Acta Baltica Historiae et Philosophiae Scientiarum
Vol. 8, No. 2 (Autumn 2020)
DOI : 10.11590/abhps.2020.2.09

SHORT COMMUNICATIONS

Overcoming Substantivism-Determinism with Pragmatist Philosophy of Technology

Carl Sagan (1990) famously lamented how "we live in a society exquisitely dependent on science and technology, in which hardly anyone knows about science and technology. This is a clear prescription for disaster". One might add that in contemporary societies, people know about the *philosophy* of science and technology even less. This tends to include scientific experts just as well. Is *this* a prescription for disaster? Scientific and technological literacy alone will not salvage us from ourselves for the simple reason that "science, by itself, does not supply us with an ethic" (Russell, 1993[1950], p. 406). Any clarity concerning the value and the meaning of these terms can only be had after one has thoroughly examined the deep networks of causes, influences and their general implications that hide behind superficially observable phenomena produced by technological innovations.

A useful and widely referred method aims at capturing the wide variety of conceptual approaches to technological change. It takes the two polar couples, substantivism and instrumentalism on the one hand, and voluntarism and determinism on the other, to define the important conceptual chart onto which important philosophical characterisations of various technologies and their evolution and impact can be mapped.

In this conceptual chart, along the *y*-axis is the pair of substantivism (pointing to the north) and instrumentalism (pointing to the south). *Substantivism* views technology as an "agency", with an exclusive power to influence the context in which those technologies are designed, produced, transferred and variously applied. Evolutionary biologists might evoke images of "niche construction" and "extended gene phenotypes" as working analogies: population–environment pairs define the meaningful units of selection, co-evolving and catalysing each other's adaptive advantages in the fitness landscape that calls for skillful anticipation and collective coordination of activities. In such organically conceived substantivist philosophy of technology, ends are connected to means in a complex, exploratory fashion, full of unexpected outcomes waiting for us at every turn. Technologies are autonomous cultural and human forces whose changes are more significant than the ostensible or explicit instrumental goals of technology. Instrumentalisation of things has become the instrumentalisation of man, in the spirit of Ortega y Gasset's (1932[1929]) grand vision pronounced nearly a century ago. Whatever the end may be, there are various and far from optimal routes to be met by which one tries to make those ends meet by a messy and tedious process with huge budget overruns. Unsurprisingly, substantivism also subscribes to the presence of substantial ethical issues involved in technology change. Those changes can be for good just as well as for bad. No claim made on behalf of technology has a fully neutral, value-free content.

A somewhat stronger version of substantivism takes technology as a form of culture (or, even stronger, a "cult") that exerts various influences and control on human collective and individual identities, on our personalities and cognitive maps wired by our brains. Humans, in this view, are not in charge of what those changes are going to be. Extreme substantivism of the far north defines the real meaning of technology as an "unhuman system" that adapts humans to its own ends and purposes. The result may be the one giant, although well-intentioned, paperclip equaling the size of the observable universe, produced by the ultimate optimisation algorithm by an exponential AI tech.

Narratives of such extreme forms appear in popular culture just as much as in the popular books written by academicians during their undersized sabbatical leaves. The low levels of critical thinking involved in such claims should not diminish the value of moderate substantivism in the least, however, which after all may well be the most defensible position in the philosophy of technology. It has a solid evidential status without too many concessions made to its rival of *instrumentalism*. For according to the latter, the meaning of technology is to be found in its "tools" (or perhaps in the subclass of "artefacts" or the superclass of "instruments"; cf. Dipert, 1993); tools that are to be are "used" by their "users" in a passive fashion, following the instructions printed on the accompanying manual. Means and ends are separate and need no particular attention in the design and innovation phases; after all, no specific normative implications are to be expected from learning how to toast the toast with the toaster.

A stronger and infinitely more interesting claim made on behalf of instrumentalism is in its implication that "switching-off" and "now stop cuddling your smartphone" are genuine human options. A new term 'nomophobia' was recently coined to identify irrational fears of losing one's smartphone (Bhattacharya *et al.*, 2019). The condition is now clinically diagnosable and may need therapeutic interventions just as other anxiety and OC disorders of the same severity degree do, such as noso-, myso- and oikophobias. Yes, offloading certain cognitive tasks to the pocket-sized supercomputer may free us from many menial tasks, but at once consumes our cognitive bandwidth at other frequencies, including obsessive and continual worry about the real content of that pocket. Rapidly accumulating evidence blaming social media on social alienation, anxiety and depression is "compelling", according to Facebook's Director of Research David Ginsberg and research scientist Moira Burke. Users who clicked more likes and links on Facebook reported a reduced sense of their own mental health. Smartphone-related social media use releases bursts of dopamine and endorphins faster and more efficiently than sex, alcohol or psychopharmacological accessories do. Jury is no longer out on this. Indeed, Zuckerberg has been honoured no less than the title of the most dangerous person in the world (Ord, 2020), the title only to be inherited by the CEOs of whatever TikTok 2.0 arises next that offers zero friction for the next clip consumption by hundreds of millions of young users within days. Big Tech has launched global non-randomised, uncontrolled global social trials to hijack as many limbic systems as possible, without asking anyone's consent, to extract maximum attention time from precision misinformation campaigns. Even when they have gotten genocidal, their experiments are allowed to continue without anyone even having begun drafting regulatory stopping rules.

The position of instrumentalism may resonate well with the comforts of our default mode network, but even a moment's reflection should reveal that characterisation of instrumentalism as "the common sense" conception of technology does not do justice to the naïveté of its "guns don't kill people, people kill people" rhetoric. Such enthymemes are either empty or positively harmful. Does the slogan mean, as someone had put it, that "guns don't kill people, college admission rewards to pretty girls do", or that "if toasters don't toast toast, then toast toast toast"? Is it consistent to claim that playing violent computer games does little harm to an adolescent psyche, whereas Zoombinis and Zoom lectures are emphatically educational?

On the *x*-axis of the agora of technological change is the characterisation of technology between the polarities of voluntarism and determinism. According to *voluntarism*, technology is what humans, collectively or individually, choose it to be. Human users are autonomous agents that decide upon what the developmental paths are that technological enterprises will take, ultimately determining what their (and our) shelf lives are going to be. The changes technology inflicts upon us are filtered through human will and oversight. I shall return to this point Qanon.

Last, the position of *determinism* may be the most interesting of all, not only since it stands in such stark opposition to those enlightened minds that grew out of libertarian ideals. Technology, it claims, works according to its own laws and behaviour (Smith & Marx, 1994). Not human, not biological, but something quite different. Depending on the details of such rules, principles or law-like regularities, technology may even be the driving force of civilizational progress. Societal changes do not happen because of autonomous changes in people's habits of behaviour, but because of the antedating changes in the nature of technology. Technology has already changed us before we get to have a chance to change our general patterns of behaviour and thought.

* * *

What kinds of codes and principles then characterise technological change from within? Melvin Kranzberg (1986) famously proposed a set of rules or laws that could be taken as a basis of attempting the characterisation of the inner logic of technological change. It involves six general clauses: (1) Technology is *neither just good or bad*, nor is it neutral. (2) *Invention* is the mother of necessity. (3) Technology comes in *packages*, big and small. (4) Although technology might be a prime element in many public issues, *non-technical* factors take precedence in technology-policy decisions. (5) All history is relevant, but the *history of technology* is the most relevant to the progress of human societies. (6) Technology is a very *human activity*—and so is the history of technology.

Do these principles—arguably not so precise as to really be called "laws" or even law-like "regularities"—result in behaviour consistent with determinism? The first rule is a statement of anti-instrumentalism. It is hardly in dispute. The second clause is borrowed from Thorstein Veblen (1899), the first institutional economist trained by Charles Peirce and others in the tradition of American pragmatism. The third rule expresses a truism, too, as Kranzberg admits upfront; from the Bigs of the global satellite navigation whose atomic clock signals precision our civilisation has become wholly dependent on, to the smalls of the millions of tech start-ups that never got off the ground within their first six months of existence. The fourth is a more substantial one, calling for a consideration of a number of issues, including the meaning of pure v. applied science, the epistemic status of knowledge involved in the process of technology, science policy making, and the fiscal, governmental and psychopathological issues to do with securing competitiveness and innovation. Selection processes that focus on manufacturing, marketing, consumer behaviour, legal and even those of ethical factors often eclipse 'pure technical success'—and for a good reason, as the latter remains seriously undefined: one would also need a precise explication of the cultural contexts in which technology was designed, introduced, assessed and transferred. At the end, the fourth rule is a rule of human social game-theoretic behaviour: suboptimal solutions arise out of the necessity of multi-polar Nash Traps, as it is always in *your* best interest to defect from coordinating actions across the board. Technological development and arms race are nearly synonymous. The Rule Five, in turn, reminds us of significant historical baggage involved in all technological innovations. Without sufficient recognition of that baggage, progress might relapse into retrogression. This is a rather explicit recognition of technological determinism.

Some may feel equating technological progress with ever-greater happiness, but that is to set before us a pernicious precedent of *argumentum ad novitatem*: a standpoint that feels like movement, like glaring out of the window of a moving train. Such Myth of Progress (Von Wright, 1993; Bouveresse *et al.*, 2011) is pernicious, since as soon as such *Fortschritt* is accepted as our shared collective cognitive illusion, we become singularly incapable of tackling the super-zilla wicked problems[1] that are putting the future of our grandchildren at existential risk. The thinking that can tackle truly vehement issues has to de-infantilise from the levels it had at the time of creation of those problems.

Our moral values are revisited by every generation, and indeed Kranzberg's rules of technology are heavily reliant on human decisions. But this is also to introduce a significant normative complication to those rules and their internal coherence. A meaningful interpretation of those rules needs a position not primarily on the status of technological determinism but on human free will. This obviously complicates the matters, but also avoids the predictability issues to do with the emergent patterns that technology may take in the future. (Of course, it is not that deterministic laws have to *guarantee* predictability: in complex chaotic systems completely characterised by standard differential equations, predictability of the future states is easily lost.) The crucial issue is whether the human decisions are

[1] A 'super-zilla wicked problem' is a super-wicked problem that may be absolutely unsolvable, and not only practically, psychologically or technologically unsolvable. For them it could be that, in the order of seriousness, one or several of the following hold: (i) Time is guaranteed to run out before any solution; (ii) those who seek to solve the problem are also causing it; (iii) any solution to the problem is the cause of it without anyone ever coming to know or recognize that; (iv) any solution to the problem is the cause of two or more new such problems (the 'Hydra Problem').

voluntary and autonomous, expressing our free will according to which we *could have* decided otherwise. Or else, such reliance on free will has to go. The matter is important, since it is one of the presuppositions of technological determinism that it needs an internal characterisation which needs no appeal to human free will and may even be incompatible with it.

So what is the status and the role of free will in the argument? As far as we can currently tell, anti-free will arguments are gaining the upper hand. Our thoughts and actions are the outputs of the brain, of our "protein computer", which has got to behave according to the laws of nature. Thus our choices must obey those laws as well, and the *libertarian* idea of "free will" may not hold: our lives do not consist of a series of decisions in which we could have chosen otherwise. In fact, we probably can never do otherwise than we actually do, for the following reasons: Even though "I" (the self) has an impression of choosing among options, the laws of nature (among them our genomes, environmental history and social and historical events) make these choices predictable, at least in principle, by those laws. One need not add to this mix the admittedly interesting experimental findings on "predictive brains", which have shown that our becoming conscious of those choices is preceded by certain peaks in brain activity. Indeed, those processes may or may not be the representations of those choices as if done by conscious selves—the jury is still out on this—but all the same, our "feelings" or "experiences" of making such choices is a confabulation that evolves from those neural processes.

Could we, then, argue for technological compatibilism? Could we have both voluntarism and determinism? Could you have stopped thinking about the location of your smartphone, even if you actually did not? Could you have done otherwise than watch yet another auto-play recommendation chosen for you by AI-curated YouTube algorithms? Winner (1983) argued early on that, even under addictive conditions, one could in principle have done otherwise, and that determinism is thus not the right position. But this is a cop-out of the same calibre as compatibilism in philosophy of mind: even if no one put a gun on your head when your choose *watch* or *no-watch*, or lingered semi-consciously in the *what-the-heck-lets-keep-it-running* mode, the meaning of "free" equivocates as it is then defined much more narrowly as "our brain choosing something autonomously"—whether under the influence and control of some external or internal causes or not. Such actions are no longer "free" in the sense required by the voluntarist conception: the brain does what its neurons, genes and environmental conditions dictate it to do. We are not mentally autonomous beings: every thought arises from previous thoughts because of some antecedent neuronal, biological and environmental causes. Most of those thoughts emerge from spontaneous stimuli and from task-unrelated reasons. The mind wanders; signs beget other signs. Symbols grow, and "the self" that creates the experience of the choice emerges as the representative product of those complex influences.

Technological determinism does not free us from moral responsibility, one needs to add. Rather, it elevates our moral cognition as the sense of responsibility becomes heightened. We need not judge actions by scriptures from the illiterate past, but by the *consequences* of those actions according to what the impact is to the society and to our well-being. Maintenance of tolerable levels of social cohesion needs no free will behaviour: our illusion of being our own honchos is robust enough to keep on telling ourselves that we had real choices that were put before us.

The upshot is that, if the theory of the myth of cognitive agency is right (Metzinger, 2013; 2018), human determinism acquiesces to technological determinism. Since the former ascribes to natural and social laws, norms and regularities as the determinant antecedent causes of behaviour and choice, from substantivism it follows that technology affects those choices as well, contributing to those causes.

What is important is of course not the meaning of these individual terms alone and in isolation but their interplay. Their relationships give rise to the major conceptual classes of technological change. There are four such quadrants: voluntarism-substantivism (I), determinism-substantivism (II), determinism-instrumentalism (III), and voluntarism-instrumentalism (IV). Out of these, I have argued that determinism cannot be conceptually detached from substantivism, and thus some positions are not just anomalous or esoteric but inconsistent. Some have sought to locate future and emerging AI technologies in the third quadrant, as is the case with the rather apocryphal notions of transhumanism (Bostrom, 2005; 2010). The consistency of the arguments is nevertheless highly in question in these essays that oddly oscillate between the poles of collective apocalypse and eternal cosmic happiness.

* * *

Lacking consistent definitions of the outcomes of the conflicting dialectics of technology, one would do better when looking for the perspectives from the middle ground that enables distancing the vantage point away from the chart itself. This is to add a new dimension to it. To "make things work" v. "seek the truth" need not be contrasting but complementary perspectives. Latour (2005) has sought some such distancing in the actor-network theory; here, I propose *pragmatism* as another, and better one. According to *pragmatist* philosophy of technology, the meaning of technology is in its experimental effects. It emphasises the importance of modelling and design in the process. Unlike substantivism, which views technologies as autonomous cultural and human forces whose changes are more significant than the ostensible instrumental goals of technology, pragmatism does not espouse a passive perspective to technology. The same holds with respect to instrumentalism, which is similarly passive with respect to human users. We cannot step outside technology, to evaluate its changes from the outside, from the point of view of the mythical *given*. We are using technology *within it*, and that use defines the boundaries of our form of life, practices and inquiries that mediate the sense-making between technology and its continuous impact in the world.

Rather that supplanting the quadrants with something like Latour's actor-network theory, I argue that we better take a closer look at the chart. In the classical works of Charles Peirce, John Dewey and William James, pragmatism emerged as the method of inquiry of active agents. Although these thinkers all had their considerably different and original emphases, the following may be its characteristic attributes: (i) Action, practice, productiveness precedes the theoretical; (ii) Technology is an activity, and for that reason cannot be exported in any straightforward or non-residual manner; (iii) There is nothing 'essential' in the meaning of technology; and (iv) The meaning is in the experiential consequences of technology, not in the things and artefacts themselves. Among the important consequences of pragmatism is that the lack of innovation is not due to lack of resources but due to lack of right conditions and understanding of socio-cultural aspects of technological knowledge and its transfer. Importantly, technology is not applied science: science and technology *co-evolve*. This needs not only *technoscience*, however. Modern science and technology are mutually interdependent activities (recall that telescopes, microscopes, steam engines, etc. had no *immediate* scientific concern). Rather, it is the *techniques* and *practices* and their historical evolution that define the inquiry. External influences on a practice are the results of the interaction between practices rather than between individual personalities. This interaction is seldom a one-way influence; the habits and practices involved are subject to change in behavioural and discourse-level interactions.

Practitioners are those who "know how" something works in the context of the language-game of the products; vindicating Ryle that knowledge is irreducible to the endless series of "knowings that". The process of converting plans and engineering designs to functions is not an intellectual, instrumentally rational procedure (Faulkner, 1994). It involves procedural elements, meta-cognition and mastery of the strategic rules in the great game of sense-making and its discontents. This co-evolution is captured best when we aim at occupying and controlling the middle ground on the board of technological change.

Moreover, the fundamental precondition for technological innovations is the emergence of new communication methods. A living discourse impacts technology from within its cultures, with the hope that any speech act is positively illocutionary on those innovations, at least in the long run. Discourse that is not living and genuinely meaningful is the one whose primary purpose is to inflate the stakes of the Big Tech. But a meliorist is neither an optimist not a pessimist but an active inquirer in the universe of the truly Spinozian descent. Nothing is inevitable. Correctness of an assertion is not judged by the amount of likes it accrues on a digital platform. Technological change is fundamentally uncertain. The result is never fully clear. There are smaller and greater perfections to be attained in such complex evolving systems. What matters is the movement between those stages—the unfailing strive to fulfil our active *conatus* that desires to move from smaller to greater completions. This conatus is ever-present, stable against perturbations, and discoverable from within. There is a lot of substantivism in meliorism and pragmatism, it is true, certainly more than instrumentalism. There may be more determinism in it than voluntarism, too. But meliorism and pragmatism are irreducible to the passive stance of the second quadrant, which as a passive perspective is an uninspiring position for living inquirers who desire to contribute to the concrete reasonableness by which to effect desired changes.

* * *

As all conceptual models, the four-fold classification of technologies and their changes is itself a blueprint that can be developed and extended alongside evidence actually gained from the history of technological changes. Moreover, it should be interpreted as a metric chart ranging from moderate to extreme positions. In the very least, such granulation applies well to its *y*-axis. The elements of technology one aims to position to it are themselves dynamic, evolving and diachronic processes rather than dimensionless points with definite location, and therefore are subject to reinterpretations and transformative effects. Applying the pragmatist maxim of meaning to them is inevitable. Technology is a complex process of information, organisation, product and transfer, located in the continuum of economies, markets, politics and governance, societies, eco- and open systems that all behave in more or less chaotic and adaptable fashion. Its analysis calls for pragmatic sense-making methods as well as inverse, abductive types of reasoning that can help clarify the nature and magnitude of ill-defined and wicked problems, before various design processes and technological artefact production mechanisms are implemented to try out prospective solutions. Without appropriate and discipline-independent sense-making methods to the nature of the problems at hand first, the notion of a quick "technological fix" is an engineering daydream, a limbic System 1 response, making innovations appear as if they were products of an instrumentally rational procedure. In truth, however, the thoughts involved had arisen from similar neural processes as the peristaltic movement of our gastro-intestinal system.

Both James's extended and individualist remaking of pragmatism and Dewey's instrumentalism (Dewey, 1927; 1939; aptly renamed 'productive pragmatism' by Hickman, 1990, 2001) take their respective forays below the *x*-axis, in contrast to Peirce's communal and habit-based theory of meaning (Pietarinen & Gustafsson, 2017; Pitt, 2011). The latter is likely to stay above the surface of the *y*-positive quadrants. As far as philosophy of technology is concerned, pragmatism is a method of inquiry which, in its disdain for dichotomies and espousal of continuity of thought, is unlikely to stretch out to any of the extremities of the conceptual chart in question. Given the complexity of that human inquiry that we call technology, the truth of what its philosophical contours looks like is likely to emerge from such middle trajectories.

References

Bhattacharya, S.; Bashar, M. A.; Srivastava, A. & Singh, A. (2019), 'NOMOPHOBIA: NO MObile PHone PhoBIA,' *Journal of Family Medicine and Primary Care*, vol. 8, no. 4, pp. 1297–1300.

Bostrom, N. (2005), 'A history of transhumanist thought,' *Journal of Evolution and Technology*, vol. 14, no. 1, pp. 1–25.

Bostrom, N. (2010), 'The future of humanity,' in J. K. Berg Olsen, S. A. Pedersen & V. F. Hendricks (eds.) *Companion to the Philosophy of Technology*, Oxford & Malden, MA: Wiley-Blackwell, pp. 551–557.

Bouveresse, J.; Crebs, F. & Helgeson, J. (2011), 'Wittgenstein, von Wright and the Myth of Progress,' *Paragraph*, vol. 34, no. 3, pp. 301–321.

Dewey, J. (1927), *The Public and Its Problems*, London: George Allen & Unwin. In *Collected Works*, *Later Works*, vol. 2 (1925–1927).

Dewey, J. (1939), *Freedom and Culture*, New York: Putnam. In *Collected Works*, *Latter Works*, vol. 13 (1938–1939).

Dipert, R. R. (1993), *Artifacts, Art Works, and Agency*, Philadelphia, PA: Temple University Press.

Faulkner, W. (1994), 'Conceptualizing knowledge used in innovation: a second look at the science–technology distinction and industrial innovation,' *Science, Technology and Human Values*, vol. 19, no. 4, pp. 425–458.

Hickman, L. (1990), *John Dewey's Pragmatic Technology*, Bloomington, IN: Indiana University Press.

Hickman, L. (2001), *Philosophical Tools for Technological Culture: Putting Pragmatism to Work*, Bloomington, IN: Indiana University Press.

Hilpinen, R. (1993), 'Authors and artifacts,' *Proceedings of the Aristotelian Society*, vol. 93, pp. 155–178.

Heidegger, M. (1977[1949]), 'The question concerning technology,' in *The Question Concerning Technology and Other Essays*, transl. by W. Lovitt, New York: Harper & Row.

Kranzberg, M. (1986), 'Technology and history: "Kranzberg's Laws",' *Technology and Culture*, vol. 27, no. 3, pp. 544–560.

Latour, B. (2005), *Reassembling the Social: An Introduction to Actor-Network-Theory*, Oxford: Oxford University Press.

Metzinger, T. (2013), 'The myth of cognitive agency: subpersonal thinking as a cyclically recurring loss of mental autonomy,' *Frontiers of Psychology*, vol. 4, p. 931.

Metzinger, T. (2018), 'Why is mind wandering interesting for philosophers?' in *The Oxford Handbook of Spontaneous Thought: Mind-wandering, Creativity, and Dreaming*, Oxford: Oxford University Press, pp. 97–111.

Ord, T. (2020), *The Precipice: Existential Risk and the Future of Humanity*, New York: Hachette Books.

Ortega y Gasset, J. (1932), *The Revolt of the Masses*, London: George Allen & Unwin. [Originally published in Spanish in 1929.]

Pietarinen, A.-V. (2005), 'Cultivating habits of reason: Peirce and the logica utens vs. logica docens distinction,' *The History of Philosophy Quarterly*, vol. 22, no. 4, pp. 357–372.

Pietarinen, A.-V. & Bellucci, F. (2017), 'Habits of reasoning. on the grammar and critics of logical habits,' in D. West & M. Anderson (eds.) *Habit: Before and Beyond Consciousness*, Studies in Applied Philosophy, Epistemology and Rational Ethics (SAPERE 31), Dordrecht: Springer, pp. 265–282.

Pietarinen, A.-V. & Gustafsson, J.-V. (2017), 'Is ethical normativity similar to logical normativity?' in D. West & M. Anderson (eds.) *Habit: Before and Beyond Consciousness*, Studies in Applied Philosophy, Epistemology and Rational Ethics (SAPERE 31), Dordrecht: Springer, pp. 123–142.

Pitt, J. C. (2011), *Doing Philosophy of Technology: Essays in a Pragmatist Spirit*, Dordrecht: Springer.

Russell, B. (1993[1950]), 'The science to save us from science,' in M. Gardiner (ed.) *Great Essays in Science*, New York: Prometheus Books, pp. 399–407. [Originally published in *The New York Times Magazine*, March 19, 1950]

Sagan, C. (1990), 'Why we need to understand science,' *Skeptical Inquirer*, vol. 14, no. 3, pp. 263–269.

Smith, M. R. & Marx, L., eds. (1994), *Technology Drive History? The Dilemma of Technological Determinism*, Cambridge, MA: MIT Press.

Veblen, T. (1899), *The Theory of the Leisure Class: An Economic Study in the Evolution of Institutions*, New York: Macmillan.

Vincenti, W. G. (1990), *What Engineers Know and How They Know It*, Baltimore: Johns Hopkins University Press.

Von Wright, G. H. (1993), *Myten om framsteget*: *tankar 1987–1992 med en intellektuell självbiografi* [The Myth of Progress], Stockholm: Bonnier.

Winner, L. (1983), 'Technologies as forms of life,' *Epistemology, Methodology and the Social Sciences*, vol. 71, pp. 249–263.

Ahti-Veikko Pietarinen

Tallinn University of Technology