In the Middle of Things

Germany's ongoing Engagement with STS

Cornelius Schubert

Abstract In order to map out the German engagements with STS, this article draws some historical and conceptual connecting lines: first, the technological society, second, the sociology of everyday devices and third, the sociology of innovation. The historical developments of discussing the relation of science, technology and society in Germany will be used as the starting point. The reception of STS in Germany will be depicted in reference to these precursors and some peculiarities of the German debates will be addressed. The article roughly follows the institutionalisation of science and technology studies in Germany and highlights some intersections with STS from the early 1980s until today.

Keywords Technological society; mundane devices; innovation studies; technology studies; philosophy of technology

1. Introduction

This is a brief and sketchy mapping of the precursors to and later reception of STS in Germany. To narrow down the broad discussions on science, technology and society, I will focus on the discussions of technology from a sociological perspective. This line of thought will be enriched by a historical account of ideas from the philosophy of technology.

Since the early 1970, there have been critical remarks, for instance formulated by Hans Linde (1972), that in the early 20th century, sociology started to excommunicate things, objects and devices from its conceptualisations for the sake of formal and methodological purification. In short, Linde argues that while things figured strongly in the works of Marx and Durkheim, the turn towards interpretative sociology proposed by Weber tipped the scales in favour of purely cognitive/cultural approaches to social relations. Thus, although there has been an ongoing interest towards things and technology in the German philosophical tradition[1], the following 50 years saw a steady cleansing of material objects from social

[1] By the late 1920s, technology, tools and devices were being discussed in philosophy from a variety of viewpoints. Martin Heidegger's ([1927] 1996) famous tool analysis highlighted the phe-

TECNOSCIENZA
Italian Journal of Science & Technology Studies
Volume 2(2) pp. 103-113 - ISSN 2038-3460
http://www.tecnoscienza.net

T/S TECNOSCIENZA
Italian Journal of Science & Technology Studies

theory. To reverse this neglect of objects, Linde calls especially for the sociological engagement with mundane artefacts in social arrangements. This line of thought became known in Germany as a "realistic sociology of technology", which was later pursued by authors such as Bernward Joerges (1989). Of course, the developments in sociological and philosophical reasoning concerning the relations of humans, technology and society in the 20th century are much more complex (cf. Jokisch 1982; Joerges 1988; Weingart 1989). I will take up some arguments in more detail later, but to end this introduction, it is important to note some peculiarities concerning the reception of STS in Germany today.

On the one hand, Germany has a long tradition of studying the relations of technology and society. Even though this tradition has many common ancestors, disciplinary boundaries between sociology, philosophy, history or political science are maintained as the various disciplines follow their own research questions (cf. Cronberg and Sörensen 1995 for a European perspective). Therefore, out of the inherently interdisciplinary repertoire of STS, only certain aspects may appear to be fruitful to the respective disciplines. The impact of STS in Germany thus differs strongly depending on the field of research. On the other hand, the critical reception of STS has transgressed the boundaries of science and technology studies and authors such as Bruno Latour are discussed by a much wider audience, for instance in sociology (Kneer *et al.* 2008).

In the following paragraphs, I will revisit some of the discussions concerning the relation of technology and society in Germany. The aim is to sketch out some of the arguments predating the onset of STS in the 1960s (by revisiting the arguments concerning the technological civilisation), to look for similarities and differences in relation to STS since the 1980s (by looking at the sociology of everyday devices and innovation studies) and to map out some current engagements with STS in Germany. I have willingly kept the references to English language publications from German authors at a minimum for the sake of concentrating on the German debates. By doing so, I unfortunately add to the underrepresentation of German contributions to English science and technology studies, but this would be the topic of another paper.

---

nomenological aspects of tools-in-use, Hans Freyer ([1923] 1966) conceived devices as objectified segments of purposeful action in an anthropological fashion and Ernst Cassirer ([1930] 1985) saw the distinct form of technology in mediated action, i.e. in the productive detours taken in the human engagement with the world. Several other authors could be named, but this short list shall suffice to make the point. A central line of thought can be traced back to the end of the 19th century, when Ernst Kapp set forth an anthropological approach in the philosophy of technology. The idea of technology as "organ projection" (Kapp 1877, p. 29) became a recurring topic not only in the philosophy of technology, but also served as a link between philosophy and sociology, for instance in the work of Arnold Gehlen concerning human life in technological societies (1957).

2. The technological society

In a very simplistic fashion, the different positions concerning the intermingling of modern technology and science in the early and middle 20th century can be arranged along the well-known dichotomy between technical and social determinism. Whereas some authors of those times see the benefits of technical progress and argue for an intrinsic technical logic coming from outside society, others insist that technology is an inherently cultural phenomenon. One of the ensuing debates in Post-World-War-Two-West-Germany was the so-called "debate on technocracy". In the 1960s, conservative authors such as Helmut Schelsky (1961) argued with more left wing thinkers such as Jürgen Habermas (1968) about the political influence and control of technological systems.

In Schelsky's analysis, the modern state is increasingly turned into a technological state based on three developments. First, as technological means proliferate into the lives of a majority of people, they become means of political power. In order not to relinquish this power to non-political forces, the state has to seize control of these means, as it did in case of the railways, air transport or atomic power. Second, the immense costs associated with modern technologies cannot be borne by individual companies and thus requires the economic power of entire nations. This leads, third, to an increase in state control over many aspects of life which are linked up by the manifold technical means. Drawing on Jacques Ellul ([1954] 1964), Schelsky sees this as a total fusion of the modern state with modern technology. In consequence, the reason of state is transformed into manifold technical constraints ("Sachzwänge"), which in turn dissolve the substance of democracy. In short, Schelsky sees the fate of the state as being tied to technoscientific decisions which are exempt from a democratic forming of political will. This very drastic account of technological societies of course met with heavy opposition.

Habermas (1968) criticised Schelsky's technocratic model for presuming immanent constraints of technical progress and supposing a continuum of rationality in dealing with technical matters. More often than not, he argues, technical constraints are in fact political logics in disguise. Neither do scientists and engineers colonise politics, nor is it the other way round. Because both are mutually entangled in the process of governing technological societies, it is precisely in contrast to Schelsky that the substance of democracy is not eroded, but reinforced. Habermas refers to the interdependencies of science and politics as the "pragmatistic model", which overcomes the one-sidedness of both the "technocratic model" of the unbound rule of the engineers and scientists as well the "decisionistic model" of all-dominant political will.

Even though there are obvious differences between the positions of Schelsky and Habermas, they both see science and technology as distinct realms, which are inherently different to that of politics. And they both take the increasing influence of science and technology on modern societies as a starting point for their arguments.

One could say that the constructivist studies of science and technology and the social shaping of technology have made both positions obsolete. However, some of

the issues concerning the relation of technology, politics and society raised in this debate continue to be relevant today (cf. Grunwald 2008; Mai 2011). For instance, how can the relations between experts, politicians and the public be designed in order to allow for democratic and participatory decisions? The recent public opposition to large scale technical projects such as Stuttgart's new underground train station shows how these questions are still on the agenda. Also, the materiality of technical systems comes back into focus as it limits voluntaristic notions of political control. Such issues have been pursued in Germany mostly within the framework of technology assessment (TA). And in recent years, there are a growing number of intersections between TA and STS on these issues which might be fruitfully exploited in the future.

3. Everyday devices

When Linde (1972) deplored the excommunication of things from sociological theory in the early 1970s, he did not so much think about the dominance of large technical systems in the technological society, but rather called for greater engagement with simple, mundane devices. His main criticism was that sociology falsely reduced technical devices to non-social-objects. Accordingly, sociology must re-endorse the institutional qualities of devices and the social consequences of their use. These, as Linde points out, were present in the writings of Marx and Durkheim, but got purged for instance by Weber, who, at the first German Sociological Meeting in Frankfurt 1910 in a reply to Sombart (and in strong opposition to Marx) argued for a culturalistic understanding of technology and emphatically renounced any ideas of technological forces driving social change (Weber [1911] 1988).

In order to reverse this culturalistic bias, Linde drew on the anthropological tradition in the German philosophy of technology, especially on Freyer's ([1923] 1966) notion of device ("Gerät"). In Freyer's view, devices are not any other thing. They are materialised segments of purposeful action and therefore can only be analysed in use. Devices are never final "things in themselves", but need to be embedded in courses of action. As such, they then transform the courses of action they are embedded in. Freyer uses the example of a bowl to fetch water: instead of having to cup their hands, humans execute different movements when using a bowl. And what is more, they start to look for wood and manufacture knifes in order to make more bowls. This way, humans are increasingly occupied with manufacturing means, creating productive detours, under which Freyer also subsumes devices such as clothing, boats, roads or cultivated fields.

Let us take a brief historical look at this line of thought. In the philosophical reasoning at the end of the 1920s, technical devices are primarily conceived in means-ends relationships. However, they are not conceived to be "mere" means, but always as a transformative force which influences courses of action. Likewise, devices are not considered to be "mere" materiality, but to be constitutively enmeshed with sense, signs and symbols. Freyer (1929) and Cassirer ([1930] 1985),

for instance, link their anthropological concepts of technology, the "form" of technology, closely with concepts of language. Freyer sees "devices" as one category of objective thought. In his book, he continues to elaborate on the importance of "signs" as a related category. Like devices, signs bear references which transgress their boundaries, they are enmeshed in systems of meaning. Thus, devices and signs are not something different, rather they are similar categories in the development of objective thought. Cassirer puts the similarities and differences of tools and language at the start of his arguments. In short, he conceives language and technology as related yet distinct symbolic forms, both of which are artificial objectivations situated between humans and their environment. Cassirer thus offers a distinctly processual concept of technology. Last but not least, Heidegger ([1927] 1967) states that equipment ("Zeug") never "is" in itself, but must be understood as a reference in relations of "in-order to". Such references of the equipment can be seen as equal to the references of signs and Heidegger uses the example of the newly introduced indicators on cars to illustrate how signs actually become equipment. We can see here that the intermingling of meaning and materiality has already been a central tenet in this line of thought, just like processual conceptualisations of tools-in-use.

Linde takes up this lead and grounds his analysis of mundane artefacts on two assumptions. First, devices incorporate a specific means/ends combination for a limited time. As such, devices must be considered essentially social entities. Second, the means/ends combination must be extended into a means/ends/sanctions combination, so that the devices may become perfectly institutionalised patterns of social action. This way, Linde seeks to re-integrate mundane artefacts into the basic fabric of everyday social life, because they are not only entrenched with meaning, but also with the capacity to sanction actions.

Ten years after Linde published his small book and roughly twenty years after the debate on technocracy, the sociology of technology was well on its way to becoming a new "sociology of …" in the spectrum of German sociology (Jokisch 1982).

The 1980s may be seen as the heydays of German sociology of technology, with professorships and curricula being set up, for instance in Berlin and Bielefeld. The 1986 meeting of the German Sociological Association, which was conducted under the topic "technology and social change", shows the broad array of issues, which were discussed under the headings "technology and work", "technology and everyday life", "special effects of technology", "technology and developing countries" and, last but not least, "technology and society – special aspects and problems". Looking at some of the prominent German publications of the 1980s, we can see that the STS contributions of those days are increasingly referred to, starting at the beginning of the decade (Jokisch 1982; Joerges 1988; Weingart 1989). For instance, the collections edited by MacKenzie and Wajcman (1985) or Bijker, Hughes and Pinch (1987) are frequently cited. The year 1982 also saw the birth of a new yearbook called "technology and society" (Bechmann et al. 1982). The yearbook sought to combine the academic research into technology with a practical critique of technology and until 1999, ten yearbooks were published. Most of the

contributions were from Germany, but the second volume (published in 1983), for instance, also included a paper by Michel Callon on electric vehicles.

Metaphorically speaking, the German discussions on technology and society continuously took the pulse of STS since the early 1980s, but they also kept a critical distance, for instance with regard to ANTs principle of "free association" (Callon 1986). Mainly, German authors did and do not see the need to abandon conceptual distinctions between the social, the technical and the natural before the analysis. Rather they try to conceptualise the different qualities of humans, technology and nature as they are interwoven in social practice. Especially, it was often considered futile to abandon the notion of actors in favour of actants, because many insights from sociology would be lost in the process. Subsequently, ANT and its "flat" ontology are considered to be "too flat".

In the 1980s it were especially Bernward Joerges (1989) and Karl Hörning (in a more culturalist manner 1989), who insisted on taking the material substance for everyday social action seriously. Both connected the sociology of technology closely with sociological theories of action. The focus on the microstructures of technically mediated action drew on the legacy of late 1920s anthropological philosophy of technology, but situated action firmly in the context of daily social activities in highly industrialised countries.

As the (chicken) debate about non-human agency (Pickering 1992) started to draw wider circles in the 1990s, the question of the agency of devices began to be discussed not so much with respect to mundane artefacts and activities, but with respect to the challenges posed by novel systems of (distributed) artificial intelligence (cf. Rammert and Schulz-Schaeffer 2002). So far, there have been only limited efforts to re-engage with the agency of simple devices, but there currently seems to be a growing interest, which can be traced through an increase of conferences concerning the topic over the last couple of years. This might be tied to the recent revival of a general material agency in STS and beyond (i.e. Barad 2007; Turkle 2007; Pickering and Guzik 2008; Pinch and Swedberg 2008; MacKenzie 2009; Bennett 2010; Coole and Frost 2010). This is interesting in so far, as we unsurprisingly find Bruno Latour as one of the main references in this revival, but likewise Heidegger and critical appraisals of his work seem to have become of greater interest over the last couple of years.

4. Innovation studies

The last issue I would like to discuss briefly is the sociology of innovation. This has been a core issue of STS since the beginning and it is a very important field within the German sociology of technology. Again, the sociological interest for technical innovation traces back to early 1980s. This interest is essentially based on an evolutionary understanding of technical innovation which drew on different sources: Evolutionary economics (Nelson and Winter 1982) and the concepts of technological paradigms (Dosi 1982) or path dependency (David 1985) deviated from economic neo-classic orthodoxy and made room for sociological explanations

of technical innovation. Organisational studies were concerned with the contingencies of decision making processes leading to dominant designs (Abernathy and Utterback 1978; Tushman and Rosenkopf 1992). And in STS, likewise, the metaphor of evolution was used to characterise the emergent nature of technological innovation, for instance in Hughes' (1987) study on "the evolution of large technological systems" or in terms of variation and selection, which lie at the heart of SCOT (Pinch and Bijker 1984). In addition, the general evolutionary approach also connected STS with evolutionary economics (van den Belt and Rip 1987).

In Germany, these developments were closely followed as the sociological debates turned (in the mid 1980s) from classic technology assessment towards the social shaping of technology. This new line of research was labelled "Technikgenese" (Dierkes 1987; Rammert 1988) and combined ideas form technology assessment with those of evolutionary economics and SCOT, with the aim of keeping up with the complex dynamics of technology development in modern societies (cf. Dierkes and Hoffmann 1992; Rammert 1997). One aspect that was highlighted in this line of research was that of the phases of technological innovation, which encompassed the whole innovation process from beginning to end. These phases are not thought of as linear or as actually coming to an end. Rather, they represent different stages of innovation, with different sets of actors being involved at different times and with different interests as the technology is being developed from the first idea to a more or less final product (Weyer 2008).

But innovation processes were not only discussed with respect to economic product innovation. The sociology of technology was always closely connected to the sociology of science. One of the junctures I would like to point out is the discussion concerning science and technology in the perspective of the "risk society" (Beck 1986). Building on a recursive understanding of technical innovation, the classic distinction between laboratory and society became blurred (Latour 1983; Knorr Cetina 1988) and the co-evolution of technology, science and society gained attention in numerous fields (Krohn and Weyer 1989). It became clear that experimental technologies could hardly be contained within the walls of scientific laboratories and that the scientific knowledge of the associated risks was either limited or disputed. This put the sociology of science and technology right at the centre of the sociological discussion about modernity.

As the relevance of science and technology studies was gradually accepted by mainstream sociology, it was finally possible to establish a section for "science and technology studies" within the German Sociological Association in the beginning of the 1990s – something which was rejected throughout the 1980s. Within this section, the different issues of science and technology studies have been clustered and focussed over the last 20 years. On the one side, studies of technology and science have been set into a mutual discussion, looking for overlapping areas of interests. On the other hand, there have been dedicated conceptual and empirical developments with regards to either science or technology.

The broad spectrum of STS therefore taps into the German science and technology studies at many different intersections. Because innovation studies cover such a wide range of topics (from technical and scientific innovation, to innova-

tions in politics and social innovations in the broadest sense), there exist manifold approaches from STS and other fields which have not always been in direct exchange.

5. End

The task of mapping the impact of STS in Germany has so far resulted in some sketchy lines drawn over a long period of time and across various domains. I am not sure if they suffice to say that there is a distinctly German approach to science and technology. I think rather not, mainly because the manifold variations within the German discourse itself. What is notable, however, is that STS has always enjoyed a – more or less – critical appraisal within the German community.

Probably the most critically discussed issues are the questions regarding the agency of devices or materiality in general in the wake of ANT. For many German sociologists outside (and sometimes) inside STS, these ideas seem utterly weird. Nevertheless, the challenges from STS have been so keen as to provoke at least a re-consideration regarding if and how the ex-communication of things from social theory could or should be overcome (Rammert 1998).

Among the German scholars of science and technology, STS is of course much more broadly discussed. Depending on the field of study (for instance gender, medicine, biotechnology, finance, politics or environmental issues) the interrelations with STS are close and fruitful. Many research questions draw directly and explicitly on STS approaches and seek to combine these lines of thought with ongoing German discussions. Since 2005, the German open access online journal "Science, Technology & Innovation Studies" (http://www.sti-studies.de) offers an English language publication outlet specialising in STS topics. Furthermore, German speaking STS scholars from various fields link up through internet platforms (e.g. http://dests.de) and mailing lists (e.g. gwtf-talk@listserv.DFN.de).

Let me finish with a personal note. It seems to me that STS in Germany today have proliferated into many areas outside their classical domains. From what I see at conferences, STS (and especially ANT) are sometimes treated as some kind of secret weapon with which to overthrow the established theories in the respective fields. I am very sympathetic to such endeavours, but there seems to be an asymmetry in engaging with the established theories. Typically, the critique is unilaterally directed at the established theories, and there is only little critique (if at all) concerning STS. This raises the problem that STS concepts are exempted from the need to be challenged themselves, which, in the end, leads to a rather orthodox application of proven recipes. This cannot be good. Rather, I would very much like to see a critical and productive discussion of STS with other fields, theories, frameworks, concepts or approaches, both historical and current.

References

Abernathy, W.J. and Utterback, J.M. (1978) *Patterns of Innovation in Technology*, in "Technology Review", 80, pp. 40-47.

Barad, K. (2007) *Meeting the Universe Halfway. Quantum Physics and the Entanglement of Matter and Meaning*, Durham, Duke University Press.

Bechmann, G., Nowotny, H., Rammert, W., Ullrich, O. and Vahrenkamp, R. (eds) (1982) *Technik und Gesellschaft. Jahrbuch 1*, Frankfurt/M., Campus.

Beck, U. (1986) *Risikogesellschaft*, Frankfurt/M., Suhrkamp.

Bennett, J. (2010) *Vibrant Matter. A Political Ecology of Things*, Durham, Duke University Press.

Bijker, W.E., Hughes, T.P. and Pinch, T.J. (eds) (1987) *The Social Construction of Technological Systems*, Cambridge, MIT Press.

Callon, M. (1986) *Some elements of a sociology of translation: Domestication of the scallops and the fishermen of Saint Brieuc bay*, in J. Law (ed), *Power, Action and Belief: A New Sociology of Knowledge?*, London, Routledge, pp. 196-233.

Cassirer, E. [1930] (1985) *Symbol, Technik, Sprache. Aufsätze aus den Jahren 1927-1933*, Hamburg, Felix Meiner.

Coole, D.H., Frost, S. (eds) (2010) *New Materialisms. Ontology, Agency, and Politics*, Durham, Duke University Press.

Cronberg, T. and Sörensen, K.H. (eds) (1995) *Similar Concerns, Different Styles? Technology Studies in Western Europe*, Brussels, Office for Publications of the European Communities.

David, P.A. (1985) *Clio and the economics of QWERTY*, in *American Economic Review* 75, pp. 332-337.

Dierkes, M. (1987) *Technikgenese als Gegenstand sozialwissenschaftlicher Forschung - erste Überlegungen*, in "Verbund Sozialwissenschaftliche Technikforschung", Mitteilungen/1, pp. 154-170.

Dierkes, M. and Hoffmann, U. (1992) *New Technology at the Outset. Social Forces in the Shaping of Technological Innovations*, Frankfurt/M., Campus.

Dosi, G. (1982) *Technological Paradigms and Technological Trajectories*, in "Research Policy", 11, pp. 147-162.

Ellul, J. [1954] (1964) *The Technological Society*, New York, Knopf.

Freyer, H. (1929) *Zur Philosophie der Technik*, in "Blätter für deutsche Philosophie", 3, pp. 192-201.

Freyer, H. [1923] (1966) *Theorie des objektiven Geistes. Eine Einleitung in die Kulturphilosophie*, Darmstadt, Wissenschaftliche Buchgesellschaft.

Gehlen, A. (1957) *Die Seele im technischen Zeitalter. Sozialpsychologische Probleme in der industriellen Gesellschaft,* Hamburg, Rowohlt.

Grunwald, A. (2008) *Technik und Politikberatung*, Frankfurt/M., Suhrkamp.

Habermas, J. (1968) *Technik und Wissenschaft als "Ideologie"*, Frankfurt/M., Suhrkamp.

Heidegger, M. [1927] (1967) *Sein und Zeit*, Tübingen, Niemeyer.

Heidegger, M. [1927] (1996) *Being and Time*, Albany, State University of New York Press.

Hörning, K.H. (1989) *Vom Umgang mit den Dingen. Eine techniksoziologische Zuspitzung*, in P. Weingart, (ed), *Technik als sozialer Prozeß*, Frankfurt/M., Suhrkamp, pp. 90-127.

Hughes, T.P. (1987) *The evolution of large technological systems,* in W.E. Bijker, T.P. Hughes and T.J. Pinch (eds), *The Social Construction of Technological Systems*, Cambridge, MIT Press, pp. 51-82.

Joerges, B. (ed) (1988) *Technik im Alltag*, Frankfurt/M., Suhrkamp.

Joerges, B. (1989) *Soziologie und die Maschinerie. Vorschläge zu einer "realistischen" Techniksoziologie*, in P. Weingart (ed), *Technik als sozialer Prozeß*, Frankfurt/M., Suhrkamp, pp. 44-89.

Jokisch, R. (ed) (1982) *Techniksoziologie*, Frankfurt/M., Suhrkamp.

Kapp, E. (1877) *Grundlinien einer Philosophie der Technik. Zur Entstehungsgeschichte der Kultur aus neuen Gesichtspunkten*, Braunschweig, George Westermann.

Kneer, G., Schroer, M. and Schüttpelz, E. (eds) (2008) *Bruno Latours Kollektive. Kontroversen zur Entgrenzung des Sozialen,* Frankfurt/M., Suhrkamp.

Knorr Cetina, K. (1988) *Das naturwissenschaftliche Labor als Ort der "Verdichtung" von Gesellschaft*, in "Zeitschrift für Soziologie"*,* 17, pp. 85-101.

Krohn, W. and Weyer, J. (1989) *Die Gesellschaft als Labor. Die Erzeugung sozialer Risiken durch experimentelle Forschung*, in "Soziale Welt"*,* 40, pp. 349-373.

Latour, B. (1983) *Give me a laboratory and I will raise the world*, in K. Knorr-Cetina and M. Mulkay (eds), *Science Observed*, London, Sage, pp. 141-170.

Linde, H. (1972) *Sachdominanz in Sozialstrukturen*, Tübingen, Mohr Siebeck.

MacKenzie, D. and Wajcman, J. (eds) (1985) *The Social Shaping of Technology. How the Refrigerator Got its Hum*, Milton Keynes, Open University Press.

MacKenzie, D. (2009) *Material Markets. How Economic Agents are Constructed*, Oxford, Oxford University Press.

Mai, M. (2011) *Technik, Wissenschaft und Politik. Studien zur Techniksoziologie und Technikgovernance*, Wiesbaden, VS Verlag.

Nelson, R.R. and Winter, S.G. (1982) *An Evolutionary Theory of Economic Change*, Cambridge, Belknap Press.

Pickering, A. (ed) (1992) *Science as Practice and Culture*, Chicago, Chicago University Press.

Pickering, A. and Guzik, K. (eds) (2008) *The Mangle in Practice. Science, Society and Becoming*, Durham, Duke University Press.

Pinch, T.J. and Bijker, W.E. (1984) *The Social Construction of Facts and Artefacts. Or How the Sociology of Science and the Sociology of Technology Might Benefit Each Other*, in "Social Studies of Science"*,* 14, pp. 399-441.

Pinch, T.J. and Swedberg, R. (eds) (2008) *Living in a Material World. Economic Sociology Meets Science and Technology Studies*, Boston, MIT Press.

Rammert, W. (1988) *Technikgenese. Stand und Perspektiven der Sozialforschung zum Entstehungszusammenhang neuer Techniken*, in "Kölner Zeitschrift für Soziologie und Sozialpsychologie", 40, pp. 747-761.

Rammert, W. (1997) *New rules of sociological method. Rethinking technology studies*, in "British Journal of Sociology", 48, pp. 171-191.

Rammert, W. (ed) (1998) *Technik und Sozialtheorie*, Frankfurt/M., Campus.
Rammert, W. and Schulz-Schaeffer, I. (eds) (2002) *Können Maschinen handeln? Soziologische Beiträge zum Verhältnis von Mensch und Technik*, Frankfurt/M., Campus.
Schelsky, H. (1961) *Der Mensch in der wissenschaftlichen Zivilisation*, Köln, Westdeutscher Verlag.
Turkle, S. (ed) (2007) *Evocative Objects. Things we Think with*, Cambridge, MIT Press.
Tushman, M.L. and Rosenkopf, L. (1992) *Organizational determinants of technological change. Towards a sociology of technological evolution*, in "Research in Organizational Behavior", 14, pp. 311-347.
van den Belt, H. and Rip, A. (1987) *The Nelson-Winter-Dosi model and synthetic dye chemisty*, in W.E. Bijker, T.P. Hughes and T.J. Pinch (eds), *The Social Construction of Technological Systems*, Cambridge, MIT Press, pp. 135-158.
Weber, M. [1911] (1988) *Diskussionsrede zu W. Sombarts Vortrag über Technik und Kultur*, in M. Weber (ed), *Gesammelte Aufsätze zur Soziologie und Sozialpolitk*, Tübingen, Mohr Siebeck, pp. 449-456.
Weingart, P. (ed) (1989) *Technik als sozialer Prozeß*, Frankfurt/M., Suhrkamp.
Weyer, J. (2008) *Techniksoziologie. Genese, Gestaltung und Steuerung sozio-technischer Systeme*, Weinheim, Juventa.

Cornelius Schubert Technische Universität Berlin
Institut für Soziologie
Sekretariat FR 2-5
Franklinstraße 28/29
10587 Berlin
Email: cornelius.schubert@tu-berlin.de