Design Philosophy Papers

Routledge
Taylor & Francis Group

ISSN: (Print) 1448-7136 (Online) Journal homepage: http://www.tandfonline.com/loi/rfdp20

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Design Philosophy Papers
VOLUME 1, ISSUE 3
PP 151–156

REVIEW

Wittgensteinian Mechanics

Review of Bucciarelli, *Engineering Philosophy*

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Books Received

The Design Way: Intentional Change in an Unpredictable World by Harold G. Nelson & Erik Stolterman, Educational Technology Publications.

The Politics of the Artificial: Essays on Design and Design Studies by Victor Margolin, The University of Chicago Press.

The Shape of Things: A Philosophy of Design by Vilém Flusser (English translation), Reaktion Books.

After-Images of the City edited by Joan Ramon Resina and Dieter Ingenschay, Cornell University Press.

Reviews will appear in DPP Issues no. 4 (Aug/Sept), 5 (Oct/Nov) or 6 (Dec).

Wittgensteinian Mechanics

by Graeme Byrne

This essay presents a review of Louis L. Bucciarelli's *Engineering Philosophy* (Delft University Press, 2003, available from the publisher info@library.tudelft.nl).

I was once a student within an engineering school that featured a strange image on one of its walls. Across a spacious canvas, electronic components had been painted with analytic rigour to depict similar, but individually eccentric, humanoid circuits. The result was a series of whimsical, some might say comical, stick figures. Intent on learning the arcane language of a technical specialisation, we sometimes felt we were being mocked. But if we chanced an experiment, our nerdy paranoia could have been assuaged. We should have matter-transmitted ourselves through the fence – for there was no direct path – to have re-materialised in the neighbouring art history department. Once there, we may have read it as a hopeful depiction of our fate. The painting by the Melbourne artist and structural engineer Edwin Tanner offered us a Wittgensteinian muse.[1] It depicted subjects enclosed by a specialised language. But given the similarities, it depicted the impossibility of an entirely private or enclosed language. Although local or specialised, language is inevitability shared but changeable and eccentric too.

This tension between the seemingly enclosed world of any expert and the necessarily communicative and social nature of design is a paradox explored by Louis Bucciarelli. Like Tanner, he is an engineer and takes Wittgenstein as a philosophical starting point. He also has a wealth of inter-disciplinary experience. Bucciarelli works as researcher, consultant and teacher within the field of engineering mechanics, based at the Massachusetts Institute of Technology. Bucciarelli has also had a long and distinguished interest in the history of mechanics and science and in the social studies of technology. Not surprisingly, he finds himself in a paradoxical place, a paradox that is rarely admitted by engineering proper. But this is exactly what he seeks to challenge. In his recent book, *Engineering Philosophy*, Bucciarelli highlights how engineering seldom regards itself as in need of philosophy but is profoundly incomplete without it. It matters not just for practising engineers but also for educating engineers. It matters as it clarifies what engineering involves.

For Bucciarelli, the crucial realisation is that engineering is (at least) dual. Although the symbolic or the expressive/ontological elements of engineering seldom get mentioned, technology and the design process is necessarily a conjoint process. Towards achieving both physical and normative goals designers imbue material form with a properly functioning intent. He elaborates this by first considering a basic design conundrum. Specialised teams and their manifold technical languages are part of any large design project. But there remains the need to design at the systems level. Accordingly, Bucciarelli introduces his own similar but different characters. These experts exist in differing "object worlds", that is, within different design or specialist languages. He then makes a crucial move. As these seemingly enclosed languages can communicate amongst themselves to enable "varied artifacts" to emerge, they also enable "negotiations among engineers" to arise such as to optimise an overall outcome.[2]

This approach helps to get inside the messy processes of inter-disciplinary design. Secondly, his refusal to draw strict boundaries between expert languages helps Bucciarelli avoid reducing the process of design to a simple diagram or formula. However, as he tends to avoid applying descriptive terms from the social studies of technology, the concept of "reverse salients" may assist here.[3] Although originally conceived as a systems-centric concept, work within the history and sociology of technology has illustrated how the pressure points or bottlenecks of system change are communicatively negotiated in relation to contextual aims and, thus, are socially constructed.[4] Beyond expert loyalties, political or even cultural agendas may be at stake. Indeed, Bucciarelli illustrates how privileging boundaries between expert worlds obscures how normative inter-changes may be crucial for design process.

Bucciarelli extends his analysis of the physically determining yet socially connected nature of design by considering how to analyse risk and failure. As (it might be added) for scientific work, the cause leading to engineering failure is seldom obvious. The existence of vying interpretive perspectives – as to what matters and what doesn't – often works to normalise success, or, to obscure the cause of risk. For Bucciarelli, similar concerns emphasise his basic contention that design failure involves inter-disciplinary communication – or problems within it. A range of contributing shortfalls beyond the physical cause per se, such as "people, agencies and social institutions" led to the event.[5] Again adding some descriptive material for him, Bucciarelli is seeking to decentre the cause, or, to show how failure is a social-physical hybrid and, therefore, a social artifact. The implication is, again, that engineers need to cultivate a capacity to consider the worldly assumptions of their own models.

In the next chapter Bucciarelli illustrates how conceptualising and analysing engineering problems has changed historically. He also contrasts the abstracted or rule-refined, knowing-that approach to doing engineering with the more contextual and contingent knowing-how. This, he believes, helps distinguish engineering science from engineering design proper. His basic point being that engineers "out in the big world, make use of existing theory … in particular settings." They need to know "how and when they apply."[6] It is the case that knowing when and how to apply abstract principles is a crucial element of the art of engineering. As this introduces issues of judgement, it is another avenue by which engineering becomes socially contingent.

However, as his introduction acknowledges, scientific research itself is context dependent.[7] Therefore, at this point, perhaps he should be pushing his inter-disciplinary conclusions a bit harder. It is not that the "ideology of engineering research" necessarily stands in the way of a design-orientated, "pragmatic" model for engineering. Its abstractions are themselves pragmatic and combine with other practices to form designs. The usefulness of their languages is something that Bucciarelli continually acknowledges. Wariness towards scientistic tendencies per se should be the focus. Conflating method (for design or research) with an approach that is supposedly purified or isolated from any commitments is the problem. Probably, this reification is the "ideology" of which he speaks. An emphasis on participatory expertise should be the key. Iterating between the abstract and the local and making judgements about what to include, then becomes the escape. As Wynne suggests, the need is to "sustain universals that do not bury the traces of their own commitment and responsibility."[8] This is how research and design are both revived and revised.

Finally, Bucciarelli turns his attention to the implications for engineering education. It is here that he argues for the introduction of a context-sensitive approach as a necessary accompaniment to engineering (science) education. He suggests that by tackling the above issues of historical and contextual conundrums, an understanding of the contingencies facing designers can be enriched. This returns us to his wariness towards engineering science – or to the pervasiveness of scientism – and to his basic contention that engineers make judgments. Ultimately, students need to be taught how to take a context-engaged approach. To improve reflexivity and creativity plus, crucially, an ability to express themselves (don't forget the art!), they need to be enabled to explicate how the ambiguous and the evaluative are part of engineering. Again, however, the role of a participative design method, although implicit in the discussion, could help connect many of his concerns.[9]

In conclusion, Bucciarelli's arguments, although well introduced, could have been assisted by some conceptual refinement. This, in turn, would have helped narrate his account. But he has done much to translate between worlds. His arguments have benefited significantly from his inter-disciplinary skills, from an engagement with the history and social studies of scitech and work as a consultant. In particular, an overly idealised approach to solving technical problems – merely as one might solve an equation – can confuse engineering students about the need for developed judgement. Instead, practically engaged methods can teach that designs are negotiated within competing, normatively and historically informed assemblages.[10] Rather than hiving-off such issues to a design method course or to a self-contained engineering and society unit, one can agree that it would be best if they were pursued as a complementary thread running through engineering subjects. Overall, therefore, Engineering Philosophy seeks to find its way out of narrowing confines. Although he could have improved the consistency and concision of his insights by bringing forward a discussion of participative methodology (for both engineering research and practice), Bucciarelli is well out of the scientistic bottle of traditional engineering education.

Notes

1. For a catalogue and essay about the work of Edwin Tanner, see.
2. *Edwin Tanner Works 1952–1980* Monash University Gallery, Melbourne, 1990.
3. L. L. Bucciarelli *Engineering Philosophy* Delft: Delft University Press, 2003, 18.
4. J. Summerton, 'Introductory Essay: The Systems Approach to Technological Change' in J. Summerton (ed) *Changing Large Technical Systems* Boulder: Colorado, Westview Press, 1994.
5. For a recent review of the field see J. Wajcman, 'Addressing Technological Change: The Challenge to Social Theory' in *Current Sociology* vol. 50, no. 3, May 2002.
6. *Engineering Philosophy* 39.
7. *Engineering Philosophy* 71.
8. Also see B. Wynne, 'Scientific Knowledge and the Global Environment', in T. Benton and R. M. Redclift *Social Theory and the Global Environment* London: Routledge, 1994.
9. Wynne, B., 'May the Sheep Safely Graze? A Reflexive View of the Expert-Lay Knowledge Divide', in Lash, S. et al *Risk, Environment and Modernity: Towards a New Ecology* London: Sage, 1996, 78.
10. F. Fischer *Citizens, Experts and the Environment: The Politics of Local Knowledge* Durham,NC: Duke University Press, 2000 and his earlier works.
11. Given the silent currents of power that flow through engineering (hence its scientism), from a sociological point of view, it deserves to be considered a paradoxical heartland for inter-disciplinary studies.