grasses is that they grow abundantly in the temperate zone, but there are also numerous drawbacks. It is difficult to identify inert from active subspecies of the herb. The quantities of DMT are highly variable, depending on the season, growing conditions and harvesting techniques. If discussions on dedicated web forums are to be believed, the volume of alkaloids can even be affected by the time of day when the herb is harvested. Furthermore, additional steps must be taken and chemical products added in order to remove vegetable fats and chlorophyll from the plant material before the actual extraction process can begin (Interview person A; Festi and Samorini 1994). Most troubling is the presence of a neurotoxic alkaloid known as gramine in some subspecies of phalaris. An indication of its toxicity is that agro-business sees gramine as a promising base material for developing new strains of insecticides.

As long as tropical plants are easy to import, the choice of extracting DMT from phalaris grass is made on ideological or aesthetic grounds. However, the clampdown on *Mimosa tenuiflora* retailers in the US gave new impetus to the community's research efforts. One line of research seeks to improve techniques for identifying active subspecies of phalaris grass and methods for removing unwanted plant materials. Concurrently, a lot of effort is going into monitoring and publishing data on the concentration of DMT and other psychoactive and toxic alkaloids present in other plants growing in temperate climates. In some jurisdictions, it is possible to circumvent legal definitions by inventing unclassified extraction processes. This is the case in Brazil, where the state is trying, on the one hand, not to prohibit the DMT-containing Ayahuasca brew integral to native traditions and, on the other hand, to honour international conventions on drug control. In this balancing act, the state permits DMT use but prohibits its extraction, an approach that raises the problem of defining what counts as an "extraction process". The native Indians too prepare the plant material that goes into the sacred brew. This has been resolved by specifying that preparation counts as extraction if it involves petro-chemicals. With this legal definition in mind, one of my respondents in Brazil has developed a method of obtaining solid DMT compounds from *Mimosa hostilis* without using any petrochemical products. Instead, he relies on the protein in egg whites to purify his DMT-containing brew. The liquid can then be solidified by placing it in a food dehydrator, an appliance usually used for drying fruit. The end product is a DMT compound that has been obtained without petro-chemicals and therefore without violating the Brazilian ban (Interview person E). In a pamphlet on DMT manufacturing distributed at a psychonaut conference, tributes were paid to these initiatives that well capture the spirit of the DMT community:

> *The major advantage of underground entheogen research is that researchers are not subjected to reviews or guidelines of agencies like the FDA or DEA, and do not have to submit methodologies to the Institutional Review Board for approval.*
>
> (Nickles 2012)

The reference to the Food and Drug Administration (FDA) in this quote gives pause for thought. The powers invested in the FDA to regulate the pharmaceutical market were signed over to them in the aftermath of numerous cases of adverse drug reaction, most notably the thalidomide scandal in the early 1960s (Gaudillière 2012). What is experienced as a freedom on the side of the manufacturer recoils as a risk on the side of the consumer. Because there are no state-backed guarantees in underground entheogen research, the reduction of health risks and allocation of responsibility have to be self-managed by the subculture itself.

USER INNOVATION TO COMPENSATE FOR THE ABSENCE OF STATE REGULATION

It is not only in its role as an external, hostile force against drug users that the state generates innovation. Equally often, it is the absence of the state as a paternalistic-benevolent regulator that compels users to innovate. A parallel can be drawn with a less controversial example, the trend towards urban gardening and home vegetable growing. At least in part, this trend can be attributed to faltering confidence in the willingness and capacity of the state to regulate the excessive use of pesticides in agro-business (Hren 2011). Applying the same logic to cannabis cultivation and drug manufacture, where the use of pesticides is unabated, growing and brewing psychoactive substances at home is a way of maintaining a minimum level of consumer safety. User communities have developed various strategies to compensate for the absence of consumer regulation in the field. One is to engage in peer education about risks. Another is to broadcast systematic customer reviews on dedicated web portals run by harm reduction activists. The drawback with information obtained in this way is that a product is discovered to be dangerous only after an emergency. In addition to collecting data, harm reduction activists provide facilities for users to test their pills and compounds. The rationale behind these initiatives was explained by an activist in the following way:

> *It was heavily weighted on the side of the dealer [. . .] they would give you anything and it wouldn't matter. We just put more tools in the hands of people for them to be able to push back.* (Interview person F)

False labelling and the use of adulterants are commonplace. The purity of tablets sold as "Ecstasy" fluctuates greatly from year to year, depending on the availability of precursors (Vogels et al. 2009). Governments monitor the chemical composition of pills that end up in forensic laboratories, but little of that information reaches drug users. When a particularly dangerous substance is encountered, the police issue a warning. In most countries, the police refuse to give details of what the dangerous pill looks like, on the grounds that if such details were given, users might interpret the warning as an official sanction to take non-identified, and, by implication, less dangerous, pills. For activists, however, governments are jeopardising the lives of users by withholding critical information. Of particular concern is a substance called PMA that is occasionally sold as Ecstasy. PMA is more potent than Ecstasy and slower acting, with the result that users have been known to take a second or third pill thinking that the first was inert, resulting in fatal overdose. Another factor is that it is not unusual for customers to be sold mislabelled amphetamine tablets—worth a fraction of the price of MDMA. The concern about medical risks is accompanied by the fear of being cheated. Consumer information blends into risk awareness when drug users informally discuss their drug experiences.

These spontaneous interactions have given rise to more sustained efforts to systematise exchanges of information and circulate results to the wider community. A case in point is the user-generated platform Pillreport.com, a globally expanding database where users can post photos and write personal accounts about a drug they have tried. An indication of the site's importance is that it receives 15,000 individual hits per day. By cross-referencing police warnings with the information found in the user-generated database, users can identify the mislabelled pills to which the warnings refer. Pillreport.com's web administrator believes that the website and similar initiatives by the harm reduction community have encouraged the police and public authorities in some countries to become more transparent with government data (Interview person F).

A few independent pill testing programmes, such as EcstasyData in the US and EnergyControl in Spain, have the resources to commission their own laboratory tests, and ask users to submit their pills for analysis. Similar resources are available in the Netherlands, where pill testing has been integrated into national drug policy since the early 1990s. In other European countries, for instance Germany and France, grassroots pill testing initiatives operate in a legal no man's land. On the one hand, local and regional authorities fund organisations that provide the service, and cooperation with medical institutions has been in place for many years. On the other hand, depending on the political climate at the time, drug-testing activities may also be targeted by the police. The varying degrees to which the different organisations are integrated are reflected in their differing attitudes to the publication of test results. Whereas the Berlin-based group Eve and Rave asserts the right of users to be informed and therefore makes all its analytical data public, others are careful only to pass information on to the user directly concerned (Kriener 2001). The reticence about making test data public arises from the difficulty of separating the user, potentially a victim of mislabelled drugs, from the dealer, potentially the predator and propagator of such drugs. In media and policy language, this line is sharply drawn, but on closer examination, it often turns out that people may both use a drug and sell it within their wider friendship circles. Consequently, testing facilities are always on the verge of becoming relays in the market circulation of drugs. This leads to an intriguing observation: in spite of a general mistrust of government information about drugs, the state is still trusted as a neutral broker between products on the market. A government-backed testing facility offers the one thing that is in shortest supply and thus in greatest demand in the grey or black market for drugs: trust. This is why test facilities teeter on the edge of becoming waystations in price negotiations on controlled substances. In addition to this risk, government officials are suspicious that harm reduction initiatives serve as a publically acceptable front for a more far-reaching agenda on drug legislation. The suspicion is not entirely unfounded, as is suggested by the fact that the discourse on "risk reduction" and "industry self-regulation" has been adopted not just by activists, but also by head shop trade associations in countries where those are allowed to exist (Ryall and Butler 2011)

As for users and harm reduction activists, they are no less wary of the opposite scenario, i.e. that pill testing facilities and similar harm reduction initiatives are being turned into government monitoring devices. The users are, as the saying goes, experts in themselves, so user-generated databases often provide a superior source of information about new products on the market, and are frequently consulted by the police and medical personnel. There is a telling story about one police officer in Australia who could no longer obtain access to Pillrapport.com. Assuming that he had been banned from the website, he contacted the web administrator and asked to be let back in. The web administrator promised that the website was accessible to everyone, including law officers. It turned out that the website had been blocked by a filter put in place by the police station's IT-department (Interview F). This anecdote suggests how anxiety to maintain a sharp demarcation line between licit and illicit becomes an obstacle to the policing of that very boundary. Or in other words, in order to effectively police the border between legitimate and illicit, traffic must cross that border in both directions, even as the existence of such a crossing must simultaneously be denied in public. An example of the same traffic, but this time from the other side of the frontier, is the adoption of drug-testing equipment by grassroots harm reduction activists. The most commonly available equipment for testing pills is known as the "colour reaction test". This was originally a forensic method used by the police when arresting drug dealers, a field test that allowed them to quickly determine whether an unknown compound found on a suspect was a scheduled substance and therefore cause for arrest. Colour reaction test kits were sold by firms specialising in forensic equipment. A list of forensic technology firms offering this and other instruments for sale figured in a legendary psychonaut newsletter from the 1990s, *Psychedelics Resource List,* next to a column with reviews of vendors selling controlled psychoactive substances. As the editor of the newsletter put it:

> *There's no good reason that such technology should be in the hands of the police only.*
>
> (Hanna 2004, 127)

Nowadays, drug-testing kits are staple ware in many head shops. However, before this market was established, and still today in countries where head shops are not allowed, users and harm reduction activists made their own colour reaction test kits, which were often distributed for free or priced at shipping cost. A kit consists of an "Eppendorf tube", a standard piece of lab equipment that contains the chemical reagent in question. There are many reagents used to identify different products. The most popular is called "marquis reagent", which owes its popularity to its ability to distinguish between MDMA and amphetamine. It consists of nine parts concentrated sulphuric acid (H2SO4) and one part formaldehyde (CH2O). Sulphuric acid is highly corrosive, and the fumes from formaldehyde are unhealthy if inhaled. Making a kit requires little more than placing a drop of the liquid mixture in a tube, but because of the hazards involved, some extra precautions are needed. At first sight, it seems equally straightforward to test a pill with the kit. The user simply scrapes a sample of the unknown pill into the tube. The liquid changes colour when it comes into contact with the substance, and this colour is compared against a colour map supplied with the chemicals. If the liquid turns purple-black, it indicates that there is MDMA in the pill. If not, the user has a strong indication that the pill does not contain that particular substance. This information is sufficient for a police officer to make an arrest, but is very short on information for someone intending to swallow the pill. In particular, it says nothing about the dosage or the presence of cutting agents. Drug dealers trying to pass off mislabelled Ecstasy tablets quickly found a way to trick the colour reaction test, simply by placing a batch of non-MDMA pills in a bag that had previously contained MDMA and shaking the bag so that the test would subsequently show positive (Interview person F).

The main drawback with the colour reagent method is that it requires the user to possess a lot of tacit knowledge in order to produce reliable results. A seasoned harm reduction activist can spot nuances in the colours produced by the chemical reaction and make an educated guess about the purity of a tablet. In countries such as Portugal and Netherlands, where drug laws are permissive, harm reduction activists can provide these services for festivalgoers without any problem. Such permissiveness, however, is more of an exception than the rule. In many jurisdictions, it is considered a drug trafficking offence to receive a controlled substance and hand it back again, even if no money changes hands. A further level of uncertainty is added in countries where the possession of "drug paraphernalia" is considered to be a crime in its own right. Here, pill-testing equipment is only one step away from the same list as crack pipes and precision scales for dosing (Interview person H). The likelihood of a harm reduction activist actually being charged for drug trafficking or the possession of drug paraphernalia depends largely on contingent and local factors, such as the political climate and the priorities of whoever is running the local police service at the time. In many, if not most, countries, pill testing exists in an ill-defined legal grey area, where national and municipal policies are often in direct conflict (EMCDDA 2001). France is an exception, because there the law explicitly forbids harm reduction associations from conducting pill tests with colour reagents. When this provision was introduced in 2004, harm reduction associations in exchange were given official recognition together with the right to apply for public funding. One activist alludes to the history of the reagent tests when explaining this tough stance on them in a law otherwise designed to normalise the working conditions of the associations:

> *It was a real issue, the ministry of justice wanted to have its tool back, and not to see it being used by the associations.* (Interview person M)

In countries where pill testing is either explicitly prohibited or left in a legal grey area, activists try to work around the restrictions by instructing users how to conduct the tests by themselves. Harm reduction associations go to festivals, hold workshops and set up tents where users can test their pills under optimal conditions. However, because tacit knowledge cannot be passed to users in this way, the test results tend to be unreliable. Indeed, the unreliability of the method in the hands of inexperienced users provided the scientific pretext for banning harm reduction associations in France from conducting colour reagent tests on behalf of users. The ban is the reason for the method's unreliability, which in turn provides the pretext for the ban. More resourceful associations have been able to work around the legal and technical limitations of colour reagents by employing technically more advanced analytical methods, such as gas chromatography. This is a routine laboratory technique that produces standardised, reliable results, but it is expensive and requires laboratory conditions that cannot be reproduced in the field, so with gas chromatography, there is no way for drug users to be involved in the testing process. This is crucial, because the main point of pill testing for many harm reduction activists was not to supply users with an analytical instrument, but to provide an entry point for peer education about drugs (Interview person M). The dissemination of more advanced forensic equipment might improve conditions for grassroots pill testing in the future. A case in point is an association in Australia called Enlighten that tried to buy a state-of-the-art "chemical scanner" from a forensic firm, a device originally designed for detecting drugs and explosives at border controls. The scanner is a black-box method for analysing chemical contents at a distance, which activists hoped would remove the legal risks of receiving and handing back a controlled substance, and at the same time remedy the unreliability of user testing. In this case, there was high-level intervention by the Australian government to prevent the firm from selling the scanner to the association, but it is foreseeable that such tools will eventually become available on the secondary market (Interview person F).

Concurrently, the need for harm reduction initiatives has been accentuated by the wider market circulation of "research chemicals", "designer drugs" and "legal highs". Whereas these experimental compounds used to remain within closed circles of connoisseurs, they have now begun to circulate among mainstream recreational users. By contrast with popular but unambiguously illegal substances like MDMA, heroin, etc., where acute risks and long-term effects have been documented over the years, novel psychoactive substances are unknown unknowns. Incubation time, dosage, adverse drug reactions and inadvertent effects from mixing substances, are vital information gathered on a trial-and-error basis and haphazardly documented in user-generated databases and discussion forums. Staying up to date with the latest developments on the market is imperative for a responsible drug user. The spread of novel psychoactive substances to ever-wider and consequently ever-less-informed circles of drug users is driven by the ambiguous legal status of these products. In most countries, where the law has not been amended to prevent this from happening, novel psychoactive substances can be advertised on websites, delivered by mail order or sold in brick-and-mortar head shops. The European Union and national parliaments in Europe are passing new laws to close this loophole (already closed in the US), but as a consumer pattern and a corresponding mass market has already been established, the likely effectiveness of these laws is much in doubt (EMCDDA 2012). The response to the new laws will not be compliance, but innovation. One pointer is the surge in encrypted and anonymous trading places, starting with Silk Road and, after its organiser was arrested by the FBI, its many lookalikes. These peer-to-peer distribution channels have upset the old patterns of drug diffusion. Previously, it was fairly predictable how a substance would circulate on regional drug markets, because of the existence of established networks and value chains. This is another facet of the challenges that innovation poses to harm reduction activists. A central function of user-generated databases is to warn users and activists about the circulation of particularly dangerous products. With these alerts, it used to be possible to make an educated guess where the product would show up next (Interview person F).

As these examples suggest, it is not only governments, but equally, drug users and activists, who find that their efforts to regulate the drug market are being disrupted by innovation. The need to put a halt to unacceptably dangerous practices and products is voiced by segments of this community as well. There is a telling editorial in *The Entheogen Review*, the fanzine mentioned above and whose claim to fame is having published the first instructions on how to extract DMT from phalaris grass. In the years when information about drug manufacturing moved from the fanzine underground to the Internet, the editor shared some deeply felt concerns with his readers:

> *Because virtually anyone with a computer can post anything they want (without the benefit of editors or peer review), information found on the Internet is suspect by nature.*
>
> (Entheogen Review 1998, 1)

A parallel can be drawn between grassroots harm reduction initiatives today and a turn of events in the history of the 1960s counterculture. As the youth rebellion drew to a close, the communities of LSD-dropping hippies, with their hopes for a better world, became infested with amphetamine addicts or "speed freaks". Seeing the detrimental effects of amphetamine on the addicts, as well as on the community and their political cause, hippies began to speak out against the drug. Nicolas Rasmussen ends his study of the history of amphetamine on a surprising yet compelling note: the fact that amphetamine was placed under restrictions by the US government, in spite of it being the most profitable product of the pharmaceutical industry in twentieth century, attests to the healthy influence of the counterculture on American political culture (Rasmussen 2008). To this observation, we can only add the following: the waning of that influence coincides with a political failure to impose restrictions on the free circulation of the cold medicines from which the precursors used for methamphetamine cooking are derived (Reding 2009).

CONCLUSION

For a long time, the co-construction of technologies by users was seen as an outlier, occurring on the margins of society and subsequently an object of study only for specialised research communities. The phenomenon has since spread to the point that it is close to becoming a generalised model for procuring research and innovation. The dissemination of advanced manufacturing tools and the media promotion of identities such as the "maker", help to render these practices ubiquitous. As a consequence, the conflictual aspects of use and non-use, already highlighted by STS scholars at an early date, also become more pronounced (Oudshoorn and Pinch 2003; Söderberg 2013). In this chapter, I have offered the DIY production of controlled substances as a limiting case for discussion on users and lay experts. The extreme nature of the case might lead the reader to think that it is also an exception. In order to argue for the general purport of my observations, I will end with a reference to something very ordinary, namely traffic regulation. Since at least the 1950s, youngsters have tinkered with their motorcycles in order to exceed inbuilt speed limitations. User innovations in this sphere have proliferated to the point of being manufactured for a mass market. Today, the driver bent on breaking speed restrictions without being caught by the police can choose from a range of products. A glossy substance sprayed onto the licence plate, while transparent to the naked eye, reflects the flash from speed cameras and overexposes the photo, making the registration number invisible. Drivers can equip themselves with radar detectors to forewarn them about police controls down the road. Now, consider how many more options will be available to user-drivers to tailor their vehicles in order to circumvent traffic laws if C,mm,n, OsCar or eCars take off. These are the names of three projects originating in the open hardware movement that are working on the development of modular car designs (Malinen, Mikkonen, Tienvieri, and Vadnt 2011). In the case of controlled substances, opinions on state intervention are highly polarised. With traffic regulation, by contrast, everyone agrees on the desirability of the ultimate goal of reducing traffic accidents and congestion. Even motorists who go out of their way to commit traffic offences are unlikely to publicly advocate *laissez-faire* as a principle of traffic regulation. They just decline to act in such a way that their conduct could be raised to a universal law.

The example of traffic regulation is analogous to the relatively uncontroversial goal behind vaccination programmes. No human being is likely to side with the non-humans in this conflict, i.e. the homicidal viruses. Of course, this does not rule out the possibility that the method of achieving the common goal, preventing epidemics, may be fiercely contested (cf. Fressoz 2012). It is not the implementation of one or another vaccination programme, however, but the founding principle underlying government intervention as such that is at stake in Dale Rose's and Stuart Blume's musings. Resistance is growing among individuals to surrender their immunity systems to the state sovereign for the greater good of national bio-security. In this trend, Rose and Blume see a measure of escalating individualism. This form of radicalised individualism concedes no grounds for the state to overrule the interests of one of its constituents for the sake of the whole. This line of thinking, though not ubiquitous, is well represented in the psychonaut subculture. The state is here experienced as an external, hostile force. In saying this, I do not question that this opinion is well grounded in experience. What is problematic with such an outlook is that it forecloses the possibility that the state could play a role as the benevolent protector of the realm. Indeed, because criminal law declares markets in psychedelic substances to be out of the bounds of state regulation, entrepreneurs have free rein to sell mislabelled and contaminated products with impunity. Or, at the very least, dishonest entrepreneurs are no worse off than the honest ones who sell properly labelled and unadulterated controlled substances. Deprived of state-backed consumer regulation, users have to resort to peer learning and self-organised, community-supported warning systems. At the same time, the responsibility to stay informed is placed squarely on the shoulder of the individual who, having taken a risk, has only himself to blame if something goes wrong. Extreme as this case might sound, something of the same political outlook and ethos can be found in many other DIY-communities and subcultures. A case in point is the strategies developed by Japanese citizen-scientists in the wake of the Fukushima incident. Mistrust of government information about the accident was rampant. Hackers and activists responded by holding workshops on how to make geiger counters and set up user-generated databases to map out contaminated areas (Kera 2012). It takes nothing away from these laudable initiatives if I say that they are a testimony to the decay of representative democracy. The possibility of petitioning representatives and swaying the state into performing these tasks on behalf of citizens had become almost unimaginable.

We might say, therefore, that psychonauts are not merely "lead users" in respect to psychedelic substances. They are early adopters of a new kind of "scientific citizenship", though it would be more appropriate to call them "scientific *sans-papiers*". Psychonauts have made themselves at home in the stateless future. The average medical patient is exposed to much the same chemical compounds as the psychonaut, but runs greater risks by putting his or her trust in the state and its certified experts. Such trust looks increasingly misplaced as safety regulations and clinical trials of medicines are increasingly scaled back in response to industry lobbying and neoliberal dogmas (Nik-Khah 2014). The same holds true for every other kind of potentially hazardous laboratory compound that finds its way onto the market (Demortain 2013; EEA 2013). What I want to direct the reader's attention to here is not the absence of industry regulation, but the extent to which psychonaut subculture has internalised this condition and celebrates it as something desirable. To them, it is a sign of individual freedom. This is consistent with the romantic and anarchistic intellectual current that the psychonauts inherited from the 1960s counterculture (Riley et al. 2010; Dabrowska and Bujalski 2012). In this perspective, authentic individuals are set against an oppressive state that is beyond reform or moderation. The state must be smashed, not through open confrontation, but through withdrawal. Exactly how this withdrawal is supposed to happen differs from case to case. In the 1960s, the hippies followed the example of Thoreau and started communes in the desert. According to at least some psychonauts, the state can be resisted just as effectively by escaping into altered states of consciousness. The most eccentric expression of this dream is the plans that frequently surface among filesharers and hackers to physically relocate their servers to ships and islands located outside territorial waters (Johns 2009). The master plan, however, is to flee into the near future of innovation, the not-yet regulated. This is what all the optimism about DIY practices, hackerspaces and open machinery tools ultimately means, an optimism shared by practitioners, academics and policymakers alike (Söderberg 2014). The latter group, although in charge of state institutions, might have their own reasons for wanting to withdraw from governmental rules and regulations. This ought to make us think twice about buying too quickly into the purported outsider position ascribed to the user-innovator, upon which the emancipatory claims attributed to grassroots innovation are founded.

What is missing from this political imaginary is the recognition that, because there is no such thing as an "outside" of society, the unrestrained freedom of the emancipated user-innovator will be experienced by everyone else as constraint, if not outright despotism. This outlook has but one answer to the question of how our living-togetherness in a shared geographical and biochemical space can be collectively managed: *laissez-faire*. We face a choice between longing for an ideal market, or for an equally idealised citizenry. According to the latter idea, freedom is not to do as one pleases: freedom is to voluntarily subordinate one's individual claims under the collective interest of all citizens, in exchange for the right to be part of the legislative process of that collective, i.e. "the state".

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Afterword

Trevor Pinch

USERS EVERYWHERE

In almost every aspect of the study of technological innovation these days, one finds the footprints of users. Take sound: a century and half before today's Internet, we had the Victorian Internet, the telegraph. This global system (secured by the British Empire) had at its core a key set of users—vast numbers of telegraph operators, mainly women, who sat in telegraph offices at tables or desks. Their job was to send and receive telegrams dispatched in real time over vast distances. Time, distance and space, for the first time in global history, contracted. The early technology, based upon the semaphore, used written symbols that could be coded into electrical impulses. This eventually became standardized as Morse code punched out by a series of dots and dashes which could, on reception, be automatically printed on ticker tape. The operators' skill was to read this tape, quickly turning code back into a written message. But at the same time as they were reading the code, the operators heard the clicks the telegraph made. They soon found that they didn't need the tape at all, and that they could do the decoding faster by using just their ears.

This was a user-driven innovation to turn the telegraph into a sonic technology. Samuel Morse and the Morse Company were at first none too impressed and resisted the innovation, as it would subvert their patents on the visual technology. But the operators prevailed and the telegraph became the first global sonic technology. As Jonathan Sterne (2003) points out in his history of these events, no one knows exactly who the innovators were—they were women telegraph operators everywhere who could tell from their own user experiences that this was a better way to do things. This echoes Adam Smith's famous remark in the *Wealth of Nations*:

> *A great part of the machines made use of in those manufactures in which labor is most subdivided, were originally the invention of common workmen, who, being each of them employed in some very simple operation, naturally turned their thoughts towards finding out easier and readier methods of performing it.*

These unknown women telegraph operators did more than just introduce a way of making telegraphy faster. Their sonic practices—which Sterne calls their "audile technique"—led to sound itself becoming a commodity. If sound is to become a commodity—a private good—then it must be bounded. After all, for something to be bought and sold to consumers, it needs to be separated off before being cut up, divided and sold. This is something which common public sounds such as the peal of church bells lacked (Corbin 1998). Bells might regulate time and order in French village life, but the sound of the bells was a shared experience—a public good. For sound to be privatized, it required a special audile technique. To do their task, the telegraph operators had to listen to proximal sounds (the clicking telegraph they were decoding), ignoring the cacophony of other telegraph clicks and other background office noise (headphones were eventually to become part of this audile technique). It required, in short, for the sonic field to be bounded by an interior and an exterior. Also as a form of audile technique, it required the listener to attend to detail. These features of "technicized sound": internal and exteriority and detail, Sterne argues, are the key features of the commodification of sound, which the phonograph and other sonic technologies took forward. Fast forward two centuries, and it is this same audile technique and the accompanying commodification of sound that is at the heart of today's sonic technology of MP3 files, the iPod and iPhone (a sonic technology that Apple depended upon to help turn it into the most valuable company in the world today (according to 2015 stock prices).

Everywhere we look in the global economy, we see this footprint of users. Goods (including Apple iPhones and tablets) could not be made in China and consumed all over the world if it was not for container ships. Who came up with the idea of the container ship? Malcom McCleran, a South Carolina farmer's son who in 1937 thought it would be nifty to unhook his truck full of bales of cotton and put it straight on a ship without having to deal with unloading all the bales first (Levinson 2008). Even smaller containers are necessary for our mass consumption society. We could not manage that big trip to the supermarket without using the shopping cart. This aid to mass consumption combines convenience with transparency and a subtle form of economic obligation. You can get a lot in it and everyone can see into your trolley (no stealing from the supermarket please)—but more subtly, a laden shopping cart at the checkout entails a form of material economic obligation. Those goods loaded in are symbolically ones you obliged to buy even before you have paid for them. If you doubt this, watch how people sometimes remove the one or two items they decide not to purchase—they slyly place them out of view of the cashier (Darr and Pinch 2013). No one unloads a whole cart and says to the cashier, "Sorry, I don't need these after all!" Who designed the shopping cart? Users, of course! Sylvan Goldman, the owner of the Piggly Wiggly supermarket chain in Illinois, came up with the idea (again in 1937) as a way for shoppers to buy more in one shop.

Shoppers even had to be trained to use the first carts (men found them too effeminate!) and the cart itself took quite some time to evolve into today's spacey and easy to maneuver stackable, open cage on wheels. The shopping cart, like all technologies, is of course open to being repurposed by other creative users, such as the homeless.

But it is not just the economy where users have left their footprint. Medicine is full of user innovation practices—whether devices for the deaf to hear better (Mills 2012), or drug testing for AIDS (Epstein 1993). The fields of sports and leisure (windsurfers, climbing gear, mountain bikes and so on (Rosen 1993; Shah 2000) and music (many innovations in musical technologies come from users, e.g., Les Paul and the invention of multi-track recording). Scientific instruments was one of the original areas studied by Eric von Hippel (1988) in his pioneer studies of "lead user" innovation, and today science itself, through "citizen science" and the like, is tapping into amateurs. A culture of DIY research is arguably emerging from the margins of natural science and is transforming the way officially sanctioned research is financed and conducted. And computers, of course, from the activities of the famous "home brew club" through to open source and hackathons, is a place where users have had and continue to play key roles. If one adds in all the current interest in maker fairs, hacker spaces and DIY, and the role played by citizens, patients and hobbyists, it is clear that nearly everyone today gets the message that "users matter." Even US President Barack Obama has hosted a Maker Faire at the White House, claiming, "Today's DIY is tomorrow's made in America!"

PRODUCED USERS

So we as scholars know that users are important. And of course, the people who produce things know this too. And this is the new aspect that the current collection of chapters has to offer. "Produced Users", as the editors call this volume, is about studying the changing strategies of producers who now aim to tap into the creative users. The book, as the editors say, is a "guidebook of the contemporary landscape of user involvement." So what does this mean, to "produce users"?

Back to shopping carts: every time we buy something at the biggest store on earth, Amazon.com, we see that little shopping cart icon appear as you "check out." One of Amazon's biggest patents is on one-click shopping. But Amazon not only realized the importance of getting the technology right to buy vast amounts of good instantaneously and conveniently online, but also the key role its users would play in shopping. Amazon was the first online company to enable, promote and capitalize upon so-called product reviews. "Product reviews" written by users have become one of the staples of the Internet. Any product transaction or service these days can be reviewed and rated, and there are special companies such as Yelp that are dedicated to providing such reviews, or companies such as Trip Advisor that specialize in one segment such as hotels. Users' own opinions, accessed instantaneously online, anywhere, are seen as a way of independently verifying the goods, service or transaction being offered. Users can also rate other users, such as the Uber drivers who rate the passenger (this rating is, however, kept secret from the passenger). How did this all come about?

Reviewing services such as those run by travel associations for hotels or the Michelin stars granted to restaurants, were in place long before the Internet. But Amazon seems to have stumbled into customer reviews by accident. Of course, before it became a general retailer, Amazon was started by Jeff Bezos as an online bookstore. It was pretty small and chaotic operation to begin with. Amazon was conceived of by Jeff Bezos as a sort of high-end online literary site and store. It employed many literary editors who would interview authors, discuss weighty literary matters and offer reviews (written initially by themselves). It even had pretensions of producing a new form of user-generated fiction—recall the venture in 1996 where a chapter written by John Updike would be followed by different users, each writing subsequent chapters. The original website was set up in such a way that all Amazon employees could write reviews. This was encouraged and soon Amazon employees, including warehouse staff, started to churn out reviews. Amazon came up with the term "product review," realizing that such reviews could be used to promote books. It then opened the process up to all customers. So customer reviews were born, and Amazon started to encourage their users to write more and more reviews and built up a platform with social media and so on for users to feel part of a special Amazon community of reviewers (Pinch 2012). They eventually added enticements to specially selected trusted reviewers, such as free goods through its Vine program, in exchange for more reviews. Books and products were ranked by stars and reviews themselves were deemed "helpful" or "unhelpful" by users at the site, leading to the overall ranking of Amazon reviewers in a tiered reputation system (David and Pinch 2006). Amazon changed its secret ranking formula, to the consternation of many of its users, in 2008 to encourage more newcomers to enter the higher ranks. It was at the same time that Amazon was diversifying to sell everything, and so the old book reviewer reputation system, where stasis had set in amongst the top reviewers who were formulaically churning out thousands of positive reviews, did not seem quite right for a website where paper clips and diapers could be reviewed alongside works of literary fiction. By this time, product reviews were also becoming ubiquitous throughout the Internet. But by deliberately encouraging and using users' creativity and energy as a way to sell and promote its products, Amazon had led the way into the sort of "Produced User" world that the contributors to this book examine.

For Amazon, the venture into "produced users" was no doubt extremely profitable. All the old literary editors who used to provide the content could be "let go" or moved to other positions in the company. User-provided content was the equivalent of a "free lunch" (Pinch and Kesler 2011). But users, as this collection shows, can be rambunctious, and soon abuses started to appear as people started to game the Amazon review system, write fake reviews and engage Internet sock puppets, catfish and trolls to trash their rival's books and products or promote their own. Amazon has recently filed a lawsuit against a website offering fake reviews and has again changed its secret algorithm for determining which reviews to show under a product and how reviewers are ranked. It is this messy world where companies themselves try and encourage users to contribute, whether through content or creative actions, which forms the backbone of most of the chapters in this book.

USERS AND PRODUCERS

How, then, have companies thought about users and tried to harness them? It is a useful starting point to think of this back in the dawn of industrial production. Sampsa Hyysalo, Torben Elgaard Jensen and Nelly Oudshoorn in their introduction to the collection mention what they call the Weaver problem, which was how GM in the 1930s could weave links as a producer to its own customers. Henry G. Weaver was the head of customer research at GM, and he bemoaned the loss of the easy intimacy between producers and customers that supposedly existed in earlier eras. GM needed to understand its users to develop better cars. Obviously, customer surveys and studies, product testing and focus groups and tapping into intermediaries (such as car dealers) can all help. But it is with the online world that the ability to interact with users has changed dramatically. Users can be solicited for their opinions and with digital products themselves, such as software and computer games, users can play the lead, such as with the open source and free software movements. In such an environment, users and producers become much more mixed up. The Habbo Hotel example discussed in the introduction makes this point powerfully. But there is a downside to all this user creativity. The inability to control users, which Amazon has faced with its customer reviews being gamed, is manifested in the Habbo Hotel in extremely undesirable user behavior that threatens the very viability of the website.

Computer and software companies seem to be particularly sophisticated at trying to understand and steer their users towards desired usages. One of the chapters in the book, the one by Hajar Mozaffar, is about a UK Oracle user group that has proved an important vehicle over the years for users to make their views known and for the software company to test products on a knowledgeable and cooperative group of users. In this sort of ecology, the webs woven with users (the Weaver problem again!) are complex as the technology evolves. Vendors use communities as a strategic tool to manage their customers, and users likewise deploy communities to push their own needs. Metaphors like "bricolage" seem to best make sense of a process where new solutions do emerge.

The working or lack of working of enterprise systems software has long been a favorite of scholars. Countless studies have shown how such generic software systems have built into them a very restricted notion of users. This is undoubtedly the case for the early adaption of such software. At my own university, Cornell, we allowed PeopleSoft to use us as a demonstration project (in return for a big donation to fund a prestigious building on campus). The human resource software PeopleSoft installed was developed in an industrial context and was now to be applied for the first time to a university. PeopleSoft had mistakenly assumed that university users were similar to those found in industry. They assumed, for instance, that a person only held a position in one department or another. But universities like Cornell have complex appointment systems with joint appointments and salary lines split sometimes between two or even three different entities. The software could not handle the complexity of real users and needed continuous costly fixes by consultants from California. But as Neil Pollock, Robin Williams and Luciana D'Adderio remind us in their review of the literature in this field, studies have moved on, and there is now some recognition of the complex interplay possible between vendors and users with more sophisticated conceptions of the user markets. This provides developers with more manageable ways to think about their services and how they could be improved in the future.

One insight into thinking about this process of links between producers and users has come from science and technology studies (STS) scholars who argue that one of the most powerful ways of tying users to producers is to have an "intended user" embedded materially or "configured" (Woolgar 1991) or "scripted" (Akrich 1992) into a product or piece of technology. Material constraint, such as forcing me to fully fit a plug into a power socket before I get power, is also the basis of many safety devices. But users can be guided by similar constraints, such as my laptop computer not being able to start until I pull open the screen. The designers have scripted a user who wants to see the screen and input from the keyboard at the same time and who does not want to input into a screen he or she cannot see. In the earlier volume of user studies Nelly Oudshoorn and I edited (Oudshoorn and Pinch 2003), Christina Lindsay (2003) called the type of user assumed by computer manufacturers the "implicit user."

In their chapter, Hyysalo and Johnson, after differentiating between four different conceptions of users, show how complex the notion of the "envisioned user" has become as companies today constantly retool and tweak their envisioned user after interaction with real users over several life cycles of a product. Companies deal with "user representations" all the time and increasingly test their products or prototypes and their user representation through things like focus groups on selected users, and then through user feedback respond to changing markets and so on. This means that talking about just one envisioned user will not suffice, as this user changes over time and life cycle. They call for the study of "how artifacts are enacted in practice . . . to reveal the interrelation between user representations and the actualized characteristics of technology in real-life settings." They also warn that as users become harnessed to innovation processes as a naturalized part of company operations, how user representations are "gauged, interacted with, motivated and given voice, as well as how they are best exploited", become key issues for the future.

The study of users has itself become a vast professional field through areas like human- computer interaction, and it is hardly news to tell anyone in computer design over the last two decades that users matter. But the rise of a professional field with its own interests and agenda, and the increasing presence of anthropologists and STS researchers doing "user studies" in companies present their own problems. One of the first scholars to be employed in this anthropological role was Lucy Suchman at Xerox PARC in the 1980s. There she carried out what became one of the most influential "user studies" of a technology ever (Suchman 2006). She showed how a bunch of computer scientists at PARC failed to understand how correctly to follow the instructions on a new Xerox photocopying machine that was being piloted. Suchman shows that the actual subtle work of users in engaging with technology is often not made visible and can be missed altogether or wrongly categorized. The welcome republication in this collection of an earlier article of hers on this very topic is a caution to anyone who studies users for a commercial company.

The amount of money available to encourage user-driven innovation today is quite remarkable. Torben Elgaard Jensen and Morten Krogh Petersen remind us that in 2007, the Danish government established a €55 million funding program for what it termed "user-driven innovation." There is a long and varied history, particularly in the Scandinavian context, of social scientists and activists being concerned with user-driven design. Jensen and Petersen identify a series of methods and approaches aimed at connecting users, user knowledge and user creativity to design and innovation processes. As more and more projects are undertaken, scholars have more and more opportunity to study this process, but as Suchman reminds us, the danger of capture by powerful corporate interests is ever present. Of course, with activists hoping to democratize technology and corporations using the discourse of "creative capitalism," the "hopes and fears" of both groups can be seen on display as each group tries to configure the other. The worry for researchers is that the better understanding of user practices will simply fuel efforts to rationalize and manipulate users, with pet anthropologists regarded as little more than part of the companies' communication strategies. Most scholars are, of course, reflexively aware of such dangers, and the interesting thing about Jensen and Petersen's own study is how they themselves observe the framing of their own study changing as they cycled through their own user involvement. They as users found themselves being reconfigured.

THE ECOLOGIES OF USERS

In the chapters collected in this book, we learn about a range of different sorts and sizes of users. At one end are the atomized users or "individuals," who Andrew W. Torrance and Erik von Hippel focus upon as they explore the legal rights of users to innovate. Larger entities (organizations and groups) are considered in other studies. For instance, Kristian Nielsen reminds us of Nathan Rosenberg's classic 1982 study on learning by using. Rosenberg's example was aircraft companies who learn how to better maintain jet engines over time. The notion of the user becomes more complex in such studies. Not all users encounter technologies de novo, with few resources other than bodily engagement. Nielsen describes the process of learning by using as a "complex, creative process in which different kinds of users develop different capacities and instruments that enable them to provide constructive feedback into processes of technological development, but also makes it possible for users to build their identity as users." He uses the notion of a "user assemblage" in his own case study of Danish wind turbine generators. This includes a variety of groups of users, such as wind turbine owners, electric utilities and research and development institutions. He also includes non-users, such as the opponents of wind turbine development in specific areas. He points out the role that socio-technical devices that aid learning, such as wind maps produced by meteorologists, play in the selection of where to locate turbines.

Although Stefan Verhaegh, Ellen van Oost and Nelly Oudshoorn do not use the term assemblages, their work too looks at a broad array of actors and distributed agency in how the city of Leiden in the Netherlands built a Wi-Fi network. They refer to "warm users"—these are users who have an affective bond with the technology they develop. These users played a key role in the Leiden case. Such users carry out care and maintenance in keeping the network alive. This complexifies further the ecology of users and draws attention to maintenance and repair—elements recently stressed in the field of infrastructure studies (Jackson 2012).

The Torrance and von Hippel chapter introduces a new metaphor for the zone of user innovation. They talk about it in terms of a "wetlands," a place that was once neglected but which has now taken on central importance as ecologists come to understand it as a place for preserving and generating biodiversity. It would seem that metaphors such as the complex webs woven in today's culture of innovation can usefully be extended to include metaphors from ecology and include notions of caring and affect. Technologies only live or die by how they are cared for, as Bruno Latour (1992) pointed out long ago in his study of the failed French subway system, Aramis.

Non-users and dissident users are very much on the agenda in the study of produced users. The Oudshoorn-Pinch collection was just starting to conceptualize this dimension with important work by Sally Wyatt on non-users in IT and a chapter by Ron Kline on the resistance to electrification by rural users in the US. The study of non-users in a hospital in Norway in the chapter by Line Melby and Pieter Toussaint describes four different groups of non-users and makes the important point that people alternate between use and non-use of the same technology depending upon the social situation. A similar point is developed on the chapter of resistance to pharmaceuticals by Kate Weiner and Catherine Will. That non-use is sensitive to the occasion in which it is performed is perhaps not surprising, since there is no material bond with the technology being non-used. In short, I can boast about how I don't buy books from Amazon almost anywhere, especially in my local bookstore. But when I'm actually buying something from Amazon, my use is very much scripted.

Lastly, Johan Söderberg's chapter on the development of psychedelic drugs by DIY methods raises important concerns over the sorts of user creative practices that we would normally laud, but in this case, the practices are aimed at doing something illegal that the state does not sanction. The pyschonauts or kitchen chemists he studies have taken over from where the legendary countercultural LSD manufacturer Oswald Owsley left off, and develop their own techniques for making psychotropic drugs. They show great skill and innovation in responding to legal changes and finding new natural substances that have psychotropic effects. Like the amateur gym chemists who take steroids for body building that we wrote about in *Dr Golem* (Collins and Pinch 2008), they develop impressive technical expertise. Söderberg develops the notion of technological citizenship to ask whether the illicit user activities do not somehow negate our collective responsibilities as citizens. One is reminded also of the discussion around DIY biologists who develop their own genetic modifications. The stakes are high and such users, as he points out, adapt the mantle of the outlaw—somehow living outside the state. This is the dark side of DIY activities. Söderberg's own earlier studies of hacking (Söderberg 2007) remind us just how important illicit users are. These studies of produced users are working in fertile ground and there is more to come, much more.

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