The "Past Future" Twenty Years of STS and Technical Universities

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Abstract: If the public engagement of science and technology has been quickly expanding in the past few decades, the same cannot be said about the presence of STS expertise in the knowledge of scientists, engineers and designers. This article focuses on the opportunity given to STS by the recent trend of European technical universities towards integrating critical and reflexive skills into their educational core.

Keywords: engineering algorithm; engineers; technical universities; interdisciplinarity; demarcation.

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The time elapsed since *Tecnoscienza* was established, has generated great transformations in the field of STS, but even more so in the area of emerging technologies. Such changes, which concern everyday-life dimensions such as communication, mobility, health, security, etc., are profoundly modifying the lives of ordinary people and, subsequently, also the meaning and methods of engineering and design. Increasingly, albeit often unwittingly, it is technologists and designers who take responsibility for determining people's future lives. So to speak, they are becoming today's (unrecognized) "politicians". I am convinced that any discussion of the near or distant future of STS should not ignore such changes. Yet, instead of looking ahead, I will look to the past.

Looking back to see forward may seem a strange and contradictory strategy. However, this is what I intend to do with the aim of anticipating the future of STS. The challenge of predicting the future is almost inexorably destined to fail for those who do not possess the right skills, which I do not. Hence, I prefer to shift perspective and look at the past future twenty years in what could be called a "future perfect" mode. That is to say, I will observe the future twenty years of twenty years ago. I believe this perspective can give us some insight into where the STS are going today.

Why go back twenty years? At the end of the last century, STS was an established and rapidly expanding disciplinary field. All major journals and international associations in the field already existed, many STS research centres had flourished in British and North American universities, disciplinary literature was widely developed and began to produce manuals and handbooks[1]. This stabilization and expansion of the field had proceeded through the most common strategies and policies that usually govern the development of disciplinary fields of Western science, such as institutionalization, boundary work to establish demarcations between contiguous disciplinary fields (Gieryn 1983), definition of a specific capital (Bourdieu 2001), construction of epistemic authority (Gieryn 1999), co-production of identities, institutions, discourses and representations (Jasanoff 2004).

In this state of effervescence and stabilization, the new field of study was confronted with neighbouring disciplinary fields, that is, first, philosophy, which was the quintessential target attacked by the sociology of scientific knowledge (SSK, see Bloor 1976), then sociology, or "sociology of the social", the main target attacked by the Actor-Network Theory (ANT, see Latour 2005). The interest for a confrontation with scientists and engineers was weaker. The so-called "science wars" originated from scientists' reactions to the constructivist approach dominating STS, rather than from a systematic engagement of STS in a discussion with STEM disciplines.

Hence, the expectations of STS for the next twenty years were quite well defined at the turn of the century. It was time to abandon the narrow academic endeavour and the anxiety of disciplinary demarcation against neighbouring disciplines – i.e., those "meta-scientific" studies that cast a critical and reflective eye over the world of science and technology, such as philosophy and sociology – and to turn, instead, to a wider interaction with the possible final stakeholders of STS expertise, such as scientists, engineers, policy-makers and decision-makers. Time was ripe to transform STS into a body of knowledge assisting the democratization of science and the governance of technological development, putting a brake on the technocratic power of experts. The editors of the third edition of the *Handbook of Science and Technology Studies* were well aware of this. Indeed, in the introduction to the *Handbook* they actually considered this change accomplished (Hackett et al. 2008, 1-2).

However, it was not. During those very years, the hectic development of digital technologies was disclosing a world governed even in its most trivial daily activities by a hypertrophic technology that was increasingly autonomous from human control. Emerging technologies proved to be pervasive in people's ordinary life, and their alleged devastating consequences were no longer limited to extraordinary situations (as it had been the case, for example, with nuclear energy). In such a changing context, the most forward-looking scholars saw in "meta" disciplines a fundamental tool to secure a more appropriate development of technologies, which otherwise risked escaping human control. The focus of STS and other "meta" disciplines on the "human, all too human" side of science and technology could arguably help humanize technological progress.

Kenneth Keniston, the founder of the STS programme at MIT, persuasively expressed this idea by describing what he used to call a "crisis of the engineering algorithm" (Keniston 1996). For him, the engineers' algorithm was a set of basic principles governing engineering regardless of the technical problem it tackles. It is based on an assumption that closely resembles the Popperian principle of demarcation. Precisely, the problems that human beings have to face both individually and collectively can be divided into two separate realms, namely problems that can be solved in principle, and everything else. The first realm includes technical problems, which require physical or mathematical knowledge and the development of adequate technologies to be solved. The second realm includes, among other things, social problems, value issues and philosophical or religious matters. Very briefly, the engineering algorithm states that, in order to effectively address the first type of problems, technologists must be completely disinterested in the second type of problems. Engineers develop technologies, and they do it all the better the more they succeed in isolating technical problems from social and cultural variables. Someone else will be concerned with evaluating the social impact and ethical implications.

Keniston's idea at the turn of the century was that the engineering algorithm was experiencing a crisis for several reasons that made the idea of demarcation less credible. The public image of the engineer had suffered, as s/he was no longer considered the untouchable hero of social progress. In addition, the public image of technological innovation had suffered as well: once defined simply as a road to a better life, it was now seen as a major cause of environmental degradation. The emerging technologies were increasingly complex, and the solo engineer designing a single product had been replaced by the interacting, coordinated team of engineering specialists working on a complex design of a component of a complex socio-technical system: "society", once something out there, had entered the workplace. The consideration of trade-offs between incommensurable factors – such as efficiency and safety, costs and reliability of technological devices – was moving towards the centre of engineering. Finally, what used to be dealt with as externalities, such as environmental impact, had increasingly become an integral part of engineering design.

To sum up, the crisis of the engineering algorithm had broken the naive separation of the two realms. It was progressively exposing technological innovation to the awareness that it was no longer possible to avoid meta-technological problems simply by either disregarding them or by delegating them to others, i.e., philosophers, sociologists and politicians who would intervene downstream of technological development. The king was naked, and the task for the next twenty years was, at that time, to equip engineers with a new sensitivity to problems that are unsolvable but also unavoidable. The goal was helping them to develop technologies that are less "naïve" from an ethical and social point of view.

This was Keniston's prediction in 1996. I dwelt on the next twenty years in a "future perfect" mode because I believe that the prediction has not been fulfilled as yet, at least not completely. If the public engagement of science and technology (both *of* technoscience and *with* technoscience) has been quickly expanding especially in Anglo-Saxon and North European countries, the same cannot be said with regard to the presence of STS expertise in the knowledge of engineers and designers. What seems to be a logical consequence of the crisis of the engineering algorithm is struggling to materialize in the practice of universities and research and development centres, and much remains to be done.

To be sure, a trend is clearly visible, at least in Europe. According to research we carried out at the META study unit of the Politecnico di Milano (unpublished), a policy of openness towards "meta" disciplines is ongoing in many European technical universities, particularly those best positioned in international rankings. This policy consists in integrating critical and reflexive skills into the educational core of technology and engineering Departments and Schools. The instances are highly diversified, since some primarily focus on teaching, and others on research; some leverage the creation of interdisciplinary groups (such as at RWTH Aachen), while others that of single-discipline institutes (e.g., STS as at TU München and Ethics at TU Delft); some aim to implement an extensive introduction of humanities courses for all engineering students, while others to the structuring of specialized courses for students who are particularly sensitive to the topic. In general, groups of STS scholars that are active in European technical universities are gradually moving from niche and marginal clusters to the core sets, thus becoming a fundamental part of the universities' teaching and research programmes.

The reasons for this process, namely the legitimating arguments put forward in official documents, refer to both the technologists' adequate education to enable them to govern emerging technologies and the university's social responsibility. For example, the "Mission Statement" published on the ETH Zürich website states that the commitment to consider humanities and social sciences integral parts of the technical university's educational profile derives from "the need for a new approach to knowledge and technology", which aims at equipping the new engineers "to tackle the enormous challenges facing mankind" (https://bit.ly/3fWtZEI). TU München, on the other hand, insists on our responsibility towards the future, which involves technologists in the forefront to the extent that technological progress has become one of the main factors determining people's life in economically advanced countries: "Our aim is to equip our students with the capacity to accompany social change with a sense of responsibility. [...] Society should know what we are working on in science and technology for our future, and how we are preparing young people for tomorrow's challenges" ("Our mission statement: We invest in talents. Recognition is our return", https: / /bit.ly/30IqcVa). Similarly, TU Delft claims to connect technological research systematically to societal challenges, "and will make this more visible to the outside world, by stimulating multi-disciplinary, and cross-faculty research that aims at responsible, societal innovation" ("Strategic Framework 2018-2024", https://bit.ly/3eOuuiN). Reference to the European cultural tradition, implicitly opposed to that of other technological giants (such as China and the United States), is found in the statements of the Département Humanités et Sciences Sociales at the École Polytechnique in Paris, which emphasize that the humanities and social sciences "provide a unique and enriching experience for students, putting their scientific knowledge into perspective with courses in history and in political and social structures. In the tradition of the age of Enlightenment, the goal of the HSS department is to train critical minds that are curious and open to the issues of the current world" ("Département Humanités et Sciences Sociales", https://bit.ly/2Brzxbu).

However, while this trend is indeed ongoing, visible and publicly claimed by European technical universities, most engineers continue to train on the engineering algorithm, and change is slow. The fact that, to date, STS have not been particularly active in seeking confrontation with engineering disciplines has contributed to the situation. A new deal is needed in the years to come, that is to say STS should develop a new attitude towards technology, no longer focused just on the critical observation of the way in which it develops but also interested in creating cross-fertilization situations with technologists themselves, as they are the main actors of technological development. Since ethnography has historically been the method preferred by STS scholars, the opportunity offered by collaborative situations with engineers will not escape the eye – that is, the chance to work side by side, experiencing, as it were, "technology-in-action".

Technical universities offer a favourable setting to this end. Our field of study, which by nature is a non-discipline born of the convergence of multiple disciplinary interests, and which has gradually acquired the ability to fertilize traditional sociology with its own methods and its own specific way of looking at reality, should now seek to apply those skills to engineers and technologists, as well as to scientists. STS could fulfil the task of training them in the ability to take a step back from the very object of technological research and to observe it with the detachment of critical thinking and with the breadth of horizon produced by reflexivity. Indeed, this could make the design work more complex and less efficient, but at the same time more sustainable in its results, which would be a substantial achievement. Cultural traditions, such as ANT and SCOT, could provide very valuable tools in this direction.

However, the precondition is for STS to emancipate themselves from the constraints dictated by the stabilization process I have described above, and to open up to a greater and more authentic interdisciplinary relationship with other social sciences and humanities. Philosophy of technology has been ground-breaking in this regard, as several philosophers have made considerable efforts, in recent decades, to open up to the realm of empirical data and, in particular, to STS methods and body of knowledge. Starting from the post-phenomenology of Don Ihde (1993; see Ihde and Selinger 2003), scholars such as Peter-Paul Verbeek (2011) have dialogued extensively with ANT and STS. Especially in the Netherlands, philosophers of technology have embraced the principles of Value Sensitive Design (Friedman, Kahn and Borning 2006), which aims at integrating technical investigations about designs and their operational principles with empirical investigations concerning contexts and experiences of people involved in technological environments and conceptual investigations intended to clarify the values at stake and to discuss the trade-offs between values (see Van de Poel and Royakkers 2011, 188-189). Similarly, STS should rediscover their original interdisciplinary vocation and overcome traditional disciplinary boundaries. They could thus become protagonists of a process that is currently changing the education of technologists and engineers and will, therefore, end up profoundly influencing the world we live in.

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[1] Although the 1995 *Handbook of Science and Technology Studies* (Jasanoff et al. 1995) is numbered as a second edition, it is actually the first edition explicitly named with "Science and Technology Studies", as the previous one was titled *Handbook of Science, Technology, and Society* (Spiegel-Rösing and de Solla Price 1977). For a study of the history of STS Handbooks see Ienna (2018).