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# ENGINEERING AS A POLITICAL PRACTICE

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## 1. The Technological and the Political

Making technology has consequences for the social world in which those technologies will be used: they open up new possibilities for action, close off others, and continue to have this influence once their makers have long left the scene. That is to say, technologies have agency: the capacity to act, and to effectuate change—whether we see this as an extension of what is still ultimately human agency, or as an agency beyond the human and something technology has in and of itself.[1] If we think of politics as a range of ways people arrange the organization of their societies—whether democratically, by the exercise of power, or any other form of rule—then it is easy to see how technologies, when seen as having agency, are relevant to politics: they directly bring influence to bear on the composition of the world, and what it affords and constrains. If we grant technologies a place in our thinking about politics, we branch out from what is conventionally thought of as politics: the institutional arrangements, i.e. *human-social relations*, that people make to resolve differences, conciliate interests, and make collective decisions (Crick 2004). This chapter explores the connection between engineering as the making of technology, and specifically how this making of technology is ultimately a political affair.



The exploration of technologies as political artifacts has a long history. One seminal example is the analysis by Langdon Winner (1988), who explained how bridges were purposely built low, such that only cars could pass under them, not buses.[2] By consequence, the area secluded by those bridges, a recreational area with beach access, could be negotiated only by rich people travelling by car, not poor people travelling by bus. Importantly, the rich-poor divide coincided with racial divides. This is thus an example of an infrastructural arrangement that is instigated by (disputable) social ideals, and which in turn reproduces social relations.

In addition, Bruno Latour (1987, 1988, 1993) explored the problematic nature of the distinction between technological and political relations and proposed that we should think of political and technological relations as essentially of the same kind, with distinction between them being as itself a matter of negotiation rather than given *a priori*. Are trains and railways political technologies? Not if we just think of them as means of transportation, and they are indeed usually staged as such. But the role of railways in sociopolitical history is hardly overestimated, and they have been very much political, for example in European integration (Schot and Vleuten 2004). It depends on the exact relations in which technologies end up, whether we can easily recognize them as political and make a convincing case for them to be seen as political.

Finally, Andrew Feenberg (1991, 2002, 2005, 2017) expanded upon the Marxist insight that technological relations pre-structure socioeconomic relations. Notably, he argues that scientific rationality pretendedly settles technological design choices in a fair and neutral way, while in fact it *underdetermines* technologies, leaving the implementation in the context of application vulnerable for colonizing by dominant interests. On the one hand, we see that indeed the underdetermination of the Internet and social media allows for them to be captured by great neoliberal interests. At the same time, the Internet in its underdetermination allows for marginalized groups to organize and emancipate themselves (Feenberg and Friesen 2012).

Zooming in from the political character of technology towards the narrower thematic of how we can think politically about the practice of *engineering*, or *making technologies*, leads to three subquestions. The first is what it means to think about engineering as a *practice*. What happens in engineering, if there is a distinct activity by that name in the first place? Is engineering a practice in the sense of a collection of mainly human relations, where members pursue some shared goals? What is and is not part of engineering? (see also Chapter 55, "Reimagining the Future of Engineering" by Neelke Doorn, Diane P. Michelfelder, et al., this volume). Who does engineering? What is *specific* about engineering, innovation and technology design practices compared to other practices?

The second question is how politics unfolds in the *practice itself*. In its most mundane form, this question is about whether and how what happens in the design laboratory, from the workbench to the coffee corner, is subject to political relations and even biases such as sexism, classism and racism (see also Part IV of this *Handbook* on engineering design processes). In a more fundamental sense it is about how particular methodologies, epistemologies (theories of knowing) and problem definitions gain dominance over others (see also Part II of this *Handbook* on engineering reasoning). While these appear as strictly methodological concerns that are the domain of 'the engineering way-of-knowing', they can be very political: they ultimately determine what kind of problems can or cannot be addressed in engineering and what solutions may or may not emerge.



The last question is how practices of engineering and innovation are political in an *external* sense, i.e. how they relate to social and political processes outside the engineering practice, in the broader social world. This relation is dialectical. On the one hand, the boundary between the inside and outside of engineering is permeable: things go in and out all the time, and these include technologies just as much as political content such as ideologies, regulations and conflicts—or at least, so I assume for the argument of this chapter. On the other hand, it should be assumed that the boundary of the practice itself is perpetually kept in place, renegotiated and policed. One central endeavour in this 'boundary work' is to perform engineering as politically neutral, so as to exempt it from politics and leave it to autonomous governance by engineers themselves. That is to say, boundary work is to keep the politics out. Another claim that enjoys continual and active support is that engineering and innovation, notwithstanding some obvious perversities, in general contribute to the common good and the prosperity of humankind; and therefore, it should not be made subject to interference from politics (which here refers to the more conventional, narrower understanding of politics limited to the aforementioned institutional arrangements). Again, an argument to keep the politics out.

Opposition to those claims is found in long-standing traditions of *technology assessment* and *constructive technology assessment* (Rip et al. 1995), and in perspectives on the ramifications of technology (including technologies in the making) into the spheres of ethics and morality (Swierstra and Rip 2007). A recent branch of this concern is found in the discourse of *responsible research and innovation* (Owen, Macnaghten et al. 2012; Schomberg 2011; Stilgoe, Owen et al. 2013), which seeks to democratize not only the use of technologies but also their development and the setting of broader innovation agendas.

All this starts, however, with the question of what makes something 'politics' or 'political', and whether there is a difference between the two. This will be the topic of the next section. After

that, sections will be devoted to the respective questions: how engineering can be thought of as a practice, how this practice is internally political, and how the practice relates in a political sense to the outside world.

## 2. To Call Something Political

Notions of politics and the political abound. The point of this chapter is not to conclusively settle what politics is. But we do need a heuristic conception of politics that helps us identify the phenomena we are looking for. In fact, Mark Brown (2017) has pointed out that calling something 'political' is in itself a potentially ambiguous attribution. On the one hand, it may refer to something being relevant to politics; i.e. it may have political origins, implications, or effects. We could call this political in an 'object sense': we do politics *about* it. On the other hand, calling something political may refer to the thing itself becoming connected to and implicated in political processes. This we could call political in a 'subject sense': the thing joins in the process of doing politics. But these are only preliminary steps in thinking about what could be political about engineering practices.

Intuitively, one might think of politics as what concerns the *state* (or more generally, the *polity* if we also want to include forms of organization that differ from present-day states). Indeed, a key political philosopher such as John Rawls is primarily concerned with what he calls 'the basic structure of society', which he aspires to arrange in such a way that political decisions can be made in a way that is fair to all members of society, irrespective of the religion or *comprehensive doctrine* they abide by (Rawls 1971, 1993). Also, politics can indeed be thought of as a specific, *institutionalized* activity (Crick 2004). When referring to this narrower idea of politics, I will speak of *conventional politics*.

However, if we talk about politics, we often also talk more generally about some process of decision-making of which the outcomes are somehow collectively binding (Luhmann 2000; Peters 2004; Weale 2004). It is the natural consequence of people being social beings: from couples to entire cities and nations, many of the actions people commit are either done in concert with others, or have consequences for others. Hence, those actions will be subject to collective decision-making. Politics is what emerges if something is at stake, notably in relation to social values. This is not to say that this politics is always democratic, or somehow justified in how (the majority of) the populace believes things should be arranged. Politics can also be hegemonic, dictatorial, or conflictual, and it has even been argued that contestation is crucial to any functioning form of politics (Mouffe 2005, 2013). What unites these notions of politics is that any member of the community is bound by the emerging rules. Politics is, for now, best understood as the pursuit of collectively binding decisions in a context of power differences and conflicts of value interests.



Following Brown (2014), two questions emerge here. First, how does something create *matters of concern*, dealing with which must be reckoned as political? This is the object sense of politics: it is something we do politics on. One example is that any modern society will have members that want to have a smaller state and lower taxes, as well as members that want a larger state and higher taxes. Decisions on what should or should not be the concern of the state are thus clearly matters of concern that require politics. Alternatively, one could think of the influx of African and Middle-Eastern immigrants that Europe is currently facing. Regardless of how small or big immigration and possible problems in its wake really are, the issue sparks concern among many and is readily mobilized by some politicians and media. This makes it political, which in this case is not clearly connected to how things are in any objective sense.

On a side note, an important aspect of matters of concern, elaborated by Noortje Marres (2007), is that these matters of concern unite and even create publics, and thus form a vital element in the emergence of politics. This means that even if we see an object as something on which politics is 'done', it is never *just* something on which politics is done, but always something on which we came to do politics through specific histories, fraught with interests and power relations.

The second question that emerges is how something potentially becomes a *site of politics* in the sense that the prioritization of alternatives becomes a matter of negotiation, power, and possibly conflict. This is the subject sense of politics: something comes to play a part in the process of politics, or the process of collective world making. Again, a straightforward example is the fact that parliaments and ministries take and enforce decisions that matter to the public at large, and produce the world in which the public lives. An example that often stays under the radar is the fact that history education in primary and secondary school usually appears as a mere conveyance of facts regarding the past, while in fact it serves an important role in the production of nationhood and citizenship. Thus, history education is quintessentially political in the subject sense.

The potential to create publics (Marres 2007) already hints at the subject and object senses sometimes being hard to distinguish. Yet, things can also contribute to politics without becoming an issue, or a matter of concern. For example, the aforementioned example of social media that shape how certain forms of information (and a lot at that!) comes to us, also entails that the information on which we base our political positions might somehow be skewed. Politics is 'done' *in* those media which thereby become a site of politics, without their being explicitly *objects* of politics.

Posing these questions specifically about engineering will be central to the following sections. The reason we have to engage with these questions is that engineering practices are not necessarily open to participation by all. If we accept that engineering and its products might be political in either an object or a subject sense or both, and we observe that not all people are members of the engineering practice, than we have *de facto* something political that is not generally accessible. This means that a certain realm of politics is kept outside of public reach, entailing that it cannot (straightforwardly) be called to account, and that the public cannot (straightforwardly) participate in decision-making processes that concern them. In short, we might be facing a *democratic deficit*; a place where politics fails to be democratic politics. This is the whole point in exploring engineering as a political practice. Things that engineering practices may impose on the broader world may call for some form of democratic, political control.



## 3. Engineering as a Practice

To think through engineering as a political practice, the notion of practice needs to be developed first. Various notions of practice exist (MacIntyre 1981; Schatzki 2012), and a conclusive definition is beyond the scope of this chapter. A number of shared properties, though, can easily be distilled. To begin with, a practice is essentially social: the practice consists of human members. These members engage in relations and interactions. Second, these relations and interactions are structured according to norms: some things are accepted and others are not. Norms are taken in a broad sense here, ranging from unreflexive routines to deep moral concerns, from mundane habits to heartfelt traditions, and including agreements, standards, etc. This is not to say that all members of the practice will agree on each and every norm, but there is sufficient shared normativity to bind the practice together.

While these first two properties of being 'social' and 'norm-based' could also be said about society at large, the third one sets practices apart as a more specific level of aggregation and analysis: practices are defined as sharing an activity or set of activities that are oriented to some commonly understood good. This means the celebration of religious beliefs for church communities, the pursuit of elegant and winning play in football, and the creation of working, efficient, and elegant technologies in engineering. This shared notion of a specific good entails that the practice has more or less clearly defined boundaries. This notion of practice is mostly associated with MacIntyre (1981) but also resonates well with how De Vries (2007) conceives more specifically of technoscientific practices (see later in this chapter). Also, it needs to be said that with Schatzki (2012), a practice is principally open-ended, meaning that it consists of the things people actually do; it is not something that is closed and scripted *a priori*.

What exactly circulates in engineering practices merits further attention, as it helps explain how it is or is not political (in either subject or object sense). The *goods* pursued in engineering practices are informative here. While the question of what makes good engineering can be expanded *ad infinitum*, some core concerns are accepted across large swaths of engineering ethics. The first virtue of engineers is generally taken to consist of making contributions to the common good, and more specifically, engineers are tasked with *solving problems*: 'resolving an undesirable condition through the application of technologies' (Sheppard et al. 2006). Note the convergence with the earlier observation that engineering is kept exempt from politics by appeal to its arguable contribution to the common good. The point here is that this is not only an argument mobilized instrumentally to the outside of the practice, but also something that we may presume to be heartfelt among engineers themselves. (See also Part VI of this *Handbook* about norms and values in engineering.)

Another generally recited virtue of engineers is the safeguarding of the public from harm (Harris 2008). As this connects to the obligation to deliver good and working technologies, it follows that engineers should master relevant parts of mathematics and natural and engineering sciences and develop a sensitivity to the risks that may emerge as the consequence of the technologies they build (Harris 2008). Also related is the norm expressed by many engineering codes that stipulates that an engineer shall never accept an assignment for which s/he is not qualified (e.g. IEEE 2006, art. 6, KIVI Engineering Society 2018, art. 6; see also Chapter 43, "Professional Codes of Ethics" by Michael Davis, this volume). In fact, this constitutes a direct connection to conventional politics outside the practice: in many countries, the state has the possibility to attach consequences to a violation of these principles, up to the level of withdrawing licences.

So far, we have been talking of the norms that *guide* engineering. That is still something different from what *happens* in engineering. What is it that circulates in engineering practices? What is engineering done upon, and what means does it use? If we want to further understand how engineering is or is not political, following the things that circulate in engineering provide insight into how the processes may be political: what kind of interactions and negotiations take place. This offers a more dynamic and conflictual view, and more politically substantial at that, than the guiding values that only abstractly provide the direction for engineering practices.



The very first thing that should draw our attention is the *knowledge* engineers have. Obviously this consists of a good dose of natural-scientific knowledge, but it also extends well beyond that: knowledge about solving design problems, about technical norms and standards, about economics, about legal matters, and about translating clients' desires into technical specifications (Dias de Figueiredo 2008; Meijers and De Vries 2013). Indeed, one of the key reasons we need the whole notion of practice lies in the observation that the activity of *knowing* is not merely an individual affair, but something located at a higher level of organization, namely the practice (Reich et al. 2014).[3] (See also various chapters in Part II of this *Handbook* on engineering reasoning.)

Shifting our understanding of knowing to the higher level of practice allows for it to include non-human parts. In particular, the role played by material entities in practices has been articulated (Shove 2017). Models, even if their 'materiality' in a very strict sense is limited when they exist only as mathematical equations, perfectly fit this idea. The use of models is deeply ingrained in the engineering way of knowing. Models are to be understood broadly here (Frigg and Hartmann 2018): not only literally scale models of envisioned or existing technologies, but also theoretical models, sets of mathematical equations that represent systems, and computer programmes that simulate technologies. Models are utterly diverse in both form and application. They are used to represent reality, to represent theories, to test designs at a smaller scale, and to partially test theories while leaving out part of reality (idealization), to mention a few applications. People might also learn from models and conduct experiments on them.

One thing that models have in common is the fact that models allow for certain ways of thinking and solution-finding, and eliminate others. Much like how problem definitions determine what is

and is not part of engineering, models pre-structure the kind of outcomes engineering can produce. Hence, the selection of models is ultimately not a politically neutral affair. Also, models amount to both an abstraction and a simplification of the real or envisioned system they represent. As will be argued later, this contributes to the *decontextualization* of technology design, which serves its positioning as non-political.

One other important class of things that circulate is made up by the *problem definitions* of engineering. We may have an intuitive notion of what typical engineering problems are, and within this notion, a virtually endless range of problems is likely to fit. Yet, problem definitions are subject to more criteria and negotiations than only the fact that 'they can likely be solved through technological innovation'. For example, it is controversial whether engineers should lend their efforts to further exploiting fossil-fuel resources. Some will say this is 'just' a technical issue that is secondary to decisions made regarding fossil-fuel use in political institutions (in the conventional sense), and hence unproblematic for engineers to take up. Others will argue in contrast that this challenge should not be considered a qualified engineering problem, because fossil-fuel solutions should (arguably) not be further pursued. The politics of engineering already looms here, in the sense that negotiating what world we want to build is operationalized into what kind of engineering we want to do.

Another thing is that engineering practices are typically characterized by division of labour (Sheppard, Colby et al. 2006). An engineer working in the automobile industry will never 'design a car', but rather develop a new head rest, or decrease the susceptibility to wear for a specific part of the engine. This means that the problem definitions an actual engineer faces are in fact partial problem definitions. This entails that the individual engineer will have only a limited perception on how their work relates to the context of use.[4] This contributes further to the decontextualization that is characteristic of engineering ways of thinking.



This decontextualization complements the following. Engineering is of course not done only for its own, internal sake. Engineers produce technologies for the broader world. This connectedness to the outside is not just some boundary phenomenon at the fringes of the engineering practice, but definitive of the practice as a whole. Engineering is essentially what in common parlance would be termed an *applied* form of knowledge work. At the same time, this connection to the outside world is anything but trivial: where the boundary exactly is remains contestable, and what crosses the boundary in terms of problems, solutions, tenders, payments, contracts, is highly heterogeneous. Indeed, a sensitivity towards this social connectedness is considered one of the goods that circulates in the practice of engineering (Harris 2008).

## 4. Internal Politics: The Objects of Engineering

We need the notion of practice from Section 3 because it allows us to direct our attention to how the content that circulates may or may not be political. From the two senses of political discussed earlier—something being an object we do politics on, or something being a subject that acts in the process of doing politics—we can already glean how what circulates in engineering practices is potentially political. In the object sense, the aforementioned problem definitions, models, and epistemologies that circulate are political. They are the result of choices, and as such are potentially subject to negotiations and power relations. Also, they have potentially ground-shaking consequences, as they lead to inclusion and exclusion, to redistribution of power and wealth, and at the fundamental level to which conceptions of the good life are and are not facilitated by the technologies we build.

In the subject sense, all parties that contribute to setting the problem definition are involved in this politics. These include engineers but also potentially all other actors that matter to the issue. Ultimately, they may also include non-human entities, such as laws, institutions, and technologies; these may have far-reaching consequences for what kind of technological world we ultimately build. While this may appear far-fetched in many cases, it is less so in others. For example, standards, once

they have been set, have a strong influence on inclusion and exclusion of what innovations are possible. And, as standards themselves may require revision, they determine at which pace innovations are even possible (Egyedi and Blind 2015).

Regarding this very political content itself, De Vries (2007) has argued that much of the writing about politics and science has too unreflexively talked about the political as something just being there, as though it were available from some reservoir of political problems that we can pick and choose to engage with. Rather, De Vries argues, we should think of the political as itself being constructed and continually modified, and constituted through its very interactions with members of a practice. The question in relation to engineering practices then becomes whether and how what circulates in engineering practices becomes *constructed as* political through the interactions in the practice.

In the Section 3 discussion of engineering as a practice, a number of circulating things were mentioned: epistemologies, models, and problem definitions, to mention the three taken as central. However, contrary to the plea by De Vries (2007), we have just assumed these to be political from an external perspective. While this may rightly articulate the political *potential*, it does not say anything about these circulating things being (constructed as) political in its real context. If we accept the idea of things being constructed as political, then what is it more specifically that helps construct epistemologies as political? Or models, and problem definitions?

The point is: they are usually *not* constructed or enacted as political, but rather the contrary. Most of these things are made to circulate under guises other than 'politics'. Problem definitions are staged as 'what the client desires', or as 'optimal solutions' in the light of specific criteria. In the selection and development of models, choices are necessarily made, but these are not likely to be connected explicitly to ideologies and power relations, but rather to notions of accuracy, elegance, and usability. And epistemologies are not even explicitly constructed in the engineering practice itself, but are largely thought of as taught in engineering schools, and moreover related to some objective methods of truth-finding.



Interestingly, the only thing that seems constructed 'as political' within the engineering practice, is 'the politics that is kept out'. Thus, the only thing explicitly political is the notion of ethics and politics itself. It serves as a rhetorical counterpoint to what engineering is. If things are politics, they are not the work of engineers. What is more, the aforementioned codes of conduct may potentially serve as a device to pacify issues: once values are condensed into seemingly unambiguous principles, it may become harder to discuss the ways in which they are equivocal (Martin and Schinzinger 2010 [2000]). This means that moral considerations are in some sense put outside the realm of negotiation. At least in appearance, they become 'fixed'.

This approach to the internal politics of engineering as constructed indeed suggests that the objects may also be constructed as 'a-political'. This is compatible with De Vries's point, if we take it to be symmetrical. Indeed, even if defining something as non-political is essentially a political affair, this does not render it any less a 'construction of the a-political'. That this is perhaps the most relevant part of the politics of engineering will indeed be discussed in the penultimate section of this chapter.

## 5. External Politics: Engineering as Society-Building

The potential political character of engineering is fundamentally connected to what happens *outside* the very practice of engineering itself. As argued earlier, if we want to understand how engineering is political, we need a broad understanding of politics as the progressive composition of the world (Latour 2004; Luhmann 2000). Before engaging in the next section with how problematic this demarcation between inside and outside of the engineering practice is in relation to the distribution of politics, it first makes sense to articulate how engineering is political in the broader world, regardless of whether or not that broader world can be distinguished from engineering in any meaningful way.

Even starting from a comparably narrow understanding of politics as pertaining to arranging the basics of society, it is only one step to seeing how engineering contributes to basics that matter: modern life is unthinkable without infrastructures, production technologies, communication and information technologies, etc. While much of this is formally privatized in capitalist societies and hence outside the reach of what is generally called politics, this is not at all self-evident. Endeavours of engineering have contributed to the normalization of large-scale animal farming, and the mobility paradigm based on cars that are now inextricably tied up with the right to eat and the right to move—to mention only two things that can straightforwardly be reckoned as objects of politics. Mind that there are also modes of transport that are in fact *hampered* by the automobility paradigm—all the more reason not to think of the latter too simplistically as a matter of free choice or free markets.

In line with the general idea of structuration (Giddens 1984), which holds that social structures are at once determining our actions and themselves the consequences of our actions, it can be seen how technologies are both human made and have important consequences for human life. The moment that cars became available, they emerged as an add-on to existing mobility paradigms. But as they gradually became pervasive throughout society, they became the new standard of personal mobility, and what is today for example expected in terms of home–work commuting at least puts some social pressure on the arguably free choice of where to live and where to work. Similarly, the argument has been made that the mere existence of *preimplantation genetic diagnostics*—indeed, a human-made technology—may lead to social pressure on prospective parents to eliminate in specific cases the possibility of giving birth to a child with a disability, which is thus displaced from the realm of 'chance' to the realm of 'choice' (Buchanan et al. 2000; Cameron and Williamson 2003; King 1999; Scannell 2002).



What is more, technologies keep carrying the traces of the context in which they are made: the normativities that rule the context of design are *inscribed* in those technologies (Akrich 1992). For example, if diversity is lacking in the context in which technologies are made—which has traditionally been the case in engineering practices (Franzway et al. 2009)—it is likely that technologies are designed with imagined users in mind that are only representative for part of society, not its whole. This happens, for example with male-dominated Silicon Valley (Corbyn 2015, 2018), where technologies are created that are allegedly based on a too-narrow experience, and that provide a poor match with the society they are to serve (Wajcman 2016). Here, a first hint at a *democratic deficit* emerges: those close to the fire of technology-making have a better shot of getting their normativities inscribed, which may lack justification for them to be imposed on the broader society.

At the same time, the ability of technologies to convey normativities outside the engineering practices should not be treated as a fixed given, but as something that is up for negotiation. As Orlikowski (2000) argues, fixation of social structures through technologies only works if people in fact abide with those structures. Instead, they can also opt for insubordination and seek to alter the structures into which they are seemingly forced. Insofar as we are concerned with the responsibilities of engineering practices to provide society with technologies that are 'good' against some criterion of societal desirability, this concern should also include the negotiations that are still possible *after* a technology design has seemingly been completed. For example, people today can still live a life without a car or without preimplantation genetic diagnostics. Hackers come up with solutions to use technologies, such as allegedly privacy-invasive social media, in different and more privacy-compliant ways. And in every workplace, one can find laptops with sticky notes covering their webcams, because their owners refuse to live by imposed paradigms of visibility.

These connections to the world outside engineering practices potentially substantiate the aforementioned *democratic deficit*: issues that should somehow be contained by properly organized political processes, but are not. In an extreme form, this could be reckoned a *technocracy*: a political system in which decisions are determined by expert knowledge and the position of experts in a technocratic system, where moral worth is replaced by calculation, and where important social relations are fixed

by technological relations (cf. Collins and Evans 2017; Feenberg 1999; Habermas 1968). In a less extreme form, such considerations underlie approaches such as *responsible research and innovation* (to be discussed in the concluding section), *constructive technology assessment* (Rip et al. 1995), and *scenario studies* (Wright et al. 2013), each of which in their own way aspire to connect technoscientific knowledge processes to sociopolitical knowledge processes (where, again, the boundary between those classes is itself a topic worth studying).

Once we understand that engineering knowledge is essentially incomplete regarding the application context of technologies, and that this incompleteness can only to some extent be remedied by the aforementioned strategies of democratization, it follows that engineering is fundamentally an experimental attitude to the broader world (Martin and Schinzinger 2010 [2000]; Van de Poel 2016). This experimental nature is even more strongly felt if the technology is itself inherently risky and uncertain, as Van de Poel (2011) discusses in the case of nuclear energy technology.

## 6. The Non-Politics of Engineering

Given the clear political implications of engineering in the previous section, and the political activities within engineering in the section before that, one might wonder why it is the case that we do not naturally think of engineering as a political affair. We do not typically find engineering matters in the politics sections of newspapers. People studying political science or political philosophy do not naturally think of engineering and technology as their object of analysis. And when asked what a politician does, most people will not answer anything along the lines of 'well, building bridges and powerlines, or anything else an engineer does, too'. Why is this?

The first answer here is that it seems not entirely nonsensical to think of engineering as the practice of putting nature's laws to work. The question of *what exactly* technology is, is often answered with 'tools that support human action'. This thought is also known as *technological instrumentalism* (Feenberg 1995). Also, the thought of leaving engineering to engineers and politics to politicians seems in itself not a nonsensical thought—even though it has extensively been shown in the scholarly literature that such a strictly neutral vision of technology is not tenable. In fact, most people can easily come up with examples of technologies indeed not being innocent, and technologies not being exactly neutral with respect to the kinds of lives people can live with them. Still, the idea that natural laws are independent of what we do politically seems hard-wired in society.



A second answer is that many parties involved have an interest in acting *as though* engineering were something radically separate from politics. Appeals to technological instrumentalism often surface when questions of the responsibility of engineers emerge. Engineers can arguably do their work best when it is not impeded upon by complex, political considerations. This suits engineers fine, and it is also convenient for politicians that they can exclude a certain practice from their realm of concern.

Yet, there is nothing natural or logically inevitable about this division of labour, of engineers doing engineering and politicians doing politics. In fact, the boundary where engineering stops and the social, political world begins is a construct, and the process of constructing the boundary is itself essentially a political process. One of the things that happens in such processes is that the genesis of technologies tends to become invisible once the technology moves from the design table to the context of use: it becomes a black box (Latour 1987, 1993). And if all the human relations that in fact went into the construction of the technology have become invisible, then indeed it requires a fair amount of critical thinking to remain aware of how the technology can be seen as political, rather than 'natural laws in a box'.

One further step of inference is that if we accept that the boundary between the inside and the outside of the practice of engineering is not self-evident, and if we accept that relevant actors on both sides of the divide have an interest in the boundary appearing as self-evident, it becomes clear that it is in fact a political move to define exactly *what* engineering is in relation to non-engineering.

Ironically, this boundary is then used as a foundation of defining what is neutral. At the same time, this neutrality is used to justify the existence of the boundary.

## 7. Towards a Good Politics of Engineering

Notwithstanding the persistence of instrumental visions of technology and the ensuing vision of engineering as—neutral—applied natural science, the political aspects have clearly been articulated and attempts have been made to reconnect engineering and the political. For example, new social movements have played a crucial role in politicizing technical domains that liberal discourse had formerly isolated from the scope of politics (Thorpe 2008).

Over recent years, the notion of *responsible research and innovation* (RRI) has gained currency. The most commonly referenced definition is the one by René von Schomberg (2011), which holds that RRI is a process by which societal actors and innovators become mutually responsive with a view to the ethical acceptability, sustainability, and societal desirability of the innovation process and its products. This conception reflects the very idea that science and technology cannot be seen apart from the effects they have outside the practices of research and development. Therefore, the external political relevance must be somehow connected to the inner content of those very practices.

A fundamental challenge to overcome here, which looms more clearly if we see engineering as a *practice*, is the fact that a practice comes with a particular *epistemology* or theory of knowledge. This means that knowledge alien to that practice is likely to be dismissed as irrelevant, unsound, or even irrational. Thus, if we want to connect the outside and the inside of the practice to aim at mitigating any democratic deficit, then considerable thought will have to be spent at connecting incompatible knowledges from different epistemologies. Concretely, how will a conversation take shape between an engineer thinking in terms of design criteria, and a politician thinking in terms of interests and ideologies?



One of the more practical ideas is to democratize the *agenda* of programmes of innovation. This would democratically provide direction to innovation practices. However, here the same incompatibility of knowledges potentially plays out. If the broader public is invited to contribute to the agenda, then it matters who makes the invitation, as a way of putting it. If the invitation comes from the engineering practice itself, it is likely that engineering epistemologies will provide the framework in which the agenda is discussed. This renders the broader audience at a disadvantage at best, and at worst puts it in a *de facto* excluded position. If the process of democratic agenda setting is initiated from elsewhere, for example from political institutions narrowly defined, then it risks remaining anathema to engineering practices. In a general sense, the process of agenda setting is not by itself neutral with respect to different sorts of knowledge. Such processes thus require experts in transdisciplinary research and efforts of translation.

It is vital for members of the engineering practice themselves to remain aware of these differences, and of the fact that their position comes with specificities that have sociopolitical consequences. The nature and boundaries of the practice of engineering cast a specific light on the ethical considerations typically reflected in professional codes: realizing the relevant values is not only a matter of individual responsibility, but also a matter of dealing with collective identities, collectively enacted separations between the inside and the outside of the practice, and with ensuing power differences between inside and outside. Insofar as engineers are already held to a *noblesse oblige* because of their mere privileged knowledge position, they are even more held to this because of the social structures that carry this position.

The concerns raised in this chapter connect to broader societal problems such as racism, sexism, and classism. Engineering as a practice is actively constructed, with its boundaries and its internal and external politics. Not the least, this is to construct and reproduce 'who gets to do engineering'. This means that the correction of many societal problems and many emancipations of subordinate groups

will come with making technologies such that they counter those problems, which in turn requires that engineering itself becomes inclusive and receptive to those groups.

This chapter has discussed engineering at the level of practice. It could be argued that engineering should rather be discussed at the level of specific practices, rather than the somewhat abstract and rather generalized way we have done here. True enough, engineering practices are in fact highly diverse. However, most of these practices are in fact also highly internally heterogeneous in terms of the science and engineering disciplines that populate them and the problems they revolve around. Also, they will in practice differ widely on the external, sociopolitical influence they have. Yet, the framework in this chapter offers a good perspective to study them. On the one hand, the abstract properties discussed here are most likely to pertain to each of them, at least to a certain extent. On the other hand, this is only a starting point, and what these properties mean for concrete practices remains to be further specified, and continues to be a valuable object of empirical analysis.

## Related Topics

Chapter 40: Ethical Considerations in Engineering (Wade L. Robinson)
Chapter 43: Professional Codes of Ethics (Michael Davis)
Chapter 50: Engineering and Social Justice (Caroline Bailly)
Chapter 51: Engineering and Environmental Justice (Benjamin R. Cohen)
Chapter 54: Engineering Practice From the Perspective of Methodical Constructivism and Culturalism" (Michael Funk and Alfred Fritzsche)



## Further Reading

Feenberg, A. (2017). A Critical Theory of Technology. In U. Felt et al. (eds.), *The Handbook of Science and Technology Studies*. Cambridge, MA: MIT Press, pp. 635–663. (An overview of critical theory of technology and the critique of rationality in modern culture.)

Leftwich, A. (2004). *What Is Politics? The Activity and Its Study*. Cambridge: Polity. (An edited volume providing a comprehensive introduction to various theories of politics and the political.)

Martin, M. W. and Schinzinger, R. (2010 [2000]). *Introduction to Engineering Ethics,* 2nd ed. Boston: McGraw-Hill Higher Education. (An introduction to the ethical problems that are typical for engineers to encounter, with approaches to dealing with them.)

Schomberg, R. (2011). *Towards Responsible Research and Innovation in the Information and Communication Technologies and Security Technologies Fields*. Brussels: Directorate General for Research and Innovation. (A manifesto on how innovation should be positioned not as something separate from society, but as something intrinsically connected to society and its democratic governance.)

## Notes

1. A narrower definition of agency, strictly linking it to *intention* and thereby limiting it to *human* agency, is central to debates in philosophy of mind, starting with Anscombe (1957) and Davidson (1980). This is, however, beyond the scope of this chapter, and the current broad understanding of agency is apt for the present argument.
2. The example centres on low bridges that only let through rich, white people travelling by car, and not poor, black people travelling by bus. The example has later been invalidated (Joerges 1999) and so must not be taken as an historical account, but as an illustrative exploration of how material, social, and political worlds can be thought to conflate.
3. See also Meijers and De Vries (2013), though the point is not couched in terms of practice there.
4. Mind that this is in fact not a matter of scale, and of engineers working at higher levels of aggregation (entire devices or even composite systems and global networks) having a better view of the context of operation. Rather, each view is partial because of the networkedness of engineering. For example, engineers working at the systems level will have a poorer view of the micro-interactions between individual persons and system elements than human-technology interface designers have.

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