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I Technology Assessment in a Dynamic Context

Knowledge and information based on science and technology are crucial resources in modern societies. They are key factors in the economy, and are becoming increasingly important ingredients in all areas of life. Therefore, modern societies are referred to as knowledge or information societies. This vision and the practical transformation of our societies in a globalised and dynamic economic context, however, entail fundamental challenges. For example, access to knowledge and information is not equally distributed and we cannot necessarily observe a linear growth of security or a stable order. Rather, there are systemic risks of various kinds, and their potentially far-reaching impacts cannot be attributed to individual failure or natural forces. Thus, technological dynamics may not only contribute to competitiveness but also add to the vulnerability of modern societies. The resulting controversies about risks and benefits, interests and values indicate both greater opportunities as well as new uncertainties. Furthermore, the need to develop and implement policies for a sustainable future poses complex challenges, not least with respect to potential technological solutions. In this situation, decision-makers have to find appropriate ways of shaping and governing technology – including, as appropriate, both promotion and regulation. Concrete and useful answers need to be developed and legitimised on the basis of sound scientific analysis.

Against this background, the Institute of Technology Assessment (ITA) provides *scientific advice to politics and society* by analysing technological change and by focusing on societal processes, options for action, and their possible impacts. Our aim is to generate knowledge about intended and unintended consequences of developmental options. This knowledge is aimed, on the one hand, at supporting politics and administration, including the legislative authorities at the national and supranational level as well as the managers of technology R&D programmes, and, on the other hand, at the general public. Our academic work also strives for a better understanding of the societal relevance of technology and seeks to develop the methodological basis of technology assessment. Furthermore, in some areas such as sustainability and privacy issues, technology assessment contributes constructively to the design and adaptation of technological solutions.

TA researchers are specialists in synopsis, consulting and facilitation. We work in interdisciplinary teams which have learned, through practical collaboration, to better understand diverse expert languages and to concentrate on the interfaces between specialists' fields. We co-operate within international networks, which helps us to generate knowledge that is relevant for decision-makers.

When choosing our topics, we look at current technological innovations and potential societal problem areas. The researchers in our institute seek to identify and analyse themes in advance, in order to offer basic insights as soon as public debates start or regulatory choices have to be made. In the medium term, our research focuses on four main research areas: the information society, technology and sustainability, governance of technological controversies, and cross-cutting issues.

In the following section 2, these main research areas will be presented in more detail; in section 3, we explain our systematic approach to selecting and analysing relevant research questions.

Knowledge and information as key resources

Risk and uncertainty

Sustainability

Technology assessment contributes to scientific bases for decision-making

Future-oriented choice of topics

Four main research areas

2 Main Research Areas

2.1 Information Society

The notion of the “Information Society” is well established in scholarly debates as a prominent characterisation of societal change. At the EU level in particular, it serves as an influential political vision. Rapid progress in information and communication technologies (ICT) and their multiple potentials for application open up a wide area of research for TA. Given restricted resources, ITA has decided to focus on three, partly interrelated thematic areas: privacy, e-Governance, and infrastructure and service innovations.

Privacy and Security Technologies

Human rights at the centre

When shaping a socially acceptable information society, a thorough analysis of the complex relations between technologies, human rights and social/political consequences is essential in order to be able to derive options for activity. One starting point and core of the analysis is the impact of new and future ICTs on privacy. In a wider perspective, we also discuss impacts of technologies such as biometrics and biotechnology, as well as further basic rights affected by ICT, in particular freedom of information and freedom of speech. The amount of user-specific data is growing due to technological progress – digitalisation, the Internet, mobile applications and ubiquitous information technologies. At the same time, we expect our abilities to store these data in the long term and to analyse them in depth to grow; consequently, privacy will be increasingly under pressure.

Political reassessment of security

Over recent years, security has been politically re-assessed in the aftermath of terrorist attacks. This is our second point of departure for research in this field. Because society is focusing on security, biometric devices and surveillance technologies are spreading very rapidly. At the same time, the diffusion of privacy-enhancing technologies is hampered, as was the case in the past. In terms of our focus on privacy, this means that we expect, on the one hand, the potential for societal conflict to grow further, and, on the other, that political backing for privacy enhancement will be rather weak in the short term.

Privacy-friendly design of security technologies and measures

However, we can already observe that the emphasis on security, which has been strongly affected by terrorist attacks and dominates many debates, is being challenged and increasingly debated in terms of human rights. In the same vein, one-sided security arguments are being questioned. The data-protection-friendly design of security technologies is becoming an important topic, but it is at the same time prone to conflicts. We are currently coordinating an EU project on security research conforming to human rights, which analyses options and criteria for privacy-friendly R&D. In another EU project we are testing the introduction of a voluntary data protection seal for IT products and services. Based on the outcomes of these projects, we intend to contribute to the adaptation and further development of so-called fair information principles.

Possible further topics in this wide field of privacy and security are the vulnerability of the information society, for instance of the digital information infrastructure (including the digital content), or developments in the domain of ubiquitous computing.

E-Governance

A particularly dynamic area of the information society is the application of ICT in the realm of the state and in politics. The technical innovations of the Internet era open up new and qualitatively different forms of access to public sector information, of communication with the authorities, of administrative procedures, of services delivery by the state, of the identification of citizens and, finally, of political participation and governance.

Electronic services in public administration (*e-government*) inside and between authorities are now well established, and new research questions and design challenges are arising. Important topics are the social, economic, and political ramifications of reorganising service delivery processes (the One-Stop-Shop principle, cross-jurisdictional and cross-border cooperation) as well as the provision of general access and secure communication.

**Electronic
Administration**

As public authorities increasingly store data and communicate electronically, a technical-organisational infrastructure able to properly identify citizens as authorised communication partners is becoming ever more important. Traditional systems and procedures of identification are being transformed into electronic identification management (*e-identity*, tied to registers such as the central registry of residents in Austria). Here we focus on questions and influencing factors related to technical-organisational design, the legal framework, in particular ensuring civil rights, and the problem of diverging interests related to potential trade-offs between economic efficiency, security and privacy.

**Electronic
Identification**

A further research focus concentrates on ICT applications for political participation and governance. A major question here is whether and how ICTs can contribute to remedying democratic deficiencies and to enhancing democratic quality (*e-democracy*) while at the same time allowing for efficient governance. Will they contribute to deepening and widening the quality of democracy and to remedying democratic deficits (e.g. increasing the electoral turnout)? Research topics include the various modes of electronic participation (e-deliberation, e-consultation, e-petition etc.), and criteria for the design and evaluation of e-participation instruments as well as their application in empirical assessments. New strands of growing importance concern impact analyses of e-participation within multi-level governance structures and exploring the use of ICT in the process of policy formulation itself.

**Electronic
Democracy**

Infrastructure and Service Innovations

Technical and societal innovations on the information and communication infrastructure level (telecommunications and media, the Internet) are at the core of the information society's dynamic development. ITA is interested both in technological innovations affecting infrastructure (broadband, ubiquitous computing) and in the emerging new social networks, as well as in the consequences of new network-based services, including digital publishing.

The core issues of this development are so-called radical innovations of wired and mobile networks, Internet Protocol-based networks and peer-to-peer networks, and the convergence of media and telematics towards a transformed societal communication system called "mediamatics". Unlike incremental innovations, such radical ones have the potential to change economic and societal structures profoundly. Against this background, we focus on the implications of these radical and disruptive technologies for broadband infrastructures and for the development and diffusion of applications; furthermore, the changes of market structures and business models and the need for

**Information
infrastructures and
services are changing
radically**

new governance structures (such as co- and self-regulatory schemes) are of great interest.

**Information technologies
become ubiquitous
and invisible**

We expect a far-reaching societal impact in the form of the convergence and networking of miniaturised computer technology, sensor technology and robotics, which are infiltrating more and more areas of our daily lives and even the human body itself. Pervasive computing and ambient intelligence denote visions that are becoming increasingly real options of application. On the one hand, they open up various new opportunities to enhance human capabilities and new services, but on the other hand they contain new risks. Among these are a loss of autonomy as a consequence of invisible, self-steering technologies with sensing and analysing capacities, possible behavioural changes as a consequence of total surveillance, and finally, new security problems due to technological dependencies. Our central research questions relate to the areas of human rights and democratic development.

**The Internet at the heart
of a TA of the
information society**

The Internet is the prime example of an emerging societal communication system that will have far-reaching economic, political and social consequences globally. Web 2.0, for instance, with its community-building and self-authoring tools, is becoming increasingly important. What impact will it have on society and the economy? We can already observe, on the one hand, the rise of powerful commercial Internet actors (such as Google or the media archive Corbis) and hence a trend towards commodification of knowledge resources, and, on the other hand, a strengthening open access movement for knowledge sharing (e.g. Wikipedia). The Internet also plays an important role in science and research, in particular with regard to new forms of publication and knowledge representation (“cyberscience”).

2.2 Technology and Sustainability

**The relevance of
sustainability in TA**

Obviously, modern societies are not following a path towards a sustainable future. However, the call for sustainability is receiving increasing support. For instance, we observe an intensified search for solutions to problems such as climate change and scarcity of essential resources. To reduce sustainability deficits, the societal impact of technologies and the societal context for their implementation need to be taken into account at an early stage in their development. This implies a shift from analysing technologies towards dealing with socio-technical areas. At ITA we not only explore and assess the potential consequences of new technologies, but also consider the conditions necessary for specific technologies to contribute to sustainable development.

Participative assessment

Sustainable development is an overarching ethical approach that includes both the individual and the societal development of humankind embedded in natural systems. Among the underlying basic values are generational fairness, distributional equity, prevention of risks (the precautionary principle), protection of resources, and public participation in political decision-making processes. The concept of sustainable development calls for the integration of ecological, social, political, economic and technical aspects, both in a local and a global context. Participatory evaluation processes are particularly important because participation could help to deal with the expected goal conflicts. TA focusing on sustainability therefore depends on cross-disciplinary expertise, but also on procedural competence (e.g. to tackle multi-dimensional trade-offs).

Sustainability assessments of technology will only lead to results and recommendations with practical relevance if they include the analysis of user contexts (including future contexts). The contribution of a technology to sustainability depends heavily on the way it is integrated into social use and everyday routines. Technological innovation thus becomes a learning process which is informed by TA-derived knowledge and in which stakeholders as well as laypersons and users of the technology are involved. The whole value creation chain and the life cycle of the technology need to be considered. In our research we focus on socio-technical areas of particular relevance for sustainability.

Sustainability assessment and learning processes

A central challenge in this research area is the integration into TA studies of scientific expertise, as well as knowledge generated in participatory processes. In the coming years we plan to explore such integration, inter alia, in the field of HVAC technologies (heating, ventilation and air-conditioning) and in the use of renewable resources. Current projects focus on the transformation of energy technologies in Austrian households as seen from a user perspective, and on goal conflicts between technical-economic efficiency and societal needs. The latter issue will be tackled on a conceptual level as well as on the basis of case studies such as technologies for older adults.

Research topics

2.3 Governance of Technology Controversies

The rapid growth of knowledge and the close coupling of science and technology development (often discussed under the labels of the “knowledge society” and the “techno-sciences”) bring new options for design, but also uncertainties and controversies. In the past some technologies with high commercial expectations such as nuclear energy and biotechnology have given rise to societal controversies. The focus of attention was not only on concrete applications, but also on the question of how research should be done and what its aim should be. Serious and still topical debates about closely related technologies have been ignited by quite diverse issues. In agrobiotechnology, uncertainties, risk and the question of how to deal with them were central, whereas in the biomedical sector mostly ethical issues are at stake. These questions not only influence the societal discourse, but also, to a considerable degree, the further development of these technologies.

Controversies about new technologies as a starting point for TA

Political decision-makers and technology developers have now become increasingly sensitive to manifest, but also to latent technology controversies: with regard to particular technologies, controversies are anticipated even before they actually occur. Prime examples here are nanotechnology, synthetic biology and neurosciences – all three are predicted to carry enormous potential for economic and societal benefit, similar to biotechnology two decades earlier.

Anticipated and manifest controversies

In the course of technology controversies, both new and established actors have a role to play – groups of concerned individuals, NGOs, expert bodies like bioethics committees, and ELSI (ethical, legal and social implications) research groups. These actors approach possible technological consequences from different, often conflicting perspectives. On the one hand, they can be seen as carrying out a kind of “informal TA” with a view to informing politics. On the other hand, these conflicting perspectives often contribute to stabilising dissent, which usually can only be resolved in the political sphere, and often only temporarily. Based on these experiences, various actors try to proactively avoid such impasses in anticipated controversies over other technologies.

Special framework conditions for TA

Analysis of technology controversies and the development of methodologies as TA tasks

In our research we seek to contribute to dealing with deadlocked technology controversies in a constructive way. To do so, we look for insights into the typical structures and development of controversies and explore paths towards new modes of governance. We empirically analyse different types of controversies over knowledge claims, values or interests, the way the general public perceives the problems raised by a technology, as well as different forums and ways of negotiating possible solutions. We focus on both important biomedical questions and on new technologies such as nanotechnology and synthetic biology. Furthermore, we prepare ourselves for the possible next big issue, e.g. converging technologies – the expected coalescence of bio-, info-, cogno- and nanotechnologies.

Nanotechnology: Risk radar and clearing house

With a view to contributing practically to governance processes, we try to initiate and support deliberative processes on the basis of appropriate methods. In the case of nanotechnology, our recommendation to establish institutions and procedures to deal with potentially controversial technologies has been taken up by Austrian politics. By means of a so-called “risk radar” we are working on a comprehensive overview of the current state of knowledge regarding potential risks of nanotechnology applications. A related clearing house will not only offer scientific facts but also address their interpretation and relevance in different contexts.

2.4 Cross-Cutting Issues in TA

Besides its thematic research areas, a central TA institution like ITA has to engage in reflection on the foundations and perspectives of its tasks with a view to carrying out excellent research that may serve as a useful starting point for others. At something of a tangent to the thematic research areas, so to speak, we therefore reflect on our own practice, contribute to the refinement and further development of the methodical toolbox of TA, and constantly explore relevant future areas.

Self-reflection of TA practice

Even more so than in established academic disciplines, the practice of interdisciplinary research designed to provide political advice (which is frequently the case with TA) requires self-reflection. TA needs to assure itself regarding both its practical relevance and its scientific claims. Furthermore, TA is a concept that needs to be reconsidered continuously in terms of its specific analytical and advisory perspectives. As part of the international community of institutionalised TA, we are constantly discussing and scrutinising the self-conception(s) of TA. These debates address the normative foundations and epistemic peculiarities of TA; they reflect on its tasks and functions in relation to consulting politics and society; and they tackle questions concerning the theoretical claims and perspectives of unified theory-building. Research on participatory methods in TA and on the relationship between science and politics (political consultation) are our empirical starting point for such basic reflections on theory, forms and functions of TA.

Refinement of TA-relevant methods

Both for research and for their tasks in advising politics and society, TA institutions depend on profound knowledge of and experience in methodology. TA-relevant methods include the proven and tested toolbox of empirical social research as well as TA-specific methods. Furthermore, in technological conflicts, participation of citizens and/or stakeholders is becoming more and more important. Traditionally, ITA has devoted itself to the further development and refinement of TA-relevant methods, such as expert interviews, participatory approaches, and the Delphi method. In the late 1990s, ITA developed a combined Delphi and stakeholder participation procedure for the first

Austrian technology Delphi. Since then, we have explored and evaluated participation experiments theoretically and conceptually. For instance, on the basis of our recommendations to include new actors in Austrian technology policy, we organised a citizens' conference on specific aspects of the current energy technology research programme, and we provide advice to another research programme in the field of technologies for the elderly. Depending on topicality, ITA will continue to make relevant proposals, e.g. regarding electronic patients' records.

Finally, in order to remain relevant, TA needs to keep up with new trends. Therefore, the observation of technological trends and societal developments relevant to technology policy is an integral part of TA. Recent examples have been a foresight project on biomimetics, a study of nanotechnology, and the current project on synthetic biology. We have recently started to observe more closely the so-called converging technologies, for instance in the field of brain research, as well as ubiquitous computing. These observations will eventually lead to new projects – as was the case recently in the field of nanotechnology.

**Monitoring and
trend observation**

3 Starting Points for TA and Internal, Thematic Networking at ITA

**Selection of approaches
and methods,
appropriate to the
problem at stake**

International TA discourse and practice suggests that there is no universal concept for designing and executing TA studies. Technologies and their applications are manifold, and so are the questions for TA today. The phases of technology development range from basic to applied research, from product development to the different stages of the diffusion process. ITA meets the challenge of diversity by choosing an approach and methods appropriate to the specific problem at stake. ITA projects may be explorative *monitoring* studies of the potential of a new technology, or they may *evaluate* the implementation of a techno-organisational application as an accompanying measure. They may concentrate on the *public discourse* and on how society deals with technological controversies. These studies will typically contribute to basic research. Others may focus on specific problems or impact areas, in which there is a need for action because of unintended *consequences* or conflicts of interest. Sometimes it may be more appropriate to understand and to analyse, in greater detail, the *diffusion processes* before starting to elaborate recommendations to politics and administration. In other cases the provision of specific *services or products* for actors, such as databases, may be the content of a TA project. Projects aiming at *developing methods*, often directly relating to political consultation, are a further distinct category of TA projects.

**Five perspectives
of analysis**

TA studies start from, or have their focus on, one of the following interdependent perspectives of analysis: (1) (basic) technical innovations and the related infrastructures; (2) applications based on the former; (3) various areas of impact; (4) societal steering and shaping processes (governance); or (5) the public discourse on technology and the related potential for controversy. The usual classification of TA projects into technology, problem- and project- induced TA is compatible with these five levels: technology-induced TA starts with technologies and applications (1 and 2), problem-induced TA with impact areas, governance and discourse (3, 4, and 5). Project-induced TA may start from anywhere in this scheme (often with applications, but also in the field of discourse, e.g. in the case of the evaluation of a citizens' conference). The following figure clarifies this approach:

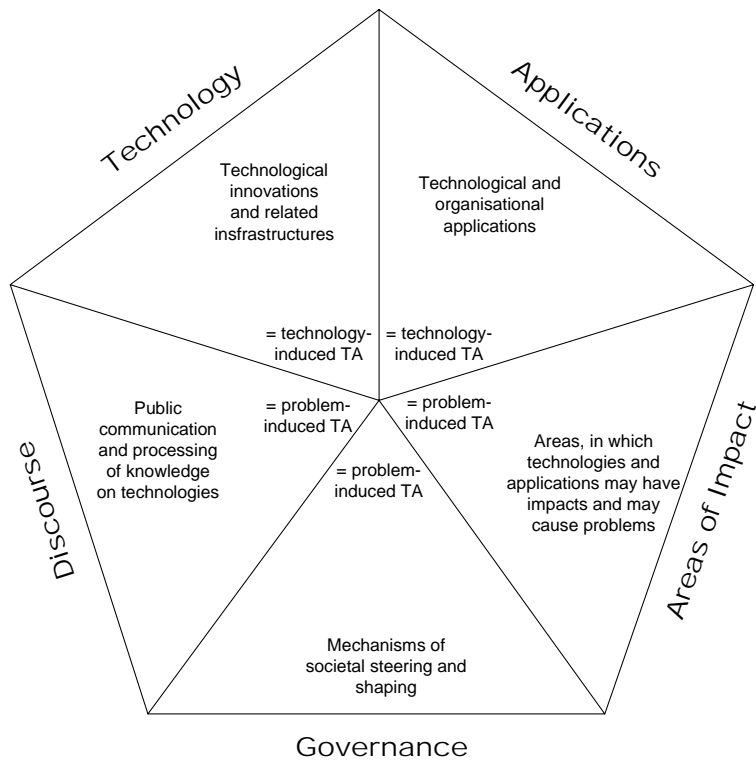


Figure 1: Perspectives of analysis in technology assessment

Typical TA studies take their point of departure from one perspective and from there explore the effects induced from other perspectives. The following Figure 2 depicts a selection of topics (projects) we have dealt with at ITA and shows that we adopt all five perspectives. We have derived and refined our main research areas (see section 2) by clustering topics and projects. The final Figure 3 shows that one of the distinctive features of our main research areas is that they usually take different points of departure in designing their projects; the arrows indicate that, as a rule, we take several perspectives into account in one project; this figure also shows how TA analyses the interdependencies between the perspectives.

**Interdependencies
between the
perspectives**



Figure 2: Selection of current and planned topics at ITA

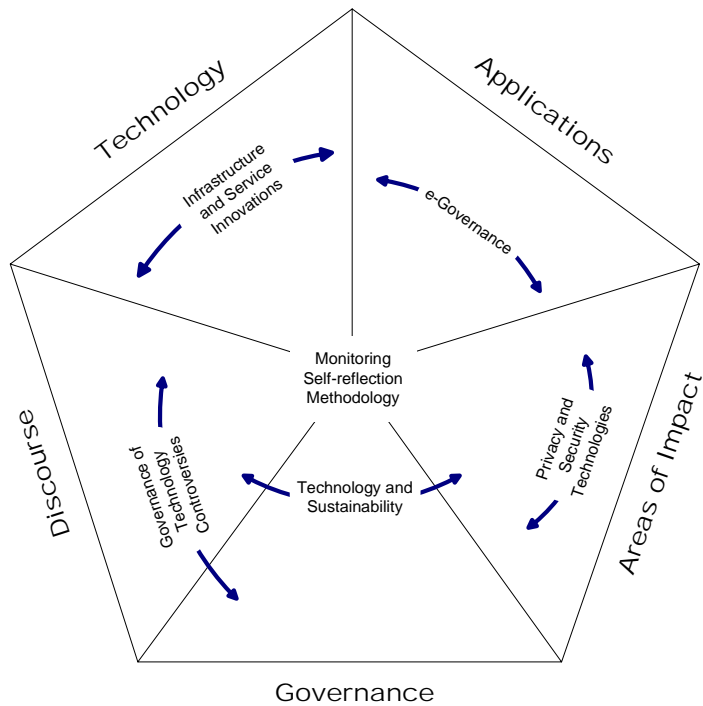


Figure 3: Starting points of main research areas of ITA