THERE'S NO TURN LIKE THE EMPIRICAL TURN

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Philosophers of technology now turn to the phenomena in order to learn from them – always, and unavoidably, selectively. This is important and, as the essays in this book testify, productive. Learning from empirical work is not limited to turned-around philosophers, however. The actual work done in the “empirical turn” and the resulting insights could also result from sociologists and other empirical scholars “turning” to philosophy. One could call this “reflexive” sociology, and consider it to be a matter of inclination, of individual sociologists with a reflective bent (my favorite example here is Brown, 1989). But I would argue that it can and should be an integral part of sociology. When attempting to synthesize a large body of empirical and analytical studies, for example, one is forced to consider the variety in the object studied and inquire into its nature. When we did our review study of technological change (Rip & Kemp, 1998), we had to start with an analysis of various conceptions of technology and offer a considered view about them to support the approach we took in the review. That section of our paper could be part of an article in the philosophy of technology without anybody suspecting a sociologist and an economist to be behind it.

There is an added value of introducing sociology (reflexive or otherwise) in the philosophy of technology, in that it can highlight complexities and increase the scope of the analysis. This is how I will position my contribution, because in most chapters in the present book, the empirical turn is a turn to practices, in particular design and engineering practices. While this is OK as a starting point for philosophy of technology, it also introduces limitations. For one thing, the concentric view of technology – which is part of the culture of engineers
— may well be reproduced uncritically in this way, and a message may be conveyed that to understand technology it is enough to understand engineering.

Accepting the starting point, I shall add to it to overcome such limitations. A participant at the Delft Workshop, Pieter Adriaans, director of Syllogic, noted: “Society is programmed by the artifacts it creates itself.” Clearly, there is much more to technology than the engineers’ doing, even if they may carry a particular responsibility. The wider world must be introduced in the “empirical turn”. And this can usefully be done by drawing on the field of technology studies, which has come into its own over the last two decades and has produced important (even if still somewhat fragmented) insights.

I will start inside the engineering world, then consider the different levels at which technology is embedded in society, and return to the engineering world by inquiring into its boundaries and partial rationalities. In the concluding section I draw some explicit implications for philosophy of technology.

**ENGINEERS AND THEIR ARTIFACTS – AND HEURISTICS AND PROMISES**

Inside the engineering world, the main actors are the engineers themselves, and their business is to design and build artifacts, whether components or complete systems, and to assure their continued working. It is on this base line that the self-image of engineers rests, and how they define their tasks and responsibilities.

Technology then appears as *configurations that work* – which is actually useful as a general definition, if one takes a broad interpretation of “configuration” (Rip & Kemp, 1998). These configurations are often realized sequentially, starting with some hardware, then adding the software of operating it (skills, logistics), the orgware of getting its production and use right, and increasingly also the “socioware” necessary for its embedding in concrete societal contexts. This concentric view allows engineers to define and defend their work style. It also implies that there is a boundary where their mandate and responsibility ends and others have to take over. The quest for such a boundary (and its eventual location) will then create a demarcation of technology (the engineer’s concern) and its use and embedment in society (society’s concern). The division of labor (and accountability) can be productive, but also allow gerrymandering – as is brought out nicely in Ravetz’s (1975) aphorism for science: “Science takes credit for penicillin, while society is blamed for the bomb.”

The boundary between technology and context is fuzzy, already in seemingly concrete cases as underground transport: where does the metro end and the city begin – and thus the responsibilities of the various actors (Achterhuis et al.,
1995)? And even more importantly: the boundary is constructed dynamically, between different and heterogeneous actors, and never conclusively. This is particularly clear for novel technologies such as biotechnology and the fusion of information and communication technologies, which are carried by promises (of the developers) and high expectations (of other actors). As the example of the metro indicates, it will also be important in infrastructural technologies. Again, promises and expectations will play their role, but now more focused on concrete functionalities.

The importance of promises and expectations is not limited to boundary work. It implies a general point about technology and engineering: on top of the base-line of actors and artifacts, “agenda” should be added to make our understanding of the dynamics of technological developments complete. We proposed a “Triple-A Triangle” – actors, artifacts, and agendas – to broaden existing technology studies (Van Lente & Rip, 1992; Van Lente, 1993), but such a triangle is equally important for a philosophy of technology that wants to profit from the empirical turn. Let me elaborate this, starting from technological design and ending up with general philosophical considerations.

Design necessarily starts with projections of what could be: an idea, a first sketch, and a story about how and why it would work if developed and realized. Agenda dynamics are immediately visible here in two ways. Firstly, expectations are formulated about what could be and what it would look like, and this sets out an agenda for further work. Such expectations can take the form of strong convictions and/or be supported by regularities in earlier developments. Moore’s Law stipulating the doubling of processing speed and memory capacity in integrated circuits every one-and-a-half years is a striking example, which defines challenges for new technological development. As a news report in Science (1996) phrases it: “Researchers around the globe are working furiously to extend the life of Moore’s Law by coming up with alternative chip-patterning techniques for use when current lithographic tools hit the wall.” (And it is exactly because of such efforts, driven by innovation competition, that advances in chip technology remain predictable. As soon as firms decide to adopt another strategy, and go for alternatives, Moore’s Law would lose its hold, and thus its validity.)

Secondly, the way to go about design and development is shaped by earlier experience, the heuristics of the dominant design paradigm (or paradigms) and other rules and standards of what has been called the technological regime. Nelson and Winter (1977, p. 57) refer to

technicians’ beliefs about what is feasible and worth attempting. For example, the advent of the DC-3 aircraft in the 1930s defined a particular technological regime: metal skin, low wing, piston powered planes. Engineers had some strong notions regarding the potential of
this regime. For more than two decades innovation in aircraft design essentially involved better exploitation of this potential; improving the engines, enlarging the planes, making them more efficient.

There are further agenda dynamics, though, which are often backgrounded – by engineers when they talk about their ongoing work, and by philosophers of engineering when they analyze what is going on. Promises are made to potential sponsors, and to the wider world at large, about what the specific design, or a new technological option, or a new project, will achieve. Such promises range from the mundane to the grandiose, but what they have in common is that they intend to mobilize resources for the project: funds and other material resources, as well as symbolic resources which create legitimation to proceed. One can see this happen in the present hype around internet companies and e-commerce and, in parallel, with mobile telephony. “The penetration of mobile phones will be more than 100% by 2003 – this is completely certain, there is no doubt about it.” I have heard spokespersons from the telecom world emphasize this, and immediately draw out consequences for their, and others’, strategies (Morley, 2000).

Promises made in public bind the speaker to some extent, and even more so when resources are acquired on the basis of the promises. As Van Lente (1993) has shown, promises mobilize resources which enable engineers to work on their project, but create requirements on what they must deliver, and thus introduce constraints on their work agenda. While a protected space is created where their work can continue, they have to work within the limits and limitations set by that space.

Thus, when a design is worked out and realized, it is not the linear unfolding of a technical possibility or the filling in of a functionality. It is an innovation journey, with its twists and turns, through which agenda dynamics materialize. And this is more than a self-fulfilling prophecy: there are continual feedbacks from experience, and these are assessed in relation to the effort actors are prepared to invest in further attempts. As Van Lente (1993) has shown for the case of a new polymer to be used as isolation in high-voltage cables, the assessments may shift over time, and lead to a (sudden) redefinition of the project and its prospects.

The innovation journey continues to pilots and demonstrations, market introduction, and niche building. The overall perspective about the role of heuristics (in existing regimes) and promises (to create openings) will again be applicable. Elsewhere, we have described a way to map the innovation journey and the way the halo of expectations gradually materializes (Rip & Schot, 1999). Figure 1 offers a (slightly adapted) version of the visualization used in that paper. For the details of the Figure, I refer to Rip and Schot (1999).
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Figure 1.
The next step in this reflexive sociology of innovation is to recognize the ontological elements involved. Engineers add to the furniture of the world, and will thus shift its ontology, in the small and in the large. Over time, major shifts may occur, as is evident if one traces the history of electricity from the late 19th century onward, and is the present, and shared, expectation about information and communication technology. This is not a matter of heroic creative acts \textit{ex nihilo}, however. The nature of the furniture added is shaped (enabled and constrained) by conditions, circumstances, and contexts, and the dynamics of this "shaping" contain a strong component of expectations and promises and how these influence action. I shall come back to the embedded nature of the new technological developments in the next section, but will here indicate the ontological implications of agenda dynamics.

As Van Lente argues in the final part of his (1993) thesis,

This self-organizing character, this movement of an unreal projection converted into reality, is particularly striking in the case of technology. But technology only expresses something that is deeply human. As Ortega y Gasset \ldots\ argued, projecting new forms of life and materializing them is the movement of human life itself.

He then goes on to quote Ortega:

This invented life – invented as a novel or a play is invented – man calls "human life", well-being. \ldots\ Have we heard right? Is human life in its most human dimension a work of fiction? Is man a sort of novelist of himself who conceives the fanciful figure of a personage with its unreal occupations and then, for the sake of converting it into reality, does all the things he does – and becomes an engineer? (Ortega y Gasset 1962, p. 108)

And he selects further quotes to support this point: The roots of all action is in the future, in the projections we design and consequentially try to convert into reality. "Body and soul are things, but I am a drama, if anything, an unending struggle to be what I have to be" (p. 113). "To live \ldots\ that is to find means and ways for realizing the program we are" (p. 116). So, as a consequence: "Man has to be an engineer, no matter whether he is gifted for it or not" (p. 136).

I cannot resist quoting Van Lente's final paragraph:

The reverse is true as well: the engineers have to be like novelists. They have to write forceful fiction and make it come true as well. Actors developing technology, to paraphrase Ortega, conceive for themselves the fanciful figure of a future technology, and for the sake of converting it into reality, they, as well as others drawn into the fancy, do all the things they do. Whatever technology may be in the present, it is rooted in the future.
THE WIDER WORLD OF TECHNOLOGY IN SOCIETY, AND THE FUZZY BOUNDARIES WITH THE ENGINEERING WORLD

Actors, artifacts, and agendas are always embedded in evolving and interacting contexts. To address such multi-level dynamics, Rip and Kemp (1998) introduced three levels at which technical change is played out: novel configurations, regimes, and socio-technical landscapes. (I note that their conceptualization focuses on technical change as such, and does not include industry structures and other patterns in society which are equally important to understand the socio-technical landscape.) Innovation and technological regimes have been discussed already; the interesting addition is socio-technical landscape — another invisible hand creating gradients of force (like a physical landscape). The upper level in Figure 2 represents the longue durée (Braudel, 1972; Bertels, 1973), the sedimented landscape resulting from earlier actions and cumulating infrastructures, and which changes only slowly. Like regimes, the socio-technical landscape enables and constrains, but it is constituted differently.

An example of analysis with the help of socio-technical landscape is the infrastructure of electricity generation and use, including networks and billing systems. This is how electricity has become embedded in society, and how its use has become so important that it is an almost obligatory passage point for fuels and other energy carriers in order to reach end users. In other words, there is a “buffer zone” in the socio-technical landscape that separates ongoing innovation (variation) in technologies to generate and distribute electricity, from innovations (variation) at the distribution and use side. Not only is selection constrained — in quasi-evolutionary terminology, by a nexus (Van den Belt & Rip, 1987), only now at the macro-level — but the range of variation is contained as well because it must be always lead to, or utilize, electricity. Alternatives to electricity stand little chance, at least in the short term.

The transport and mobility regime, centered on automobiles, is much more heterogeneous than the electricity regime, and could perhaps better be seen as a set of overlapping regimes. These are tied together by the reliance on vehicles using internal combustion engines, and what this implies for fuel, construction, maintenance, and ways of using automobiles. Staudenmaier (1989) has shown how this socio-technical regime became dominant and disciplined various communities. One can see a buffer zone again, less homogeneous than in the electricity sector, but still enabling further innovation while constraining it in particular directions. The development (and to some extent non-development) of electric vehicles (Hoogma, 2000) and of fuel cells (Schaeffer, 1998) are instructive examples.
Evolving sociotechnical landscapes

A patchwork of regimes

Novel "configurations that work"

Local practices & novelty creation

Development over time

[1] Novelty, shaped by existing regime
[2] Evolves, is taken up, may modify regime
[3] Landscape is transformed

Figure 2. The three levels of socio-technical change

There are other meso- and macro-level dynamics, for example the shift from economies of scale to economies of scope (and now also economies of skill) as the joint outcome of industrial and technological developments (Chandler, 1990). In another vein, Hughes (1989) analyzed what he called the tidal wave of technological ingenuity and enthusiasm in the USA, which created a particular form of modernity (with hierarchical control orientation and tightly coupled systems), which is less appropriate to the present-day world and is being changed partly through technological developments in the direction of distributed systems (cf. Hughes, 1998).

Freeman (e.g., Freeman & Perez, 1988; Freeman, 1992) has introduced the notion of a techno-economic paradigm to capture the effect of what he calls a pervasive technology, that is a technology which not only changes its own
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sector but the whole economy because of pervasive effects in many sectors. One can argue that steam power, coupled with iron and steel, constituted the techno-economic paradigm of the railway (and steamship) age. While such a paradigm is dominant, technologies (in this case, electricity) develop that will characterize a subsequent paradigm. In retrospect, one can speak of a mismatch of the new technologies and the socio-institutional context shaped by the dominant techno-economic paradigm. For the present period, Freeman sees the new information and communication technologies as the emerging techno-economic paradigm of the 1990s and later decades. This is not so much a question of wealth creation (witness the productivity paradox), but of changing structures and interactions. One example would be the new possibilities for co-production when information exchange is not limited by geographical distance.

One can look at information and communication in another way as well, and study it as part of a broader secular trend: the increasing role of "software" in handling "hardware." Software development and use in computer technology is the obvious example, with the advent of programming languages in the late 1950s as the key step. Using the concept of software more broadly, one can see the advent of operations research, of "traffic engineering" (in telephone networks) and the increasing importance of logistics as examples of software. The design and "disciplining" of activities and organizations on the basis of blueprints are also software in the broad sense. Just like computer software, this generalized software is engineered, and thus qualifies as technology.

The broader notion of software links up with the analysis of historians and sociologists of how people, organizations, and society are monitored and disciplined with the help of technology. Michel Foucault has emphasized the "normalizing" tendency in modern societies, and the way technology is implicated in it (Foucault, 1975). Prisons are built in such a way that surveillance is optimal. At first, such technologies are specific to the particular purpose. But surveillance becomes a generalized problem: in hospitals, in armies, in shopping malls. And the engineering challenge shifts from the particular circumstance (the hardware) to ways to discipline people (the software).

Interestingly, the process of normalizing can also be seen in how the idea of what are "good" technologies becomes articulated – environmental technologies are good by definition, biotechnologies were OK until ambivalences crept in and food ingredients deriving from genetically modified organisms became dubbed as "Frankenstein foods". One indicator of normalization is the importance of expectations and symbolic features: "no dirty chlorine in my food, or in the toys for my child, no products linked to genetically modified organisms in the shop." In other words, there are requirements about symbolic features which may dominate performance requirements. In these examples, negative
associations were dominant, but positive connotations occur just as well, as with vitamins (Rip, 1991).

It is within these wider worlds that the engineers work and accommodate to their various (and changing) contexts. Their charter, or mainstay, is double: their products have a life of their own, as captured in Latour (1987)’s beautiful phrase of artifacts as “immutable mobiles”; and they work within a mandate where they are responsible for technological progress (Van Lente, 1993; Van Lente & Rip, 1998). Thus, a division of labor, and of responsibilities, is possible between engineers and the wider world.

Such boundaries and distinctions are not unproblematic, however, and may be called into question. A thought-provoking example are cochlear implants (Ragud & Ahlstrom, 1997). A double dynamic was visible: insiders (developers) were confronted by outsiders (regulators, providers, prospective users); and the market projections from the “hearing majority” met with strong reactions from the “deaf community” who see cochlear implants as an attempt to undermine deaf communication and culture.

This example indicates that the universalistic tendencies implied by the notion of technological effectivity (configurations that will work, or must work, wherever and for whomever) run up against what Staudenmaier called “human pluralism” (Staudenmaier, 1992, p. 224). An obvious, and often voiced, response is to call for participation, but this is only one response, and itself plagued by difficulties. Difficulties deriving from the general issue of ongoing practices, their partial rationalities, heterogeneous interactions and temporary closures (Rip, 1988; Rip, 1999), and from the multiple ontologies involved (Mol, 1999).

Engineers have been adept in closing off their rationalities from the wider world: such closure, which enables them to go on with present concerns, is their overriding goal. The call for opening up their practices to participation, however well intentioned, is not a sufficient reason by itself. Citizen groups have their own partial rationalities, for example NIMBY – Not In My Back Yard. Discussion of boundaries and participation should be framed by considerations of short-term and long-term quality of technology in society. To do so, one needs (in the end) a technological version of Kant’s Urteilskraft. Judgmental competence has to be built up and valued. And tools to support judgments, for example reflective scenarios, have to be developed.

Increasing interest in participation, in giving voice to those who used to be excluded from engineering/technological decisions, has led to short-circuiting the quality issue by assuming that wider participation, somehow, leads to better technology (in a better society). This is doubtful, to say the least, and work on Constructive Technology Assessment (Rip et al., 1995; Schot & Rip, 1997) has identified approaches that do not depend on participation by spokespersons,
and has studied concrete cases to evaluate possibilities and limitations on this count.

By contrast, one should recognize that in emphasizing quality assurance and the eventual goal of better technology in a better society, other considerations, in particular issues of democracy and justice, are backgounded. At a minimal level, the requirement of transparency, which is important in a democracy (Van den Daele, Pühler & Sukopp, 1997, p. 90), may not always be conducive to productive negotiation. More generally, broad participation, while perhaps a "right," is not a productive way to encompass variety. Van den Daele, who has been confronted with these issues repeatedly, suggests that the multiplication of viewpoints (as a result of increased participation) will make the achievement of an integrated result and formulation of concrete policies more difficult. This could lead to a return to formal democratic policy and decision making procedures, unless civic society itself is able to achieve such integration (Van den Daele & Neidhart, 1996, p. 14). Clearly, this will not come about by itself.

In the reflexive co-evolution of technology and society, dominant patterns, and thus dominant designs, emerge that allow for such integration. The proponent-opponent dichotomy and the risk discourse which emerged in the 1960s and 1970s is one example of such a dominant de facto design. One may have one's doubts as to its productivity, especially in the face of the new technologies and the new circumstances of the 1990s, but it is definitely a solution to Van den Daele's concern.

When discussing these issues (Rip, 1999), I also asked what might be (and could actually become) a dominant design for managing technology in society, better suited to the times and technologies? One can specify general "societal" design requirements: It must always produce kaleidoscopic integration, that is, integration without doing away with antagonisms and outliers. It must relate to ongoing societal dynamics and accept the pragmatic limitations this implies: to have an ideal approach which does not work because it does not fit the tribal norms is of little purpose. Engineering design can then be positioned as part (and parcel) of societal design. Backgrounding the wider aspects can be productive in the short term, but risks having them return with a vengeance. For modern biotechnology, this is now happening. And for infrastructural investments, a similar backlash is possible.

ISSUES FOR AN EMPIRICALLY-ORIENTED PHILOSOPHY OF TECHNOLOGY

There are many explicit and implicit philosophical issues embedded in what has been said, some of which, have been discussed. In this concluding section
I shall briefly focus on two issues: the methodology of the empirical turn, and the political ontology of engineering.

How to learn from phenomena? The principle problem is that one has to have a priori diagnosis of the interest and value of the case at hand to select it as an occasion for learning – but then, the original aim was to learn from what one encounters, rather than selecting beforehand . . . . Carl Mitcham, when confronted with this challenge (in discussion after a lecture at the Technological University of Delft), offered a solution: learn here, in case A, and use these insights to advise and improve what happens elsewhere (in cases B, C, . . . ). If the analyst has sufficient grounds to diagnose what is “good”, this route can be followed even if path dependencies can occur which introduce limitations (Thagard, 1988; cf. also Lipton, 1993). Recognizing the limitations that path dependencies will introduce is a key step to start an open-ended learning process.

What are sufficient grounds to identify which cases are “good”, or at least exemplary? We are confronted here with the general problem (or challenge) of naturalistic approaches: in order to learn about “good” science or “good” technology, one has to select cases as exemplifying good science or technology, and thus have some prior criterion about what is good and what is not. Thagard (1988) has addressed this issue, and shown that the vicious circle can be turned into a virtuous circle by learning as one goes along. (He also shows that the narrow reflective equilibrium that can be achieved in this way has to be evaluated in terms of a broad equilibrium.)

Donald Schön’s (1983) analysis of learning by practitioners is helpful as well. Engineers, architects, and psycho-analysts all learn in games with the situation, and transfer their insights by considering new situations as instances of types of situation they have encountered before. Similarly, philosophers and sociologists of technology can play a game with their case-studies, by naming them as case of, say, bottom-up aggregation, and try out whether their data can be fitted into the story they want to tell, in partial contrast to other analysts’ stories. Clearly, this is not a recipe, but a heuristic that enables learning.

Political ontology (of engineering) is a new phrase, coined for this occasion. It does resonate with Mol’s (1999) discussion of “ontological politics”, and her discussion of “multiple realities” which can be, and are, performed – which includes partial materialization. As she emphasizes, reality is not an immutable given for technologists and politicians. The point of technology and of politics is

the assumption that the world might be mastered, changed, controlled. So within the conventions of technology and politics the question of how to shape reality was open: at some point in the future it might be otherwise.
And she adds: “But along with this it was assumed that the building blocks of reality were permanent: they could be uncovered by sound scientific investigation.” What I add here is the recognition that engineers, in interaction with their contexts, are attempting to reduce the “multiple realities” that are projected, to one dominant ontology, in the sense of the actual furniture of the world. It is not just the multiplicity that gives rise to politics (even if such reconstructions are important to convince the Horatios of this world that there is more between heaven and earth than originally thought), but the negotiations and concrete assemblage work which reduce multiplicity to a concrete configuration.

In addition to the materialization of stories, and the issues of quality and participation, which I have discussed already in the previous section, there is an underlying issue that has to do, in Hannah Arendt’s words, with our responsibility for a world which we create ourselves (Arendt, 1958, pp. 136–138; Achterhuis, 1999, pp. 11, 116–117). As Achterhuis emphasizes, this is not about the morality of our actions and good intentions toward our fellow human beings, but about the political question of establishing and maintaining arrangements in and of the world. Engineers are well placed to take up this responsibility (and are actively involved in establishing and maintaining the arrangements of the world), but rarely have the competencies to address the issues of political ontology productively.

Traditionally, private spaces have been the topic of philosophy (cf. Heller’s 1987 critique), but there is in-between space, and its cumulation to public space. This is what Arendt calls “the world”, and care for the world is an attempt to maintain in-between space, with its tensions. Public space is supported, and shaped by material infrastructures, which themselves derive from actions and interactions. Political action and interaction is thus continuous with material shaping. Conversely, the engineers’ work adds to the material landscape, and thus shares with political action the care for the world.

Thus, design of public places – Schiphol airport is a very interesting example –, and of infrastructures, are strategic sites for an empirically-turned philosophy of technology. This is not just because of the presently visible controversies – these are fought at a surface level –, but their occurrence is an indication of a struggle about care for the world.

What I have tried to show here is that the empirical turn is visible and viable, and that it promises a better philosophy of technology. Accepting the courage implied in the convictions set out here, I add that my reflections also presage a better philosophy in general. But that is another story.
REFERENCES

Morley, P. (Member of the Board, KPN Telecom) (2000). Lecture, University of Twente, 7 February.
Rip, A. (1999). Contributions from Social Studies of Science and Constructive Technology Assessment. ESTO Project on Technological Risk and the Management of Uncertainty,
commissioned by the Forward Studies Unit, European Commission. Enschede: University of Twente, April.


