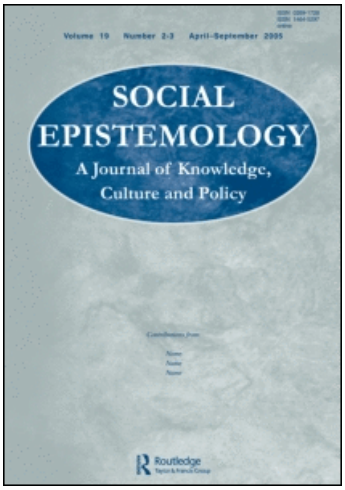

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Reconstructivism versus Critical Theory of Technology: Alternative Perspectives on Activism and Institutional Entrepreneurship in the Czech Wireless Community

Johan Söderberg

This article sets out to compare reconstructivism and critical theory as two possible avenues for a normative science and technology studies (STS) discipline "after constructivism". This investigation is pursued through a case study of a wireless network community in the Czech Republic. The case study focuses on a schism that erupted after some users attempted to commercialise an invention for sending data with visible light. Their enterprise was partly motivated by a larger, political aspiration of creating a decentralised communication infrastructure. Other members in the Czech wireless network community opposed this attempt as they perceived commercialisation as more of a threat than an aid for their politics. I will argue that these conflicting viewpoints over the role of markets can also clarify the different, theoretical assumptions behind reconstructivism and critical theory, and give some direction for a future, normative STS discipline.

Keywords: User Innovation; Wireless Community; Hackers; Critical Theory of Technology; Reconstructivism

Introduction

The once-dominant position of constructivist science and technology studies (STS) theory looks increasingly tenuous, and the question has been raised of what will come after constructivism (Sterne and Leach 2005). A number of proposals for future

Johan Söderberg is a PhD candidate in Science and Technology Studies, Department of Sociology, at Göteborgs Universitet. Correspondence to: Johan Söderberg, Avdelningen för Vetenskaps- och Teknikstudier, Sociology, Box 720, Sprängkullsgatan 25, Göteborg, 40530 Sweden. Email: johan.soderberg@sts.gu.se

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research avenues have been put forward in recent years. One candidate for a reinvented, more politically engaged STS programme continues to build on constructivist theory. It retains the basic insight that knowledge and technology are constructed, but gives political import to that statement by asking how things could be reconstructed in a better way (Woodhouse 2005; Woodhouse et al. 2002). Another avenue goes back to the writings of the first generation of the Frankfurt school. A number of contemporary scholars have, for the most part independently of each other, re-adopted critical theory as their starting point for reflecting over science and technology (Brey 2008; Cooper 2002; Feenberg 1999, 2008; Kirkpatrick 2008; Radder 2008). Numerous other traditions have been called upon for the same purpose of launching a politically engaged STS programme. Several build on feminist theory (Wajcman 2004), while others turn back to Weberian sociology (Frickel and Moore 2006) or seek inspiration in institutional economics (Klein and Kleinman 2002). In this article, however, I will limit my discussion to a comparison of reconstructivism and critical theory of technology.

The line of demarcation between these two schools has not been worked out in detail since both groups have mainly been addressing their constructivist interlocutors. Their objections against constructivist STS are rather similar and underpinned by the same political concerns. Nevertheless, the philosophical traditions on which reconstructivism and critical theory of technology build are distinct. It is this difference that stands at the centre of my investigation here. I will argue that from these two philosophical traditions have followed, among other things, varying estimations of the relevance of overarching, analytical categories. Suspicion against general truth claims is part and parcel of the intellectual current to which the many constructivist STS schools belong. In contrast, the inclination in critical theory to use "totalising" concepts can be traced back to Hegel and Marx. The significance of this debate over rather abstract and philosophical points of difference becomes clear when relating to analysis of the economy. A theoretical understanding of commodity exchange as a relation that permeates the whole of capitalism is the starting point of an analysis of science and technology conducted in the critical theory tradition. I believe that such an approach is useful for addressing some of the more urgent, political concerns that await a normative, STS discipline "after constructivism".

My argument will be developed through a case study of the Czech wireless network community. At the centre of the study is a schism in this community over the commercialisation of an invention called "Ronja". The device is used for sending data with visible light. Free space optics, the technical term for the method, offers a cheap alternative to Wi-Fi technology. Although there were many attempts to develop commercially viable products from the invention, I will focus on one of them called "Crusader". This was the most ambitious and enduring business venture stemming from the Czech wireless network community. Ronja and Crusader are interesting to compare because both projects were guided by well-articulated political visions. The inventor of Crusader wanted to challenge monopolistic business practices in the Czech Telecom sector. By equipping small businesses with Crusader links he hoped to contribute to a decentralised community network resistant to state censorship and surveillance. In

contrast, the inventor of Ronja was convinced that he could not further his political vision by devising an alternative business model. He saw his goals as being in conflict with the market system as such. If he took the customary route of financing the development of Ronja through the market and the patent system, it would only perpetuate the ills of commercial development. Instead, he tried to make the project economically sustainable by asking for donations from its users. The donation model provides a touchstone when reflecting over the link between technological change and established, economic structures. It testifies to the idea that market relations shape technological design in a systematic fashion, and that a truly new technology would necessitate the invention of a different economic relation.

The route taken by the inventor of Crusader is in line with current trends in social movements more generally. For instance, it has become common for environmental activists to start garage-firms around recycling and renewable energy solutions and/or ally themselves with companies who support their goals (Lounsbury, Ventresca, and Hirsch 2003). These kind of actors have been named "institutional entrepreneurs" by scholars combining social movement theory and organisational theory (Garud, Hardy, and Maguire 2007; Rao, Morrill, and Zald 2000).[1] I will borrow this term and suggest that it resonates well with how constructivist STS theory understands the market; that is, as an open-ended resource subject to appropriation from below (Callon 1998). Although the donation model of the Ronja project could also be interpreted as a micro-political intervention into the economy, there is a crucial difference. The latter project confronted the market economy as a single entity that it sought to transcend rather than to subvert. I will claim that this approach resonates with the "modernist" outlook of critical theory. While the first strategy looks for possibilities to improve the way a local market works (or at least limit its destructiveness), the latter strategy insists on thinking beyond the market economy as a whole. It is from such an imagined horizon that our world can be subjected to a critique that strives to go beyond what already exists. This stress on negative thinking going beyond the positivity of the present is the hallmark of a critical theory of technology (Feenberg 2005; Marcuse 1991, 170ff.).

This article starts with a brief overview of the Ronja project. Thereafter, I will survey how constructivist theory and critical theory have taken account of economic relations in studies of science and technology. In the following section, the article describes how user-initiated inventions in the Czech wireless network community were redesigned into marketable products. Emphasis is put on how some normative aspirations of the community were realised while others were swept aside by intensified commercialisation. Thereafter the article looks more closely at the donation model as an alternative economic relation. The main arguments of the article are summarised in the concluding section.

Brief Description of Ronja

Ronja is short for "Reasonable Optical Near Joint Access". A Ronja link consists of two devices mounted in line-of-sight of each other. The main part of the device, the so-called "head", is made from two metal chimney-pipes. One pipe is equipped with a

transmitter ("Tx") and the other pipe contains a receiver ("Rx"). The key component in the transmitter is a light-emitting diode (LED). The incoming light is registered by a photogenic cell placed in the receiver. The photodiode translates the pulses of light into electronic charges. The light signal is thus translated into the "1" and "0" of a digital communication network. In this way, Ronja is able to send 10 Mb per second of data over a maximum range of 1.4 kilometres.

The device is intended to be manufactured at home by its users. This DIY approach is endorsed by a philosophy labelled "user-controlled technology". It prescribes that a lay person without previous knowledge of electronics should be able to assemble the machine and understand how it works. In order to fulfil this vision, the schematics are released under a free license commonly used in free software development. Great effort has been put into writing the construction manual so that it is comprehensible to novices. Equally important is that the technology has been designed with off-the-shelf components that are relatively cheap and widely available. Development of the technology has been discussed on a public mailing list.

Ronja was invented by Karel Kulhavy, or, as he is better known by his peers, "Clock". He released the first public version in December 2001. It was at about the same time that the movement around wireless networks emerged in the Czech Republic. Community activists around the world had just started to build computer networks by utilising a frequency that had been left unregulated by States. In those days, much of the equipment was hard to acquire and the price for setting up a single Wi-Fi access point was more than 20,000 Czech koruna. In comparison, the parts for building a complete Ronja link cost between 1000 and 3000 koruna. Until 2005, when Czech regulators lifted some restrictions on Wi-Fi technology, Ronja was considerably faster than equivalent, industrial products. Price and performance came together and generated a strong interest in Ronja that lasted for about five years.

Reconstructivism and Critical Theory of Technology

It is often said that the STS field has taken a "normative turn" in recent years (Lynch and Cole 2005). In a recent assessment of the old divide between what Stever Fuller once called the theoretical "high church" and the activist "low church" of STS, Sergio Sismondo concluded that the two camps are now about to converge in an "engaged program". He predicted that this development will render the distinction between the two churches increasingly meaningless (Fuller 1993; Sismondo 2008, 21). However, I expect that this newfound concord will quickly switch back to disagreement once the question is raised of whether a normative STS programme should continue to build on the past two decades of constructivist research, or, alternatively, whether a normative turn requires a more decisive break with the premises of that established tradition?

Unsurprisingly, the former route has been travelled by the old protagonists of constructivist STS who have started to have second thoughts about their earlier musings over science and politics (Latour 2004; Law 2009). Not everyone is convinced that this signals a real change of position (Sterne and Leach 2005, 194). In contrast, the sincerity of those writers who gather behind the term "reconstructivism" cannot leave

anyone in doubt. The concept was born out of a dissatisfaction with what is perceived to be a normative deficit in mainstream STS (Woodhouse 1991). The goal of reconstructivism is to steer constructivist theory in the direction of a politically engaged STS programme. The epistemological critique hammered out in the "science wars" is here taken as the stepping stone for further reflections. If knowledge and technology have been shown to be constructed, then the next step must be to ask how they can be constructed in a better way (Hess 2001). Crucially, this research question can be posed from any of the theoretical positions within the constructivist STS field, whether that be Sociology of Scientific Knowledge (SSK), Social Construction of Technology (SCOT), Actor-Network Theory (ANT), or any of their many derivations.[2] Aside from choosing different topics and posing different questions, reconstructivism does not require a major re-evaluation of the basic premises of constructivist STS theory:

> Such reconstructivist studies would not be all that different from the ones we now undertake, but might be directed more strategically and conducted more regularly. (Woodhouse 2005, 201)

Some commentators have been more hesitant about the implications of constructivist STS theory for the possibility of addressing concerns about injustices and inequalities (Hacking 2001, 95). For instance, Michael Lynch has repeatedly warned that the principles of symmetry and/or impartiality, two cornerstones in constructivist STS thinking, might not be reconcilable with political advocacy (Lynch 2006, 820; Lynch and Cole 2005, 270). If he is right, a reinvented, normative STS discipline might do better looking for inspiration in other philosophical traditions. Although many different traditions can be called upon, I believe that critical theory is a particular strong candidate. Present-day debates about science and technology were foreshadowed by the critique of scientific rationality and technocratic rule developed by members of the Frankfurt School. Furthermore, they anticipated the ambition in STS to combine philosophical reflections with empirical observations, and they were pioneers of interdisciplinarity (Jay 1973). Andrew Feenberg offers the most systematic attempt for anchoring a STS programme in the thinking of the Frankfurt School (Feenberg 1999, 2002, 2005). Hence, the following discussion will focus on his version of "critical theory of technology", while further points are added from other writers who refer to the same philosophical tradition (Cooper 2002; Kirkpatrick 2008; Radder 2008).

It should be stressed that reconstructivism and critical theory of technology share a similar, political outlook. The entrenchment of powerful groups in society, economic inequalities, environmental destruction, and the dominance of military funded research are some of the issues these writers are investigating (Feenberg 1999; Woodhouse and Sarewitz 2007). While some critics of constructivist STS research have imputed a left–right, ideological dimension to their theoretical differences (Martin 1993; Radder 1992), there are no such undertones here. Even the theoretical line between reconstructivism and critical theory is blurry. It remains ambiguous to what extent reconstructivism is a rhetorical concept chiefly aimed at questioning constructivism, and to what extent it is meant to be an heir of constructivism.[3] Neither

can Feenberg's version of critical theory be held up as the polar opposite of (re)constructivism. His ambition is to bring together the best of both camps. Constructivist STS and the ideas of the Frankfurt School can be cross-fertilised, he asserts, because most of the practitioners in the former discipline, although they are unaware or unappreciative of Marx's contribution, unwittingly reproduce Marx's thoughts in their analyses (Feenberg 2008, 14).

Since the proponents of reconstructivism and critical theory of technology have not clashed, I will resort to debates taking place elsewhere in order to pinpoint a key, philosophical difference between their traditions. The existence of such a rift is suggested by the crossfire directed against Feenberg's anti-essentialist version of critical theory. From a constructivist position, David Stump has protested that Feenberg's critique of essentialist philosophical concepts falls short because of a hesitation to let go of the general, analytical framework that these categories make available (Feenberg 2000; Stump 2000, 2006). The opposite charge has been made by Simon Cooper, who believes that Feenberg concedes too much ground to the constructivist critique of essentialism. Cooper attributes this to Feenberg's preoccupation with securing a space for pragmatic, micro-political interventions into technological designs. The price Feenberg pays, according to Cooper, is that he loses sight of the bigger picture addressed in substantivist (or, if preferred, essentialist) philosophy (Cooper 2006, 20).

What is at stake in this debate is the validity of general, analytical frameworks. This has been a central point of contestation between constructivist STS scholars and those among their critics who declare allegiance to Enlightment values. While the first group rallies against illegitimate "master-narratives of unity" (Turnbull 2005, 28), the second group takes aim at "bricolage epistemologies" (Nanda 2005, 154). On this question, however, there are big differences between the various schools within constructivist STS. At one end of the spectrum, we find the "methodological internalism" of the laboratory studies tradition. Theoretical generalisations, structural explanations, and macro-sociological perspectives are here rejected *tout court* (Knorr-Cetina and Mulkay 1983; Latour 1983).[4] When Trevor Pinch and Wiebe Bijker launched Social Construction of Technology (SCOT), in contrast, they acknowledged from the outset that the technological artefact was related to a wider, socio-political milieu (Pinch and Bijker 1984, 428). Latter, Trevor Pinch affirmed that this theory is not inherently biased against structural accounts. Where the focus is placed depends on the topic that is being studied (Pinch 1996, 31). Nevertheless, critics of SCOT remain unsatisfied by what they consider to be a piecemeal and *ad hoc* approach towards structures (Klein and Kleinman 2002; Russell 1986; Tympas 1997). Similar admonishments have been voiced by Edward Woodhouse against the field of constructivist STS more broadly. He laments a general failure to "consider larger problems" and engage in "systematic theorizing" (Woodhouse 1991, 399).

Although an assessment based in critical theory is likely to end up with similar cautions about the agency-centred bias of much constructivist STS research, this conclusion springs from a different philosophical tradition. An indication of this is that when ANT scholars take aim against overarching, analytical categories within the social sciences, they have two targets in sight. One opponent is, of course, the

structuralist–functionalist tradition of Robert Merton, Talcott Parsons, and Émile Durkheim (Latour 1993, 52). The other target is Hegelian dialectics (Latour 1993, 57).[5] Animosity towards Hegel is a common trait of the thinking that originates in the intellectual milieu of post-1968 France (Descombes 1980). Behind this hostility towards dialectics lies a disavowal of its modern off-spring, which is to say western Marxism (Jay 1984, 515; Postone 1993, 80). In particular, it is the idea of Totality in this philosophical tradition that has been singled out by Foucault, Lyotard, Deleuze et al. and their numerous, present-day disciples as something terminally flawed (Grumley 1989; Jay 1984). Long after the passing-away of the Marxist foe, the repudiation of theoretical generalisations in favour of ethnographic micro-studies continues to hold sway over much of the social sciences (Webster 2005). This situation has contributed to what one critic calls an amnesia in the social sciences with regards to the continued presence of capitalist relations (Burrows 2005).

When these abstract, philosophical debates about structure, multiplicity, totality and so on are applied to the field of economics, the stakes involved become clear. Michael Callon's extension of ANT to economic science is instructive in this regard. His micro-sociological approach for studying the economy is congruent with the tradition of laboratory studies.[6] Accordingly, he argues that there is no such thing as a single, all-encompassing economy. There are multiple economies and these are created through local practices and discourses by economists, in the same fashion as laboratory facts are said to be constructed by natural scientists (Callon 1998; Law 2002; McKenzie, Muniesa, and Siu 2008). The emphasis on the multiplicity and locality of economies throws down the gauntlet against the macro-sociological concepts with which the economy has usually been discussed in the social sciences. "Capitalism" and "class" are two "social facts" that many constructivist STS researchers find illegitimate because of what is seen as totalising and rigid explanatory claims (Jasanoff 2004, 31). In contrast, in the tradition of critical theory, "capital" and "class" are indispensable concepts for an analysis of the economy. Without such overarching, theoretical ideas, it is not possible to envision a radical break with the present (Feenberg 2002, 167).[7]

Whether the economy is conceived as, on the one hand, multiple and local, or, on the other hand, as a single totality of capitalist relations, is decisive for the choice of political goals and strategies. George Lukacs was a forceful advocate of the latter perspective. In his work *History and class consciousness*, Lukacs famously endorsed revolution as the only change that could make a difference. He was correspondingly hostile towards the reified, partial view of reformist trade unions and social democrats (Lukacs 1971, 196–197). As the project of modernity and its hopes in revolution have drawn to a close, such appeals to Politics with a capital "P" have lost much of their former attraction. Constructivist STS theory, when it adopts an activist outlook, aligns itself with politics written with a lower case "p" (McInerney 2009).[8] This reorientation is, without doubt, compliant with present-day social movements. Many civil society organisations are exploring micro-political strategies and forming alliances with for-profit interests as a means of advancing their political goals (Hess 2005). This development signals a cognitive sea-change among activists. The traditional understanding of capitalism on the political left as a totality, leading on to an unconditional rejection of

it, seems to have given way to a more "partial view", where the market is seen as local, diversified, and open to interventions from below.

That this viewpoint on the market economy is shared by at least some of the reconstructivist writers is suggested by Edward Woodhouse's comments on Andrew Feenberg's authorship. Although his review is mostly sympathetic, Woodhouse sees little merit in analysing science and technology through a "high-flying critique of capitalism". He gives Feenberg the advice: "[…] rather than attempting directly and holistically to analyse entire political-economic systems (capitalism/socialism), I propose that key elements of technological governance can be separated out for study […]." (Woodhouse 2006, 153).[9] This reasoning is consistent with the ideas outlined above where the abstract principles of plurality and locality take precedence. It suggests how the philosophical tradition which reconstructivism has borrowed from their interlocutors in the constructivist STS camp continues to influence their analyses, although their focus is moved to different issues.

I do not deny that this philosophical tradition has advantages and can be valid depending on the questions being asked. What I doubt is that it offers the most promising route for dealing with the kind of concerns that are stressed by reconstructivist writers. When making inquiries about the privatisation of higher education, the corporate funding of university research (Woodhouse 2005, 206; Woodhouse et al. 2002, 307), or how "planned obsolescence" and overconsumption is designed into new technologies (Woodhouse 2003), a theoretical idea about capitalism seems to offer a good starting point. What such a high-flying critique provides is an elevated point from which it becomes possible to see how money/capital works "behind the backs" of individuals. In other words, it makes us sensitive to instances of technological governance that are not apparent to the actors/entrepreneurs themselves. This point of perspective allows us to take a step back from the immediacy of the present and assess it instead in the light of its subdued potentialities. In the following section I will highlight the commercialisation of the Ronja project as an example of such a forsaken potentiality. What I hope to demonstrate is how the design of the technology was successively transformed as the innovation process became more firmly subsumed under commodity relations, and, furthermore, how this development displaced the political aspirations which had originally been invested in the device by its users.

The Czech Wireless Network Community

An influential idea among hackers is their principled rejection of state censorship and Internet surveillance. Such political commitments have informed a number of user-initiated software applications (Söderberg 2010). A few well-known examples include: Freenet, a system designed for decentralised information retrieval; Tor, a method for hiding electronic communications from traffic analysis; and PGP, which was a landmark in diffusing tools for encrypting email messages. The dream of building community-based, wireless networks extended the same idea from the software side to the infrastructural side of the equation. In the early days, enthusiasm for Wi-Fi technology was fuelled by the hopes that the growth of neighbourhood wireless networks would

reverse the trend of an increasingly centralised and regulated Internet (Carpentier 2008; Sandvig 2004). Community-based computer networks were thought to be resilient to centralisation because the ownership over the hardware is spread out among its many users. Law enforcement agencies have therefore a harder time identifying the wireless network as a legal entity subject to regulation (Lada Myslik, interview, 9 January 2008). State regulation has come in, however, in the limited frequencies permitted for Wi-Fi transmissions as well as in other restrictions on how the technology may be configured (van Oost, Oudshoorn, and Verhaegh 2009). It is against the background of these regulations that some neighbourhood network activists came to embrace the idea of using the light spectrum instead:

> […] The main attraction for this is no regulation—we can beef up our light output to whatever we please, as much as our equipment and genius will allow. (Whirlpool mailing list, 15 May 2007)

In addition to the absence of regulations on visible light, free space optics soon proved to be technically advantageous from the standpoint of a decentralised communications network. A shortcoming with Wi-Fi technology is that only a limited number of antennas can operate in the same area before the ether becomes crowded. Worse still, the speed of transmission quickly drops after just a few jumps between links. Because of these obstacles, the backbone of many neighbourhood computer networks relies on fibre-optic cables provided by large companies. One of the selling points of free space optics is that long chains of nodes can be strung together without causing major losses in speed. Hence, at least in theory, it is possible to extend a wireless network with optical links to cover a whole city. The Ronja project was subsequently heralded as the missing piece in the puzzle that could realise the dream of a decentralised communication infrastructure completely owned by its users.

One of the founding members of the Czech wireless network community, Lada Myslik, was enticed by this potential of free space optics. He did not think that Ronja was up to the task, however, because of what he considered to be the amateurish approach of the project. The skills, time and fortitude required to build and aim the equipment prevented a wider diffusion of the technology. Lada wanted a design where the units could be mass produced and sold cheaply. For this purpose he started a company together with four companions. They launched a proprietary free space optical device called Crusader. The name was borrowed from an old computer game set in a dystopic future where a small band of rebels are fighting against an evil, global consortium. It was meant as a nod to the underdog position of the wireless network community *vis-a-vis* the monopolistic practices of the Czech telecom company. He coupled the aspiration to overthrow old business practices in the telecom sector with his political agenda of building a decentralised communications network resistant to censorship and surveillance. Thus the Crusader project can stand as an example of what in the social movement literature is referred to as institutional entrepreneurship. Having said this, Lada was nothing like the high-tech, free market evangelist who can be found in some quarters of the computer underground (Barbrook and Cameron 2001). Although he saw the creation of a market for Crusader as a step towards the

realisation his goal of a decentralised communication network, Lada concurrently acknowledged that this political vision had already to some extent been undermined by the widespread commercialisation of the wireless network community:

> This was the idea, to have this independent network, which would be immune against eavesdropping and snooping and which would provide people with the means of free communication as in freedom. But as can be seen, people who were more business-like, or, highjack-like, [name emitted], had the idea of going the business route. And once they managed the network in this manner, it becomes a business and a telecom operator subject to Czech laws. If you do not go this route, it is nothing, it is guerilla. (Lada Myslik, interview, 9 January 2008)

The commercialisation of community-based wireless networks was partly driven by the need to pay for upgrades of the infrastructure in order to keep pace with raising expectations of speed and reliability among new members (Michael Polak, interview, 16 January 2009). Another factor was growing difficulties to allocate work assignments within the community. The first generation of users consisted of technically-savvy enthusiasts who liked both to tinker with the technology and wanted to have a functional, computer network. Hence, in the early days, there was no shortage of people volunteering to do maintenance work. This situation changed when the wireless networks expanded to include users/consumers who were simply interested in getting cheap Internet access. Concurrently, maintaining the networks has become more of a nuisance, and the surest way to get the job done is to pay someone to do it (Jakub Sykora, interview, 27 November 2008). The intensified commercialisation of wireless networks is mirrored by a similar trend in the extended Ronja community. This development started with experienced users receiving requests from less knowledgeable users to build Ronja for money. Many old-timers sold one or two links and a handful of people set up shops where they promoted their services more actively (Jakub Michnik, interview, 17 December 2008; Jakub Horky, interview, 17 January 2009). The demand for Ronja was fuelled by small Internet Service Providers who began to use the technology in their businesses (Ondrej Zajicek, interview, 14 December 2008).

It should be stressed that no-one in the Ronja community was opposed to commercialisation *per se*. The official website directed visitors to places where they could buy Ronja devices. When someone made an inquiry on the Ronja mailing list if he could sell equipment and keep the profit for himself, he was encouraged to do so (Ronja mailing list, 1 November 2004).[10] It was the consequences of commercialisation to which parts of the community objected. Secrecy and suspicion grew when free space optics started to look like a good business opportunity (Michal Elias, interview, 27 September 2008). There are historical parallels going back to the enthusiasts who built the first small computers in the Homebrew Computer Club in the 1970s. When a market in personal computers emerged, the willingness to share information weakened and the community fell apart shortly after (Levy 1984). Another effect of the commercialisation of Ronja technology was that, with the emergence of a market, pressure built up for a complete overhaul of the design. This point is worth stressing since it underlines a central claim in this article, namely that commodity relations make a dent in technological design. The design of Ronja was influenced by the goal of having a

technology controlled by its users. Consequently, the device had been tailored for amateurs who were short of money but had plenty of spare time. If a choice had to be made between an expensive, special-purpose component and a cheap, general-purpose component, the latter would win, even though it often required extra work to tweak the thing into doing something it was not meant to do. This bias became an obstacle to serial production of the device.

A case in point is the electronics. Early versions of Ronja used electronics that had to be soldered manually from discrete components. The air-wired construction of electronic components was commonly spoken of as a "bird's nest". Members of the extended Ronja community soon began to experiment with printed circuit boards (PCBs) instead. These were eventually included in the official release of Ronja, although the project leader, Clock, did so grudgingly. He lamented that the shift from hand-made, air-wired constructions to PCBs made the user less self-reliant. Part of the goal of the Ronja project was to induce a learning process and cooperation among lay users. This was as much part of the transition towards a user-controlled technology as the spread of the device itself (Karel Kulhavy, interview, 16 November 2008). Another consequence following from the use of PCBs was that it reinforced the logic of economies-of-scale in the project. It became more costly to produce a few units for personal use, and, conversely, easier to make several units for sale. The adoption of PCBs was just one out of numerous modifications to the original Ronja design which were made by people who produced the item for an emerging, small market (Michal Elias, 27 September 2008). Lada attests that the all-important benchmark when designing Crusader was to minimise the amount of manual labour required for building the machine:

> […] I know at some point I have to get rid of this work. So I give it to some other guy, or, to a machine, which is the cheapest. So, I am aiming for complete machine controlled manufacture where only this part of aiming is done by people. Even though I am preparing for automatic alignment on these units. (Lada Myslik, interview, 9 January 2009)

The attempt to automate not only the production process but also the aiming of Crusader lends additional support to the case I am trying to make: that the design of the technology changed as a result of its adoption for a market. Ronja had been designed with simple electronic parts that were easy to find and could be assembled by amateurs. The trade-off was that it required much more work to aim the device. A Ronja link must be aimed during the hours of darkness. By holding up a car reflex at the opposite end of the link, it is possible to see when the transmitter is pointing in the right direction. Then the receiver has to be placed in line-of-sight with the light. A volt meter is connected to the head and gives notice of incoming signal strength. Thereafter the whole procedure is repeated to position the second transmitter and receiver. If the optical link is mounted on a tilting roof, the operation can be quite a challenge. Since the metal is compressed after it has been mounted, the aiming needs to be fine-tuned during the following two weeks. It is a time-consuming task but it works reasonably well for cash-strapped hobbyists (Ondrej Zajicek, interview, 14 December 2008). Lada's intended customers were not hobbyists, however, but small Internet Service

Providers. He quickly realised that the overhead costs for installing a free space optical link sky-rocketed for a company that had to pay two employees for every hour they spent on the roof aiming the equipment. For Crusader to become competitive, Lada had no option but to automatise the alignment process.

While narrating this story about the commercialisation of the Czech wireless network community, I must caution against the ready-made storyline of an idealistic cause being betrayed by greed. The comparison between Ronja and Crusader is intriguing precisely because it underlines what a contradictory process commercialisation can be. The philosophy of user control that informed the Ronja project was abandoned in the development of Crusader. But this also meant that the threshold for using free space optics was lowered, at least in respect to the time and skill demanded of the user/builder. Hence, in Lada's opinion, the marketing of Crusader brought the wireless network community one step closer towards the dream of a fully decentralised communications network. It goes to show how commercialisation, at the same time as it arrests some political visions of inventors, opens up new horizons for interventions at a different level. This observation applies with equal force to the Ronja project. The vision that it should be possible for ordinary people to build a Ronja link anywhere in the world presupposed that the parts were widely available through global markets in home electronics. Putting it more cynically, one could say that the dream about a home-brewed, user-controlled technology presupposed that the workers had already been deprived of their control over the factory machinery (Söderberg 2009).

Hence, the many complexities notwithstanding, there are also some resemblances between the user/consumer and the worker in their relation to the technology. My claim is that these similarities point in the same direction; that is, towards the commodity relation. Just as factory machinery is designed with an eye to cutting labour costs, this criteria became decisive in the development of Crusader. In the Ronja project, in contrast, such a computation did not enter into the development process. These diverging evaluations of time are illustrated by a discussion on a Czech mailing list where the merits of the two projects were compared. The exchange started when a discussant declared that since he could not afford to buy Crusader, he had no interest in the project. He was gainsaid by a second commentator. Although the latter person agreed that the material costs for Ronja were much lower, he insisted that the time required for assembling the device must also be taken into account. The reply from a third respondent underlines that these two perspectives are worlds apart:

> How much does the time cost for drinking at the pub?/Kolik asi stoji cas propity v hospode? (CZFree mailing list, 3 November 2003)

Summing up the argument so far, I have told how the growing market demand for free space optics called forth a redesign of the product in line with the requirements of mass production. It meant, on the upside, that the demands on the time and skill of the user/builder were drastically lowered. The technology could now be diffused in wider circles, and, thus, it contributed to the growth of decentralised communication networks in the Czech Republic. On the downside, information about the design was no longer shared among participants in the community and users ended up with less

control over the technology. I have stressed the similarity with how the market puts downward pressure on the control that factory workers can exercise over the machinery at the point of production (Noble 1986). As concerns the wireless networks community, it too has been transformed by commercialisation. Consequently, parts of the communication network are now being run by legally recognised entities subject to law enforcement. Concerns about this situation will loom larger in the near future since an EU directive is being implemented in the Czech Republic that will authorise the police, on behalf of rights holders, to access the Internet traffic data of customers. If these scattered dots are connected (i.e. the restricted access to the hardware device, the centralisation of the communication networks, and the regulation of information "content"), so emerges an overarching, theoretical concept about market relations, commodification, and ownership control. Without these overarching, theoretical concepts, there is a risk that the commercialisation of user-initiated innovations is taken for granted in the analysis. With this problematic in mind, I will now move on to describe the experiment with financing Ronja development through donations. The donation model provides access to that imagined vantage point "beyond" the market from which we can catch a glimpse of the totality of market relations.

A Non-market Model for Financing Technological Development?

The purpose of the donation model was explicated by Clock on a German mailing list called Oekonux. The list is dedicated to discussing the political and economical consequences of free software development. Clock made a comparison between the donation model and the General Public License (GPL), the modified copyright agreement used by hackers to protect free software code from being locked up behind proprietary licenses:

> GPL exploits the power of copyright to undermine it's own power and creates the exact opposite—copyleft. I think the Ronja "financing model" could use the power of money to undermine their own power in technology and create the exact opposite—technology, that is free. (Clock, Oekonux mailing list, 28 September 2005)

The problem identified by Clock was that inventors have to make a living either as employees or by selling their products to a market. He saw the donation model as an alternative source of providing financial support. It would set free the time in which inventors could devote themselves to independent development projects unconstrained by market demands. Far from just being a theoretical concept, Clock had tested the model for about two years when he posted the idea on the Oekonux mailing list.

It worked like this. New features ready for release were announced together with a price tag. The price was based on the time spent and the materials consumed. The specifics of the technology would not be shown until after the requested amount of money had been collected. Thus, information was kept secret for a period of time. Clock considered this circumstance to be less grave, however, since the information was only withheld for as long as there was no product in circulation. When the technology was released, all details about it would be made available to everyone and

without restrictions. The chief merit of this practice was that money could be collected without requiring any further restrictions on the rights of the user.

The donation model was first tested with the release of a product called Twister. This is a box that translates the signals going from the optical head to the computer. Twister was long awaited in the Czech wireless network community. Earlier versions of Ronja relied on an outdated network card that had become increasingly hard to find. Twister was completed on 11 April 2004. Clock asked for 30,000 Czech koruna before he published the design. The target was met in just six days. During the next two years, three more designs were released under the same conditions. Eventually, however, the donation model was abandoned. Later improvements such as the second generation of Twister were published without any requirements for compensation. Since Clock received all the money he asked for, the experiment could be said to have been a success. But the sums were relatively small. It is a safe guess that the donation model will not work if the goal is to maximise returns. If the goal is to sustain independent hardware development, however, the Ronja project suggests that this might be possible, given some exceptional circumstances.

An important factor behind the relative success of Clock's experiment was the backing he got from wireless network communities in the Czech Republic. Although many of these communities remain non-profit organisations, some of them have become quite well-off due to the subscription fees paid by their members. For a couple of years, modified Ronja machines ran on the backbone of many of these networks. Thus there was a high demand for de-bugging and new features. Fund-raising in these communities provided the first round of donations. When some money had been collected, individual contributors felt assured that their gifts would not be given in vain. Crucial for the model to work was that people trusted Clock's ability to deliver on his promises. His reputation as an inventor had been established with the release of the first version of Ronja.

The introduction of the donation model stirred some concern on the Ronja mailing list. A participant feared that it would set off a vicious circle. If insufficient money was gathered, the development process would be halted and people would become even less willing to give donations when nothing was released (Dalton, Ronja mailing list, 30 June 2003). This scenario sounds plausible but did not occur. Part of the reason might be that Clock only asked for money to cover his own expenses. He did not try to take advantage of the full demand for his product, in which case the sum would have been much higher. A different line of critique was voiced on the Oekunux list. One commentator wondered whether the donation model did not reintroduce aspects of commercial development which Clock had rejected. This result could be said to have occurred if a quasi-market emerged where the development process started to bend around the demands of the donors (Merten, Oekonux mailing list, 27 September 2005).

There is too little information to confirm or disprove this interpretation. What seems to have happened, however, is that a gap opened up between the main developer, Clock, and the other participants committed to the Ronja project. This result is all the more remarkable since the project styled itself in the fashion of a community-based development project similar to those found in the free software world. Although

numerous experiments with free space optics were made by members of the Ronja community, few contributions became part of the official release (Jiri Bohac, 14 September 2008). Although many possible explanations exist, one reason might be the contradictions of the donation model. In a discussion on the Ronja mailing list over what is holding back the development of a faster optical link, complaints surfaced that Clock does not share his plans for the future with the community. On the question of whether the community can contribute to the development of the next generation of Ronja, Clock answered:

> Yes, in sending financial gifts up to such density that thanks to Ronja I wouldn't have to waste time going to work and could work on Ronja full time instead. (Clock, Ronja mailing list, 23 June 2005)

Open to question is whether it is possible to square the dream of making a living from product development without reintroducing a division of labour between the developer and the end user. The reflections of Peter Simandl are instructive in this regard. In addition to participating in the Ronja project for a short period of time, he publishes regularly his own hardware designs on the Internet. Peter Simandl is accustomed to seeing other people incorporating his ideas in commercial projects without giving any information back. But he has no regrets and considers it to be a waste of time to try to enforce a code of conduct on these people. He explains his relaxed attitude with the fact that he never had any ambitions to earn money from hardware development:

> The biggest thing that is free in my mind about this is, I have never been using it as my job, it is my hobby, always it is my hobby. So when anybody wants he can take it and use it and sell it, why not […]. (Peter Simandl, interview, 27 October 2008)

In the light of the quote above, it is worth recalling that Clock had published the first version of Ronja without asking for any compensation. In the beginning he was financially supported by the educational system. Indeed, much of the activity in the extended Ronja community was sustained by developers who at the time were high-school pupils or college students. They had plenty of spare time to devote to a hobby project, and, as long as it was a hobby project, spending time on tinkering with free space optics was not perceived as a lost opportunity cost. It did not call for monetary compensation any more than the time spent in the pub drinking beer. Things seem to have changed when the necessity of making a living made its presence felt. Lada sees Crusader as his best bet of avoiding what he calls the "slavery" of working as an employee. By becoming an entrepreneur he hopes to realise his dream of doing exciting development work (Lada Myslik, interview, 9 January 2008). Clock did not want to start a traditional business, but the donation model was meant to fulfil exactly the same purpose. That is, to enable him to work with Ronja full-time after his respite in the educational system was up. The fact that the size of the donations were calculated based on the number of hours that Clock had spent on solving the problem in question shows how the donation model reintroduced a monetarised way of conceptualising time.

These observations reflect back on the debate between constructivist STS researchers and their critics over the role of economic relations in shaping innovation processes.

The argument that research and development is constrained by economic structures has typically been advanced where it is hardest to refute. That is to say, by showing how technological choices are limited by demands of corporate managers or investors (Croissant and Smith-Doerr 2008; Marlin-Bennet 2008; Mirowski and Sent 2008; Rowland 2005). However, in addition to these bureaucratic forms of exercising control, choices about technological design are shaped by the more diffuse, but no less real, necessity of making a living in a world permeated by market relations. This necessity goes a long way to explaining the regularity by which user-initiated innovations are commercialised in the course of the lifecycle of user communities. The institutional entrepreneur might feel that he is free to follow his own whims, especially when he compares himself with the engineer working for a company. As has been argued by Nikolas Rose and others, however, the entrepreneurial individual is the *sine qua non* of the active and autonomous subject who takes responsibility for his own subjection in advanced liberal capitalism (Kelly, 2009; Miller and Rose 2008). Although no-one told the inventor of Crusader how the device should be built, some design choices simply made more sense than others when the product was streamlined for a market. These individual choices are not completely local and contingent, but form a pattern that is recurrent in the development of science and technology more generally. A theoretical idea about commodity relations is useful because it puts these patterns at the centre of analysis.

Conclusion

This article has investigated two competing, user-initiated inventions, Ronja and Crusader. I have highlighted their different responses to the intensified commercialisation of the Czech wireless network community. The instigator of the Crusader project, Lada, embraced a hybrid identity as an inventor-entrepreneur. His political engagement was channelled through a start-up firm. The goal of the venture was to overthrow the established business monopoly in the Czech telecom sector. Thereby he hoped to strengthen a decentralised and community-based wireless network that would be more resilient against censorship and surveillance. The strategy of linking political causes with for-profit interests has a strong precedent in the computer underground, and it is becoming increasingly popular in more traditional, social movements as well. Micro-political interventions and institutional entrepreneurship of this sort are in line with how the market economy is commonly understood in constructivist STS theory; as pluralistic, under-determined, and open to interventions from below.

I do not dispute that these strategies and corresponding world views can make valuable contributions to political struggles. Two examples demonstrating the merits of this pragmatic and case-by-case approach to doing politics are the diffusion of free software and renewable energy technologies. Both causes have been greatly advanced by the creation of garage-firms. The willingness of social movements to experiment with such strategies might be attributed to a disillusionment with the failed, political hopes of the old left. This disappointment extends to the epistemological assumptions of past generations as well. The old left, heavily indebted to Marxism, aspired to possess a

"rational grasp of the whole" that could match the totality of the capitalist, social relations which they opposed. This outlook has come under sustained attack during the past few decades. Not only is it supposed to be wrong, it is said to be politically dangerous as well.[11] ANT scholars have developed their own variation on this common theme by extending their critique of universal truth claims in natural science to include the methods of "critical sociology" (Latour 2005). In this article I have defended the emancipatory tradition of critical theory. A key tenet of this tradition is the aspiration to apply theory to subjective experience in order to restore to view the conditioning of those subjects (Bauman 2000, 211). I believe that this intellectual standpoint has become more, not less, urgent because of the abandonment of corresponding, political strategies among activists and/or institutional entrepreneurs.

In order to support my argument, I have contrasted the Crusader project with the donation model of the Ronja project. This case is noteworthy because it tried to break free from the customary, entrepreneurial route of financing innovation. Clock experimented with donations since he believed that the principle of user-controlled technology was irreconcilable with how the market works. He hoped that the donation model could finance inventions independently of the market and the patent system. It should not come as a surprise that this attempt failed in many respects. The donation model could not step "outside" the totality of market relations, and, subsequently, it was afflicted with contradictions. Two contradictions discussed above were that the Ronja project depended on a global market in consumer electronics for its realisation, and that the donation model reintroduced a monetarised way of thinking about time. The example of the donation model has nevertheless a lot to contribute to reflections over how technological design and economic structures relate to each other. The exceptionality of Ronja brings into relief the extent to which innovation processes in society are framed by industrial mass production, global consumer markets, and waged or entrepreneurial means of making a living. In other words, it offers one of those rare, utopian vantage points from which the positivity of the present can be assessed.

Many constructivist STS researchers—in particular, those affiliated with the ANT tradition—reject the notion that design choices are constrained by economic structures (Latour 1993, 126; Pickering 1995, 64f). However, by assigning ontological primacy to the contingency of techno-human hybrids, and the malleability of all uses of technology, such a theory ends up having nothing to say about change in the individual case (Gingras 1995; Radder 1992, 154). Such a theory provides no criteria by which we can tell how a user of Ronja is better off than a user of Crusader. Seemingly, the possibility to subvert the technology was the same irrespective of the fact that the first user has access to the schematics of the design, the device comes with instructions for how to build it, the machine consists only of widely available, general-purpose components, and no legal restrictions are imposed on the user by the license agreement. All of these parameters are different in Crusader. The crucial point to stress here is that these differences did not come about haphazardly. The inventor of Crusader aimed for a product that could be mass-produced and compete on a global consumer market. To get there he had to keep information about the technology secret from competitors, and, subsequently, from users. Furthermore, the design had to be

streamlined for industrial production in a way which made it next to impossible for amateurs to tinker with the technology.

In order to catch sight of the systematic and global dimensions of these design choices, an analysis must start with a theoretical idea about the economy as a "social whole" of commodity relations. This assumption rests on a philosophical tradition that, among other things, vindicates the concept of Totality. It stands opposed to a contending, intellectual current where priority has been assigned to the local and the multiple. I recognise that the latter approach can be valid too, depending on what the scholar wants to achieve. However, if the ambition is to do normative research about science and technology in a world rewritten by three decades of neo-liberal reforms and shock doctrines, then an idea about society as a social whole of commodity relations seems to be the indispensable starting point. For this reason, I have questioned the proposal that a politically engaged STS programme can be adequately developed simply by appropriating any constructivist STS position. All that is needed, according to this argument, is to apply the constructivist toolbox to different research topics. Although the reconstructivist writers are not the only ones who advocate this way forward, I have focused on them chiefly because their activist credentials are beyond question. What I am most wary about is that this hurry to reach an agreement between the various factions within the STS discipline will result in a premature closure on the "normative turn". We might then find that "after constructivism" looks pretty much the same as what reigned before.

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Notes

[1] Although my article could be read as a critique of the notion of "institutional entrepreneurship", the priority has not been to engage with this literature. Such a critique has been provided by Farzad Khan, Munir Kamal and Hugh Willmott. They have studied an apparently successful campaign against child labour in Pakistan. While the institutional entrepreneurs managed to put an end to child labour, broader issues about wages and labour rights were excluded from the campaign. As a result, the people in question might have ended up worse off than they had been before the campaign started. The authors argue that this failure to consider the more systematic aspects of inequality and injustice is built into the agency-centred discourse of institutional entrepreneurship (Khan, Kamal, and Willmott. 2007). What makes their argument resonate with the case I am making here is that their critique focuses on epistemology and the question of what cannot be seen from within the horizon of the institutional entrepreneur.

[2] There are deep-seated differences between the various camps within constructivist STS, particularly as concerns the role they afford to the "social" in their analyses of science and technology (Shapin 1995). It is clear that the writers rallying behind reconstructivism stand much closer to SSK and SCOT than to ANT and affiliated, post-humanist currents within

constructivist STS. Nonetheless, they have argued that scholars working in the latter tradition can adopt a reconstructivist position (Woodhouse 2005, 200; Woodhouse et al. 2002, 299). It is for this reason I treat the concept of "reconstructivism" as applicable to any position within constructivist STS, even though this is not necessarily the case with the individual positions of those writers who identify themselves with the label.

[3] A hint that the concept of "reconstructivism" is chiefly meant as a critical concept is given by Edward Woodhouse when he asserts that the stress is on "re-" as opposed to "constructivism" (Woodhouse 2005, 201). Likewise, David Hess has written elsewhere that a normative STS programme would require a deviation from some basic premises in constructivism that, to my understanding, goes beyond the concept of reconstructivism: "The necessity of beginning an analysis with a principle of cultural relativism, which I show to have some parallels with the impartiality and symmetry principles, is therefore linked to the equal and opposite necessity of concluding the analysis with a framework that is partial and asymmetrical, and likewise that is grounded in an epistemological and moral anti-relativism" (Hess 2001, 238).

[4] This stress on methodological internalism is a point that the writers in the laboratory studies tradition hold on to even after they have become wary of some of the political consequences of their earlier, theoretical positions. When John Law tries to distinguish his version of constructivism from the "imperial performativity" of neo-conservative writers, the argument hinges on his commitment to the particular and multiple (Law 2009).

[5] Curiously, the polemic of ANT scholars against structuralist and/or functionalist sociology is preceded by a similar critique formulated from the standpoint of dialectical Marxism. Mainstream sociologists were accused of ending up with a stale and conservative analysis due to their use of fixed, stable categories and an inadequate methodology which could not adequately explain social change (Gouldner 1973; Swingewood 1975, 187ff.).

[6] Michel Callon's proposition strikes many as being overly voluntaristic, not to say outright apologetic of free market forces (Mirowski and Nik-Khan 2007). Teun Zuiderent-Jerak tries to take a middle position. From his involvement in a market reform of the healthcare sector in the Netherlands, he found that the scope for STS researchers to "perform" markets in a radically new way was rather circumscribed. Zuiderent-Jerak's conclusion is that the argument about the performativity of market laws needs to be qualified with a heightened awareness of what he calls "historical investments in forms" (2009, 788). This point is in line with the core argument put forward in this article. Unlike Teun Zuiderent-Jerak, however, I do not believe that his proposal can be offered as a complement to Callon's reasoning, since the notion of "historical forms" is antithetical to the premises behind ANT-and-after.

[7] At this point it is in order to make some qualifications about the concept of Totality. There never existed any single, stable interpretation of the concept common to all the members of the Frankfurt School. For instance, while it strongly influenced Max Horkheimer, it remained alien to Walter Benjamin's thinking, and the writings of Theodor Adorno developed in the tension between these two positions. In their late works, Horkheimer and Adorno foreshadowed much of the critique that shortly after would be directed against the notion of Totality by post-structuralism (Jay 1981, 1984). This is to say that the concept is not unproblematic. Still, those theoretical stances that seek to repudiate all references to Totality run into even greater difficulties (Eagleton 1996, 10). In particular, they contradict themself in that the local, the emergent, and the multiple are now being turned into new, unacknowledged Totalities. This argument has been compellingly made against Michel Foucault (Grumley 1989, 194) and Michel Serres (Hayles 1988), two authors who have been hugely influential for the development of constructivist STS theory. Contrary to these many positions, I espouse the concept of Totality in the way it has been defended by Fredric Jameson. He has convincingly argued that it is indispensable as a negative and methodological tool for becoming aware of (exploitive, coercive, etc.) relations that would not otherwise have been perceptible (Jameson 2002, 38).

[8] In fact, endorsements of *technological micro-politics* are commonplace in both reconstructivist thinking and among contemporary interpreters of critical theory (Feenberg 1999, 120ff.).

Even so, some distance between the reconstructivist position and Andrew Feenberg's version of critical theory can be derived from a comment by Graeme Kirkpatrick. He has complained that Feenberg's musings over technology in civilisational terms overshoot the moderate, reformist proposals for a democratised technology with which Feenberg ends up. The conclusion of Kirkpatrick is that a normative critique of technology inspired by critical theory is not helped by its old suspicions of technology, scantly covered up as a monumental critique of instrumentality. Kirkpatrick identifies with the same tradition but is less charitable towards its indebtedness to substantivist philosophy. In its place, Kirkpatrick wants to see a method of contra-factual statements applied to specific designs, a suggestion that in fact is similar to the reconstructivist position (Kirkpatrick 2008, 86).

[9] After having made that proposal, Edward Woodhouse gives a concrete example. He suggests a reform of the payment schemes for corporate executives. His idea is that monetary incentives could be created to encourage executives to take socially responsible decisions about research and development. In a reply, Andrew Feenberg questions the plausibility of this proposal. He puts down the difference between them to that: "[…] Woodhouse thinks government policy rather than labour struggle will be the source of reforms limiting manager's power" (Feenberg 2006, 204).

[10] This pragmatic approach towards commercialisation testifies to the influence of the free software community on the group of people building free space optical devices. Free software developers have fully integrated the creation of business models based on free licenses into their arsenal of political strategies (O'Mahony and Bechky 2008). Conversely, many established firms in the computer industry have gone out of their way to incorporate the free software community into their business practices (Bonaccorsi, Giannangeli, and Rossi 2006).

[11] One does not have to look far in the STS literature to find critiques where universal, emancipatory truth claims are being associated with dictatorship and prison camps (Latour 1993, 125; Smith 1994, 293). It should then be recalled how much this anti-totalitarian rhetoric owes to the 1970s *nouveaux philosophes*. As has been shown by Michael Christofferson, these ideas became fashionable in France against the backdrop of an anticipated, and, in many places, loathed, parliamentary victory for the socialist party (Christofferson 2004). Perhaps this intellectual setting adds another piece to the puzzle in the writing of an unauthorised genealogy of the "Parisian school of STS" (Fuller 2000).

References

Barbrook, Richard, and Cameron, Andy. 2001. Californian ideology. In *Crypto anarchy, cyberstates, and pirate utopias,* edited by P. Ludlow, pp. 363–88. Cambridge, MA: MIT.

Bauman, Zygmunt. 2000. *Liquid modernity.* Cambridge: Polity Press.

Bonaccorsi, Andrea, Silvia Giannangeli, and Cristina Rossi. 2006. Entry strategies under competing standards: Hybrid business models in the open source software industry. *Management Science* 52 (7): 1085–98.

Brey, Phillip. 2008. The technological construction of social power. *Social Epistemology* 22 (1): 71–95.

Burrows, Roger. 2005. Sociological amnesia in an age of informational capitalism? A response to Webster. *Information, Communication & Society* 8 (4): 464–70.

Callon, Michel, ed. 1998. *The laws of the market.* Oxford: Blackwell.

Carpentier, Nico. 2008. The belly of the city—alternative communicative networks. *The International Communication Gazette* 70 (3–4): 237–55.

Christofferson, Michael. 2004. *French intellectuals against the left: The antitotalitarian moment of the 1970s.* New York: Berghahn.

Cooper, Simon. 2002. *Technoculture and critical theory: In the service of the machine?* London: Routledge.

Cooper, Simon, 2006. The posthuman challenge to Andrew Feenberg. In *Democratizing technology: Andrew Feenberg's critical theory of technology*, edited by T. Veak, pp. 19–36. Albany: State University of New York Press.

Croissant, Jennifer, and Laurel Smith-Doerr. 2008. Organizational contexts of science: Boundaries and relationships between university and industry. In *The handbook of science and technology studies,* 3rd ed., edited by E. Hackett, O. Amsterdamska, M. Lynch, and J. Wajcman, pp. 691–718. Cambridge, MA: MIT.

Descombes, Vincent. 1980. *Modern French philosophy.* Cambridge: Cambridge press.

Eagleton, Terry. 1996. *The illusions of postmodernism.* Cambridge, MA: Blackwell Publishers.

Feenberg, Andrew. 1999. *Questioning technology.* London: Routledge.

Feenberg, Andew. 2000. Constructivism and technology critique: Replies to critics. *Inquiry* 42 (2): 225–37.

Feenberg, Andrew, 2002. *Transforming technology—a critical theory revisited.* New York: Oxford University Press.

Feenberg. Andrew. 2005. Critical theory of technology: An overview. *Tailoring Biotechnologies* 1 (1): 47–64.

Feenberg, Andrew, 2006. Replies to critics. In *Andrew Feenberg's critical theory of technology*, edited by T. Veak, pp. 175–211. Albany: State University of New York Press.

Feenberg, Andrew. 2008. From critical theory of technology to the rational critique of rationality. *Social Epistemology* 22 (1): 5–28.

Frickel, Scott, and Kelly Moore, eds. 2006. *The new political sociology of science: Institutions, networks and power.* London: University of Wisconsin Press.

Fuller, Steve. 1993. *Philosophy, rhetoric, and the end of knowledge: The coming of science and technology studies.* Madison: University of Wisconsin Press.

Fuller, Steve. 2000. Why science studies has never been critical of science: Some recent lessons on how to be helpful nuicance and a harmless radical. *Philosophy of the Social Sciences* 30 (1): 5–32.

Garud, Raghu, Cynthia Hardy, and Steve Maguire. 2007. Institutional entrepreneurship as embedded agency: An introduction to the special issue. *Organization studies* 28 (7): 957–69.

Gingras, Yves. 1995. Following scientists through society? Yes, but at arm's length! In *Scientific practice: Theories and stories of doing physics,* edited by J. Buchwald, pp. 123–50. Chicago: Chicago University Press.

Gouldner, Alvin. 1973. *For sociology: Renewal and critique in sociology today.* New York: Basic Books.

Grumley, John. 1989. *History and totality: Radical historicism from Hegel to Foucault.* London: Routledge.

Hacking, Ian. 2001. *The social construction of what?* Cambridge, MA: Harvard University Press.

Hayles, Katherine. 1988. Two voices, one channel: Equivocation in Michel Serres. *SubStance* 17 (3): 3–12.

Hess, David. 2001. Ethnography and the development of science and technology studies. In *Handbook of ethnography,* edited by S. Delamont, P. Atkinson, and A. Coffey, pp. 234–45. London: Sage.

Hess, David. 2005. Technology and product-oriented movements: Approximating social movements studies and science and technology studies. *Science, Technology and Human Values* 30 (4): 515–35.

Jameson, Frederic. 2002. *The political unconscious: Narrative as a socially symbolic act.* London: Routledge.

Jasanoff, Sheila, ed. 2004. *States of knowledge: The co-production of science and the social order.* London: Routledge.

Jay, Martin. 1973. *The dialectical imagination: A history of the Frankfurt School and the Institute of Social Research 1923–50.* London: Heinemann

Jay, Martin. 1981. Positive and negative totalities: Implicit tensions in critical theory's vision of interdisciplinary research. *Thesis Eleven* 3 (1): 72–87.

Jay, Martin. 1984. *Marxism and totality: The adventures of a concept from Lukács to Habermas.* Cambridge: Polity Press.

Kelly, Jean. 2009. Not so revolutionary after all: The role of reinforcing frames in US magazine discourse about microcomputers. *New Media & Society* 11 (1–2): 31–52.

Khan, Farzad, Munir Kamal, and Hugh Willmott. 2007. A dark side of institutional entrepreneurship: Soccer balls, child labour, and postcolonial impoverishment. *Organization Studies* 28 (7): 1055–77.

Kirkpatrick, Graeme. 2008. *Technology and social power.* London: Palgrave.

Klein, Hans, and Daniel Kleinman. 2002. The social construction of technology: Structural considerations. *Science, Technology & Human Values* 27 (1): 28–52.

Knorr-Cetina, Karin, and Michael Mulkay, eds. 1983. *Science observed: Perspectives on the social study of science.* London: Sage.

Latour, Bruno. 1983. Give me a laboratory and I will raise the world. In *Science observed: Perspectives on the social study of science*, edited by K. Knorr-Cetina and M. Mulkay, pp. 141–70. London: Sage.

Latour, Bruno. 1993. *We have never been modern.* New York: Harvester Wheatsheaf.

Latour, Bruno. 2004. Why has critique run out of steam? From matters of fact to matters of concern. *Critical Inquiry* 30 (2): 225–48.

Latour, Bruno. 2005. *Reassembling the social.* Oxford: Oxford University Press.

Law, John. 2002. Economics as interference. In *Cultural economy: Cultural analysis and commercial life*, edited by P. du Gay and M. Pryke, pp. 21–38. London: Sage Publications.

Law, John. 2009. The Greer–Bush test: On politics in STS. Draft paper, 23 December. Available from http://www.heterogeneities.net/publications/Law2009TheGreer-BushTest.pdf; INTERNET.

Levy, Steven. 1984. *Hackers: Heroes of the computer revolution.* Garden City, NY: Anchor Press.

Lounsbury, Michael, Marc Ventresca, and Paul Hirsch. 2003. Social movements, field frames and industry emergence: A cultural-political perspective on US recycling. *Socio-Economic Review* 1 (1): 71–104.

Lukács, George. 1971. *History and class conciousness: Studies in Marxist dialectics.* London: Merlin.

Lynch, Michael. 2006. From ruse to farce. *Social Studies of Science* 36 (6): 819–26.

Lynch, Michael, and Simon Cole. 2005. Science and technology studies on trial: Dilemmas of expertise. *Social Studies of Science* 35 (2): 269–311.

Marcuse, Herbert. 1991. *One-dimensional man: Studies in the ideology of advanced industrial society.* Boston: Beacon Press.

Marlin-Bennet, Renee. 2008. Science in whose interest? States, firms, the public, and scientific knowledge. In *Who owns knowledge? Knowledge and the law*, edited by N. Stehr and B. Weiler, pp. 125–52. London: Transaction Publishers.

Martin, Brian. 1993. The critique of science becomes academic. *Science, Technology & Human Values* 18 (2): 247–59.

McInerney, Paul-Brian. 2009. Technology movements and the politics of free/open source software. *Science, Technology & Human Values* 34 (2): 206–33.

McKenzie, Donald, Fabian Muniesa, and Lucia Siu, eds. 2008. *Do economists make markets? On the performativity of economics.* Princeton, NJ: Princeton University Press.

Miller, Peter, and Nikolas Rose. 2008. *Governing the present—administrating economic, social & personal life.* Cambridge: Polity Press.

Mirowski, Philip, and Edward Nik-Khan. 2007. Markets made flesh: Performativity, and a problem in science studies, argumented with consideration of the FCC auctions. *Do economists make markets: On the performativity of economics,* edited by D. MacKenzie, F. Muniesa, and L. Siu, pp. 190–224. Princeton, NJ: Princeton University Press.

Mirowski, Philip, and Esther-Mirjam Sent. 2008. The commercialisation of science and the response of STS. In *The handbook of science and technology studies,* 3rd ed., edited by E. Hackett, O. Amsterdamska, M. Lynch, and J. Wajcman, pp. 635–90. Cambridge, MA: MIT.

Nanda, Meera. 2005. Response to my critics. *Social Epistemology* 19 (1): 147–91.

Noble, David. 1986. *Forces of production: A social history of industrial automation.* New York: Oxford University Press.

O'Mahony, Siobhan, and Beth Bechky. 2008. Boundary organizations: Enabling collaboration among unexpected allies. *Administrative Science Quarterly* 53 (3): 422–59.

Pickering, Andrew. 1995. *The mangle of practice: Time, agency & science.* Chicago: University of Chicago Press.

Pinch, Trevor. 1996. The social construction of technology: A review. In *Technological change—methods and themes in the history of technology,* edited by R. Fox, pp. 17–36. Amsterdam: Harwood Academic Publishers.

Pinch, Trevor, and Wiebe Bijker. 1984. The social construction of facts and artefacts: Or how the sociology of science and the sociology of technology might benefit each other. *Social Studies of Science* 17 (3): 399–441.

Postone, Moishe. 1993. *Time, labour, and social domination: A reinterpretation of Marx's critical theory.* Cambridge: Cambridge University Press.

Radder, Hans. 1992. Normative reflexions on constructivist approaches to science and technology. *Social Studies of Science* 22 (1): 141–73.

Radder, Hans. 2008. Critical philosophy of technology: The basic issues. *Social Epistemology* 22 (1): 51–70.

Rao, Hayagreeva, Calvin Morrill, and Mayer Zald. 2000. Power plays: How social movements and collective action create new organizational forms. *Research in Organizational Behaviour* 22: 239–82.

Rowland, Wade. 2005. Recognizing the role of the modern business corporation in the "social construction" of technology. *Social Epistemology* 19 (2): 287–313.

Russell, Stewart. 1986. The social construction of artefacts: A response to Pinch and Bijker. *Social Studies of Science* 16 (2): 331–46.

Sandvig, Christian. 2004. An initial assessment of cooperative action in Wi-Fi networking. *Telecommunications Policy* 28 (7–8): 579–602.

Shapin, Steven. 1995. Here and everywhere: Sociology of scientific knowledge. *Annual Review of Sociology* 21 (1): 289–321.

Sismondo, Sergio. 2008. Science and technology studies and an engaged program. In *The handbook of science and technology studies,* 3rd ed., edited by E. Hackett, O. Amsterdamska, M. Lynch, and J. Wajcman, pp. 13–32. Cambridge, MA: MIT.

Smith, Barbara. 1994. The unquiet judge: Activism without objectivism in law and politics. In *Rethinking objectivity,* edited by A. Megill, pp. 289–312. London: Duke University Press.

Sterne, Jonathan, and Joan Leach. 2005. The point of social construction and the purpose of social critique. *Social Epistemology* 19 (2&3): 189–98.

Stump, David. 2000. Socially constructed technology. *Inquiry* 43 (2): 217–24.

Stump, David. 2006. Rethinking modernity as the construction of technological systems In *Democratizing technology: Andrew Feenberg's critical theory of technology,* edited by T. Veak, pp. 3–18. Albany: State University of New York Press.

Söderberg, Johan. 2009. Hackers GNUnited. In *Free beer*, edited by S. Eide, pp. 91–108. London: Lulu.

Söderberg, Johan. 2010. Mis-user inventions and the invention of the misuser—hackers, crackers and filesharers. *Science as Culture* 19 (2): 151–79.

Swingewood, Alan. 1975. *Marx and modern social theory.* London: Macmillan.

Turnbull, David. 2005. Multiplicity, criticism, and knowing what to do next: Way-finding in a trans-modern world. Response to Meera Nanda's Prophets Facing Backwards. *Social Epistemology* 19 (1): 19–32.

Tympas, Aristotle. 1997. Reviewed works: Of bicycles, bakelites, and bulbs: Toward a theory of sociotechnological change by Wiebe Bijker. *Isis* 88 (2): 379.

van Oost, Ellen, Nelly Oudshoorn, and Stefan Verhaegh. 2009. From innovation community to community innovation: User-initiated innovation in wireless Leiden. *Science, Technology & Human Values* 34 (2): 182–205.

Wajcman, Judy. 2004. *Technofeminism.* Cambridge: Polity Press.
Webster, Frank. 2005. Making sense of the Information Age. Sociology and cultural studies. *Information, Communication & Society* 8 (4): 439–58.
Woodhouse, Edward 1991. The turn towards society? Social reconstruction of science. *Science, Technology & Human Values* 16 (3): 390–404.
Woodhouse, Edward. 2003. Overconsumption as an ethical challenge for engineering education. *International Journal of Mechanical Engineering Education* 31 (1): 15–31.
Woodhouse, Edward. 2005 (Re)constructing technological society by taking social construction even more seriously. *Social Epistemology* 19 (2&3): 199–223.
Woodhouse, Edward. 2006. Technological malleability and the social reconstruction of technologies. In *Democratizing Technology: Andrew Feenberg's critical theory of technology,* edited by T. Veak, pp. 153–74. Albany: State University of New York Press.
Woodhouse, Edward, David Hess, Steve Breyman, and Brian Martin. 2002. Science studies and activism: Possibilities and problems for resconstructivist agendas. *Social Studies of Science* 32 (2): 297–318.
Woodhouse, Edward, and Daniel Sarewitz. 2007. Science policies for reducing societal inequalities. *Science and Public Policy* 34 (3): 139–50.
Zuiderent-Jerak, Teun. 2009. Competition in the wild: Reconfiguring healthcare markets. *Social Studies of Science* 39 (5): 765–92.