

Technology as a Product of Boundary Work

The Case of Historic Debates on the 'Machine' in Engineering

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ABSTRACT

The paper focuses on *boundary work* in engineering, in particular in the course of the professionalisation of engineering as an academic discipline in Germany in the 19th century. The guiding thesis is that the continued historical debates about the relationship between technology and science, technology and arts etc. were a constitutive and productive dimension of the modern technological field and its gender dimension, i.e. of a field of knowledge that counts as genuinely technological and is linked to diverse concepts of masculinity.¹

Keywords

Engineering, mechanical engineering, history of technology, boundary work, technical knowledge, concepts of the machine

In several approaches science and technology studies have profoundly challenged modern dualistic thinking and its dualistic arrangement of categories, mainly the dualism between nature and culture and related other binary categories like the gender category. Feminist historians have shown how the ruling images of the engineer (as well as the image of other professions like that of the scientist) were closely associated with the dualistic gender order of modern civil society. While these historical studies offer fruitful and reasonable links for social scientific studies on engineering knowledge, they often primarily focus on the problem of exclusion of the female coded spheres and experiences [8]. But what are the major strategies to generate male-coded knowledge of the engineer? How consistent and steady are the social constructions of technological masculinity? What sort of discontinuities, contradictions, disruptions or also reconstructions of this construction can be found that rely on conceptual controversies within the field of engineering? Are these inner boundaries that were constituent for the historical emergence of professional engineering relevant until today? How are they charged with (gendered) significance?

Today's studies of relevant boundaries in engineering and ICTs predominantly address the dualism between the technical and the social referring to insights in the mutual co-construction of technology and society. Feminist research has indicated to what extent this dualism does not only separate the domain of technology from society

but also works as a gender relevant segregating mode within the everyday practices and workplace cultures of engineering [2]. Further distinctions between theoretical approaches and more hands-on capabilities of engineers, between the abstract and the concrete, have also been identified as boundaries with a complex gendering effect [1],[5]. Less attention was paid however to the boundaries that can be found on the level of professional knowledge, i.e. to the theoretical foundations of the more traditional fields engineering. While in the field of ICTs conceptual shifts that have emerged with the computer or with the Internet [7] as well as with an increasing division of (technical) labour definitely have been challenged from a gender perspective, the study of concepts of the 'classical' machine is largely lacking.

Drawing on Thomas Gieryn's concept of "boundary work" to analyse the epistemic formations of early German mechanical engineering in my talk I ask how engineers constituted their field, how they tried to gain "epistemic authority", that is "the legitimate power to define, describe, and explain bounded domains of reality" [3, p. 1]. Gieryn's argument is built on a constructivist insight that the boundaries of science are contingent. "The contours of science are shaped [...] by the local contingencies of the moment: the adversaries then and there, the stakes, the geographically challenged audiences" [3, p. 5]. Unlike Gieryn I do not regard those constructions of epistemic boundaries as mainly interest-driven rhetoric. Following Bourdieu, actors of a field are not conceptualized as mainly intentional actors in an idealistic sense. But they are acting as part of a normalized logic of the social field they belong to or they try to belong to. Thus I study concepts of the emerging field of academic mechanical engineering in the late 19th century as constantly "contested knowledge" (Hark 2005) which is 'at stake' in the struggles for the advancement of the profession.

Based on these theoretical lines of argument, central questions for the analysis are the following:

- Where and how are boundaries drawn in order to produce the "machine" as a certain subject of engineering science? What kind of gender order is thereby co-produced?
- What are the resulting specific formations of boundary work? What are the strategies to gain epistemic authority the engineers embarked on, while acting from the periphery of science?

Let me give you a brief outlook on the findings of my investigation in early modern engineering journals and

¹ The study of gendered concepts in engineering was part of a larger empirical project, conducted in the years 2006 and 2007. For further detail, see [6].

textbooks. Two case studies show how the boundaries between the natural and the artificial were illuminated and negotiated in late 19th century engineering in Germany: the case of the early controversies about the concept of the "machine" in mechanical engineering and the case of the kinematic studies on "biomechanics". They both indicate that there are implicitly negotiated diverse understandings of the engineer that also reflect different, if not opposing, conceptions of masculinity of the time. They also show that boundary work in engineering took place under particular conditions resulting from the engineers' position on the margins of academia.

These findings also provide new insights in the epistemic instability of the field of technology and in the role of the social and gender dimensions of knowledge production. Consequently, the concept of the machine is fundamentally shaped by the processes of professionalisation and institutionalisation of technology as part of the academic field. Uncertainties about the 'nature' of technology itself and struggles about its boundaries are no typical late modern phenomenon that first came up with the shift from a clear conception of the classical machine to ICTs or with late modern technoscience. Uncertainties rather have deep roots in the earlier historical phases of technology. Following this, the disposal of gendered images of the engineering tradition seems to be much more complex than often retrospectively presumed. Thus, I understand uncertainties and instabilities as a constituent factor of the technological tradition. At least relying on the conceptions of the 'classical' machine in the industrial age one can say that engineers produced definitely contested knowledge on their very subject. Each of the concepts was supposed to constitute a specific version of a genuinely technological domain.

To put it more in general: The social co-construction of hybrid scientific artefacts and of contested epistemological boundaries happens not only today in the everyday practices of the laboratory, in current transformations related to ICT development or in engineering workplace cultures. There is evidence that it can also be reconstructed with the help of historical material of

engineering science. Thus the findings show the epistemic instabilities in the traditional foundations of engineering that also provide the potential to destabilise the today's normalised version of a monolithic and likewise obviously male coded understanding of 'traditional' technology. They point at the social prerequisites of professional knowledge in engineering that are rooted in complexities and contradictions, i.e. the 'messy' historical situatedness of its "making".

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