Technology Assessment

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INTRODUCTION

Technology Assessment (TA) has developed over the past more than forty years against the background of challenging experiences concerning unintended and often undesirable side effects of science and technology. Development, production, social use, and disposal of technology have often resulted not only in more welfare, employment, health, and other positive issues but also in negative or at least ambivalent consequences, including risks to human health, society, and the natural environment. The aim of TA from the very beginning was to contribute to shaping scientific and technological progress and its transformation into innovations according to societal values and goals by investigating and assessing possible impacts and consequences *in advance,* and by transforming this knowledge into advice to decision-makers.

TA has taken up the field of Information Science and Technology (IST) as a subject of study from the 1970s on. Nowadays, this field is of central relevance to TA in a triple respect: (a) as research field *per se*, e.g. with regard to impact dimensions such as privacy, data protection, increasing use of autonomous agents, safety and security, sustainable development, intellectual property rights, regulation, societal vulnerability, *et cetera*. It is (b) also of major and even increasing importance by entering and influencing other fields of technology, e.g. energy supply, military, robotics, logistics, nanotechnology, cognitive science, neuroscience, *et cetera*. Finally (c), several new services made available by IST developments are of high utility in TA, e.g. in the fields of e-petitioning and e-participation (Nentwich/König 2012). This article will provide a brief overview of TA with respect to its origin, its development, its objectives, and its current situation in general, followed by a more specific consideration of TA themes and activities in the IST field.

BACKGROUND

Technology Assessment has its roots in specific historical circumstances in the 1960s and 1970s. Activities and concerns in the U.S. political system, in particular in the U.S. Congress, led to the creation of the Office of Technology Assessment (OTA) in 1972 (Bimber, 1996). This origin of TA found a lot of successors in Europe which succeeded in establishing the European Parliamentary Technology Assessment network (EPTA, see www.eptanetwork.org).

Parallel to this development in the political system, far-ranging intellectual changes were taking place. The optimistic belief in scientific and technical progress, which had predominated in the post-Second World War period, came under pressure. Western societies were deeply unsettled by the "Limits of Growth" published by the Club of Rome in 1972, which addressed the limitedness of natural resources. In many fields, problems with unintended side effects of technology such as pollution and severe accidents became a matter of public debate on further scientific and technological progress. In many countries, social conflicts arose at the occasion of controversial technologies such as nuclear power (from the 1970s on) and genetically modified organisms (from the 1990s on). Ethical questions led to conflicts on the development and use of new technology, in particular in the field of health and human reproduction. Issues of privacy and data protection became a field of controversy, in particular following measures of homeland protection and surveillance strategies after the 9/11 attacks. The challenges led to a complex and multi-dimensional set of objectives and rationales of TA (Grunwald, 2009).

Nowadays, the term "technology assessment" is widely used to designate systematic approaches and methods to investigate the conditions for and the consequences of technology and to assess and evaluate them. Its task is to provide knowledge, orientation, and procedures on how to cope with challenges at

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the interface between technology and society *in both directions*. TA explores and assesses possible impacts and consequences of technology in a prospective manner on the one hand (technology push), and it helps to introduce society's expectations and needs towards new technology into the relevant decision-making processes on the other (demand pull). The mission of TA is, thus, to contribute to "a better technology in a better society" (Rip et al., 1995), including reflecting about what the "better" could or should mean in detail and how the respective meaning of the "better" could be determined. There are three partially overlapping branches of TA addressing different targets in the overall technology governance:

1. TA has initially been conceptualized as *policy advice* (Bimber, 1996, Grunwald, 2009) which is still a strong motivation of large parts of TA. The objective is to support policy makers with advice concerning political measures which could either influence the further development and use of technology or which themselves could be influenced by new technological developments and achievements. Frequently, policy advice in this sense is about *adequate regulation* (e.g. environmental or safety standards), *sensible research funding* (e.g. in the field of new and emerging sciences and technologies such as nanotechnology and synthetic biology), and *political strategies towards sustainable development* involving appropriate technologies. *Parliamentary* TA is an important sub-category of policy-advising TA, showing a high variety of institutional configurations (Cruz-Castro & Sanz-Menendez, 2006).
2. *Participatory TA* has developed approaches to involve citizens, consumers and users, actors of civil society, stakeholders, the media, and the public in different roles at different stages in technology governance (Joss & Belucci 2002). According to normative ideas of deliberative democracy, the assessment of technology should be left neither to the scientific experts (expertocracy) nor to the political deciders alone (decisionism) (Habermas 1970). Participative TA procedures are deemed to improve the practical and political legitimacy of decisions on technology. They should make it possible for decisions on technology to be accepted by a larger spectrum of society despite of remaining divergent normative convictions. Several methods have been developed and applied in the recent years, such as consensus conferences, citizens' juries, and focus groups (Joss/Belucci 2002).
3. Building on empirical research on the genesis of technology and on the theoretical framework of social constructivism (Bijker et al., 1987), the idea of *shaping technology* according to social expectations and values emerged. It motivated the development of several approaches, with Constructive TA (CTA) being the most influential one (Rip et al., 1995). The general idea is not to address policy makers or the public but rather to approach those groups who are directly involved in the "making of technology" such as engineers, developers, and planners in companies and publicly funded research and development centers. Ethical issues and social desires shall, according to this approach, be implemented in technology by enriching and orientating decision-making processes in the design and development phase of new technological systems, products, and services.

An international community evolved around the concept of TA and its various dimensions and diverse objectives, using different concepts and methodologies. Part of this community works in institutions explicitly devoted to TA (e.g., to provide advice to parliaments, cf. the EPTA network mentioned above), part of it is organized in networks (cf. www.netzwerk-ta.net), part is describing its work as systems analysis and life cycle assessment (LCA), and another part converges on the fringes of disciplinary organizations and conferences, such as in sections of sociological or philosophical organizations, or in the STS Community (science, technology & society studies). Also many IEEE (Institute of Electrical and Electronics Engineers) activities relate to the social implications of technology.

TECHNOLOGY ASSESSMENT IN THE IST FIELD

Information and communication technologies (ICTs), related with advanced information science and technology (IST), are among the main driving forces in all modern economies. Development and change in all