European Concepts and Practices of Technology Assessment

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Europe and the European Union are interchangeable terms when it comes to understanding the Continent and attempting to uncover a common culture and approach to policy making. This assertion stands true at least when seeing Europe from the outside and providing a description of the world's state-of-art on a particular issue. Many people would disagree that Europe has a common cultural entity and would point to a myriad easily evident cultural and political differences on the Continent to prove the point. Nevertheless, no one can dispute that there is a common cultural inheritance and history across Europe and that most differences we witness can be balanced out by commonalities. Proof of this is nothing else than the existence of the European Union itself. A union covering more than 80% of the Continent in a borderless area with common decision-making bodies, is a testament that Europe can indeed be seen as a common entity in world affairs. Therefore, it is acceptable to refer to European ways of "doing things" by using the European Union as the main unit of analysis.

When it comes to Technology Assessment (TA), this argument is even more accurate since S&T policy is evident in the European Union as much (or even more so) as within the individual member states. Where decisions and budgets are concerned, the EU runs one of the biggest science and technology (S&T) research budgets in the world and develops legislation that is adopted by all member states, thus, making it the most important actor in this regard on the Continent. As such, the EU has developed its own analytic and advisory

structures, including specific TA-focused ones. On the other hand, it is still a grouping of independent countries that have their own views and priorities on S&T and as well as specific TA capabilities. But this fact does not negate the other and in reality, the actual actors and processes are, more often than not, the same in individual countries as in the EU. Based on this thinking, one can clearly deduce a European TA with specific European characteristics. These will be analysed below.

1 Science and Technology Policy Structures in Europe

As an amalgamation of independent states with varying degrees of S&T capabilities, one should provide a brief overview of national aspects as well as EU ones. In terms of research and development (R&D), gross domestic expenditure in the EU in 2016 was EUR 303 billion (a 0.4 % increase on the year before, and 40.0 % higher than 2006). In terms of world comparison, in 2015 R&D expenditure in the EU was 66.6 % of that recorded in the United States, and 48.5 % higher than in China, more than double the expenditure in Japan, and more than five times as high as in South Korea (Eurostat 2018). The individual country expenditure varies greatly from more than 3% (R&D expenditure as percentage of GDP) in Sweden and Austria, to less than 0.5% in Latvia and Romania. In fact, one can deduce a north-south, west-east divide when it comes to R&D expenditure in the EU, where the Northern countries have higher expenditure than Southern ones, and Western more than Eastern ones. The source of R&D funds varies amongst countries but on average more than half (55.3 %) of the total expenditure is funded by business enterprises, about one third (31.3 %) is funded by government, and about 10.8 % from abroad (foreign-sourced funds).

Decision-making structures in S&T also vary from country to country yet certain commonalities can be found. Most national public funding is channelled

through the Ministries of Science to research councils and universities, however regional authorities also play a role in funding and deciding on S&T policy. National Research Councils or Associations usually administer the bulk of the public R&D funds through competitive grants that are mainly absorbed by universities, research centres and small/medium enterprises. Decisions on allocation are usually done through expert, peer review systems that nowadays are mostly international in nature. National decisions and R&D evaluations commonly include the participation of European or even international experts. This, in addition to the fact that most national R&D projects include international collaborations, shows how far national S&T structures are interwoven in the European system.

At the European Union level, S&T policy is undertaken through specific and unique structures. Central amongst them is the European Commission, (EC) the executive branch of the European Union. With a wide remit akin to a government cabinet and about 32,000 civil servants, the EC is the most powerful decision-making body in Europe, also in the area of S&T. The Research and Innovation Directorate General is responsible for S&T policy and an annual budget of ca 10.1 billion Euros. Most of the budget is dispersed in the form of competitive research grants with a clear purpose to foster European cooperation. As such, grants request collaboration between institutes and businesses from a number of member states and most of them will involve consortia with ten or more individual member state representation.

Another key EU research funder is the European Research Council (ERC). ERC is an independent organisation to the European Commission, with a budget of ca 1,3 billion Euros and a remit to promote European R&D through individual funds to be spent within Europe. Competitive calls disperse grants to individual experts, from anywhere in the world, to undertake research in Europe. Wide European collaborations are not obligatory, neither the focus of research has to be in Europe. Only the location of the individual must be in Europe as this is seen as another way of promoting European S&T excellence through individual expertise.

Furthermore, even the briefest of European S&T structures description would be insufficient without mentioning the European Parliament (EP). The EP is the legislative part of the European Union with a remit similar to any standard Parliament in a parliamentary democratic system. Debates on S&T issues are enacted in the EP, relevant legislation is approved and the final budgetary decisions for the entire EU are also made there. The main responsibility in the S&T area lies within the Committee on Industry Research and Energy that has about 45 members representing all EU member states. Significantly, the EP has its own independent TA advisory structures as described below.

Finally, one should also include the Council of Europe as another player in S&T developments in Europe. As an international organisation with 47 members, representing the whole of the European Continent and founded in 1949, the Council of Europe's aim is to uphold human rights, democracy and the rule of law in Europe. Despite this vague set of goals, the Council of Europe has been active in debating S&T developments and has designed influential guidelines in the fields of biomedical research, genetics and biotechnology (Council of Europe 2018). European TA is active in the Council of Europe as it relies on established TA institutes for advice.

2 Science and Technology Priorities and Values

Describing the fundamental values that underlay S&T policies in Europe as part of a European cultural identity – beyond the diversity of the many nation states that form Europe geographically – one can easily trace back to the world views and beliefs that are basically rooted in the Greco-Roman and Judeo-Christian traditions shared by all European nations, which centrally involve respect for the rights and dignity of the individual human being. This tradition continued throughout the European Enlightenment in the 18th Century which set out to free the individual from all secular as well as religious authorities and dissolved the individual to independently guide their action

by nothing else than the in-born reason. The values and concepts that form the core of the EU charter of Fundamental Rights that was made legally binding by the European Union's Treaty of Lisbon in 2007 are clearly rooted in this humanist tradition. Taking the values and concepts addressed in the charter as a proxy for "the European value system" Schroeder and Rerimassie (2015) have shown how values such as justice, solidarity, equality, dignity and citizen rights (all connected to the appreciation of the rights and needs of the individual) can be identified as guiding principles in S&T policy. This is also evident in recent public discourses about the right way to shape scientific and technological 'progress' in a socially sound, publicly acceptable, or ethically justifiable way and thus, in the best interest of the 'common good'. This not only applies for the obvious prominent role of the concept of 'human dignity', for instance in recent debates about modern bio-medical options (such as gene-therapy or human in-vitro-fertilisation and embryo research). It is also relevant for societal discussions about a 'just' social distribution of benefits and risks of innovation processes, about 'equal' access to the benefits of advanced technologies, or about 'citizen rights' in the governance of new technologies and in protecting themselves or their living environment against un-intended impacts connected to technological innovations.

As part of the European value system relevant to S&T policy, one must add to these concepts – as Schroeder and Rerimassie do – a more recent appreciation of nature and natural resources. This ranges from the "Silent Spring" discussion in the 1960s to recent climate change policies and its implications for energy policy in the 2000s. Nowadays the value of 'nature' is widely accepted and addressed as a guiding principle of S&T as indicated in the political concept of sustainable development and in the legal enforcement of environmental protection in private and public administration and management. Besides this, it goes without saying that individual freedom as a heritage of Enlightenment and an achievement of the European bourgeois revolution is historically connected with freeing S&T development from restrictions of religious beliefs or governmental barriers. Enacting research at the frontiers of

human knowledge, investing in innovative technologies, striving for new technological options that open up new markets is regarded to be an indispensable part of human freedom and driving force of social welfare. This is mirrored in the many private investments of R&D companies and in public R&D programmes on the EU level as well as initiatives of the national European governments in areas such as Biotechnology or Information Technology.

Thus, one may say that both the continuous effort for innovation and technological change as well as the protection against its possible ethically unintended consequences, are rooted in the value system evident in European culture. This, beyond socio-historical reflections, can be seen in the "Lisbon Strategy" that accompanied the ratification of the Lisbon Treaty on the European Union (2007)[1] and has been continued by the current "Europe2020 strategy"[2]. The agenda of the European Union as formulated in these documents, clearly underlines the European claim to be one of the leading innovation hubs globally and declares that increasing the global competitiveness of the European research area and economy is the foremost goal of European S&T policies. On the other hand, the Precautionary Principle is prominently featured in the Treaty on the Functioning of the European Union (Article 191) as the guiding principle for protecting European citizens' health and the environment. The application of the Precautionary Principle is justified as follows: "where scientific data do not permit a complete evaluation of the risk, recourse to this principle may, for example, be used to stop distribution or order withdrawal from the market of products likely to be hazardous." (EC 2000). The principle "may be invoked when a phenomenon, product or process may have a dangerous effect, identified by a scientific and objective evaluation, if this evaluation does not allow the risk to be determined with sufficient certainty" (EC 2000).

[1] http://www.europarl.europa.eu/factsheets/en/sheet/5/the-treaty-of-lisbon
[2] http://ec.europa.eu/eu2020/pdf/COMPLET%20EN%20BARROSO%20%20%20007%20-%20Europe%202020%20-%20EN%20version.pdf

The application of the principle implies a) thorough scientific evaluation of possible dangers and of the degree of scientific uncertainty involved in this, b) an evaluation of risks and potential effects of non-action and c) the participation of all interested parties in the evaluation of measures to be taken. The principle thus, can be seen as a reaction to the uncertainties implied in the ever-accelerating pace of technological progress by inducing thorough analysis and an inclusive democratic process of risk governance. Moreover, the application of the precautionary principle on a case by case basis (not as a general routine) also implies that the burden of proof (for danger or risk) is put on the maker of the products in question, who has to show their harmless nature. The Precautionary Principle has guided many regulatory processes in the EU – such as REACH[3] on hazardous chemicals or the regulations regarding Genetically Modified Organisms (GMO) – and manifests itself in many EU-wide regulations for environmental or consumer protection.

Furthermore, it can be said that the parallel or accompanying working of the enforced support of research and innovation on the one side, and the precautious protection against its possible negative consequences on the other, is not only a characteristic for the level of the EU S&T administration and governance, but is virulent also in the European member states and their S&T activities. The move to orient the current EU research framework programme towards and alongside great "societal challenges" (and not, for instance, alongside fields of technology or research) can be read as a formula to foster both. As progress in social welfare by increased research and innovation efforts oriented towards pressing societal needs and as the alignment of S&T with societal demands and expectations and the rights of the European citizens. Orientation of S&T towards society – or embedding science in society – in this double respect of demand driven R&D and societal governance of its course, are general features (including a broad scope of local interpretations) of R&D policy in Europe. This, however, should not allow us to forget that in

[3] Regulation concerning the **R**egistration, **E**valuation, **A**uthorisation and Restriction of **CH**emicals

each case, technology development is subject to societal and political debate on how a balance can be defined between innovative dynamics and global economic competitiveness on the one side, and demands for protection of negative affected values or interest of societal groups on the other.

3 TA State-of-art: Methodologies and Impact

Past drivers and prospects of TA in Europe

TA as a concept was established in the 1970s and 1980s in Europe and led to the development of institutions in academia, public administration and the private sector that are active in research on societal or environmental impacts of technologies as well as in advising policy making on S&T issues. The scope of institutes and research groups dealing with aspects of TA such as science and technology ethics, risk assessment and communication, science and society studies is very broad. The term Technology Assessment itself, however, is mainly used for activities focusing on policy advice. The success of TA in Europe after the establishment of the Office of Technology Assessment (OTA) at the US Congress in 1973 and beyond its closure in 1995, is represented by the establishment of the European Parliamentary Technology Assessment (EPTA) network representing 12 parliamentary TA institutions and the European parliament plus 10 associate members representing TA related institutions in other countries in Europe and beyond.[4]

Certain socio-cultural developments and structures in the 1970s and up to the 1990s can be identified as being conducive to the development of TA in (Western) Europe (Hennen & Nierling 2015). Firstly, in most Western European countries, there was a highly developed and differentiated R&D system with a strong and visible commitment by governments to develop and fund national R&D performance, mainly in order to improve or foster international

[4] www.eptanetwork.org

competitiveness of the national economy. S&T was clearly regarded as a decisive factor of social development, which in the best interest of society had to be taken care of by the government. This was reflected in the setting up of specific structures in governmental administration (i.e. Research Ministries), growing public funding for R&D, as well as by increasing the salience of R&D issues in many standing parliamentary committees. Secondly, there was a strong and articulated public interest in S&T issues. Apart from a more generalised criticism against "industrialisation" or "consumerism", citizen initiatives on every political level developed demands for a say in planning decisions and R&D politics. This was a reason why the issue of public participation in TA, right from the inception of TA in the US and even more later in Europe was a main aspect. Thirdly, problem oriented research and self-reflexive science gained importance in the academic sector, first in the field of environmental politics and later on in risk assessment and systems analysis in the social sciences (e.g. Science and Technology Studies, risk perception), and in ethics of S&T (environmental ethics and bioethics). The term 'sustainable development' served and still does, as a focus for interdisciplinary problem oriented research. Within these activities, there has been a visible and growing fraction of the academic sector advocating TA-like 'hybrid-science' and policy oriented research. An effect of these factors was a strong and explicit demand from the policy making side for support via the best available scientific knowledge in order to deal with public concerns. In some countries, this manifested mainly in demands for a particular support of the national parliament with best available and non-partisan scientific advice. In other countries, demands for stimulating a vivid (and well-informed) public debate and a better connection of parliament and government to ongoing public debates prevailed. This resulted in different forms of institutionalisation of TA bodies in relation to parliaments and governments (van Est et al. 2015; Enzing et al. 2012; Hennen & Ladikas, 2009).

Nowadays, Technology Assessment as a means of policy advice is widely established in many Western European countries. Otherwise, in Southern Europe and especially in the new European member states in Central and

Eastern Europe, TA structures are often missing or only weakly developed. One has to be clear about the fact that today the situation for Central and Eastern European countries is significantly different from the times that TA was originally established in Western Europe. Since the collapse of the 'Iron Curtain', Eastern European countries have been facing a great challenge in building up the socio-economic structures and political cultures that have been the norm in Western Europe for decades. As TA was a widely unknown term in these countries, the conditions for building up TA structures differ from those that initiated the development of TA in the 1970s and 1980s (Hennen & Nierling 2015). In most Central and Eastern European countries the main challenge remains building up new structures or fundamentally restructure existing R&D systems. In these cases, R&D policy has been busy setting up new funding structures (e.g. by establishing competitive instead of institutional funding) as well as new agencies for funding, promoting and evaluating S&T. Here, the R&D landscape is in transition and is less about 'protecting' societal needs and values against the dynamics of S&T, and more about instigating dynamics and exploring innovation paths to generate economic growth and to keep up with pressures of globalisation. Social impact of S&T comes into perspective less in terms of environmental or health risks and ethical issues, and more in terms of supporting societal welfare.

Nevertheless, the exploration carried out in during the Parliaments and Civil Society in Technology Assessment (PACITA) project[5] revealed that despite existing barriers, there is a role for TA in adapting and offering support with regard to existing deficiencies and problems of S&T policy making. Concerns about problems of S&T policy making often result in an explicit demand for 'knowledge-based policy making' for which TA is welcome as a means of underpinning decisions with best available knowledge in an unbiased manner. TA can significantly contribute to ongoing activities of modernising the R&D

[5] PACITA was a four-year EU financed project under FP7 aimed at increasing the capacity and enhancing the institutional foundation for knowledge-based policy-making on issues involving science, technology and innovation, mainly based upon the diversity of practices in Parliamentary Technology Assessment. http://www.pacitaproject.eu/

system by supporting the strategic planning of landscapes, evaluating capacities, or supporting the identification of socially sound and robust country-specific innovation pathways. Due to often poor transparent democratic decision-making structures in S&T policy making, which results in a lack of communication and cooperation among relevant actors (academia, government, parliament, CSOs), TA could find a role as an independent and unbiased player able to induce communication among relevant actors on 'democratic' structures. Other than in the 1970s and 1980s in Western European countries, nowadays S&T is generally far less an issue of a livid public discourse and activism of CSOs. Currently relatively low public engagement in S&T debates in Western Europe happens in an established system of professional and public authority bodies dealing with risk and ethical issues, which is often missing in Central and Eastern Europe. The capacities of TA to "stimulate public debates" (as particularly developed by the Dutch and Scandinavian TA organisations) may gain particular importance here.

Overall, in some European countries TA is in the making and has to define its role in relation to the specific challenges without merely adopting structures and concepts from Western neighbours. It is clear that institutionalising TA at parliaments or governments is not necessarily the next step. It might well be that in terms of institutional solutions, none of the Western European models realised so far are appropriate. Enabling an independent form, but at the same time keep a close exchange with existing S&T policy making is therefore desirable. In this respect, ideas like a TA network including different (governmental, scientific, societal) actors and bodies with more or less close relations to policy making, as well as a 'NGO model' for TA are on the table. In this respect, it is important for future activities to take into account the fact that TA can be supportive (and organised) on different levels of R&D policy making activities. The explorative endeavour of the PACITA project focussed mainly on the macro level of national bodies and authorities of policy making. Yet, supporting activities could also aim at the meso level of regional or local bodies or on the micro level of R&D strategies developed in industrial companies or individual research institutions. By initiating TA activities on different levels

a “distributed structure” of TA could evolve that might be more appropriate for some countries, rather than aiming at establishing powerful TA organisations on the national level.

Concepts and methods of TA

TA has always been driven by two impulses: one relates to expert analysis and the other to public deliberation. Accordingly, two models of TA have been prevailed throughout its history: a policy analysis model and a public deliberation or interactive model. Both models play a role in Europe (Guston & Bimber 2000). When the Office of Technology Assessment at the US Congress was established, this policy analysis model was predominant and over time influenced the take up of TA in Europe in the 1970s (Vig & Paschen 2000). The deliberative or interactive model gained importance in Europe during the 1980s and 1990s. Nevertheless, both the scientific as well as the deliberative vein of TA are indispensable features and in most cases TA projects are a blend of the two. One could argue that e.g. in the Netherlands and in Scandinavian countries a more deliberative brand of TA is predominate, whereas in German speaking countries, TA stands for a more scientific (policy analysis) approach[6]. Of course, this should not imply that the respective other side would be completely missing in each case. For instance, in the Netherlands organisations such as TNO or Twente University have significant research activities on social and environmental impacts of new technologies, while many institutions active in the German speaking network also apply participatory or deliberative methods when carrying out TA studies.

Overall, TA processes in Europe involve scientific as well as interactive methods and procedures (Hennen et al. 2004; Decker & Ladikas 2004). Scientific methods such as Delphi surveys (for gathering multidisciplinary expert knowledge), modelling, simulation or systems analysis (for understanding socio-technical systems) or scenario techniques, as well as discourse analysis for evaluating and uncovering argumentative landscapes of political and public

[6] For a full account of the German-speaking TA network activities, see (in German) www.openta.net

debates, are widely applied. This is true not only in dedicated TA organisations or institutions, but also in a broad scope of public and private research groups and academic bodies active in sustainability research, transition research, environmental impact assessment and social studies in science and technology. In many European countries problem oriented research of this type is part of the public S&T portfolio and established in specialised research institutions as can be seen e.g. from the port-folios of public research organisations such as TNO[7] in the Netherlands, VITO[8] in Belgium, HGF[9] in Germany, ESRC[10] in the U.K., or INRA[11] in France.

Currently, many of the widely established interactive, participatory or dialogue methods have been adopted or even developed by European TA institutions, such as consensus conferences and citizen juries, stakeholder workshops, or scenario workshops. Meanwhile, beyond TA organisations, participatory methods are widely applied in S&T policy making by consultancy groups and other specialised private companies on behalf of public authorities and local governments[12].

In the following, we provide an overview on the state of institutionalisation of TA as policy advice, mainly at national parliaments and a discussion on the relevance of participation for S&T policy making with a focus on the EU-level.

TA as policy advice

TA's mission is not merely to do research of the potential impacts of technologies on society, but also to give advice to policy making regarding options for a socially sound implementation of technologies with a focus on social welfare as well as environment and health. The two constitutive veins of TA,

[7] www.tno.nl
[8] https://vito.be/en
[9] www.helmholtz.de/
[10] esrc.ukri.org/
[11] www.inra.fr
[12] See e.g. overviews supplied by the engage2020 project – www.engage2020.eu

the scientific and the deliberative, imply that it is established for relevant actors mainly as a way to build "bridges between science, society and policy" (Decker & Ladikas 2004). How these relations are structured and to what degree TA relates itself to policy making, science and society differs according to national context. Also, the different links between these spheres imply complex institutional and interactive practices. The level of TA's involvement in S&T governance, the organisational level of S&T structures as well as the project level of knowledge co-creation involving different stakeholders, has been explored in detail for several European countries (van Est et al. 2015).

Nowadays, S&T policy making in European countries cannot be done without taking into account and trying to anticipate possible consequences of S&T, which in turn is relevant for setting up research funding programmes. Thus, most programmes include some type of risk assessment activity, research on sustainability aspects, and ethics that aim to include the interests and values of relevant actors. TA in this respect serves as advisor for governments on the national, but also on the regional level.

In Europe, research on the impacts of (new) technologies on society is represented in academic systems by departments, institutes or research groups in various manners, such as risk assessment and risk communication, social studies of science and technology, environmental research, sustainability research, etc. Programmes on TA are established as part of big public research institutions (e.g. HGF, TNO). Also among the so called "Joint Research Centers" of the European Union there is an institute active and specialised in the field of TA (Institute of Prospective Technological Studies). Beyond public institutions, TA or related studies are also carried out by independent private research and consulting institutions (e.g. Technopolis, Öko-Institute, etc.).

Here, we focus on the most visible type of TA as policy advice which is the parliamentary TA landscape in Europe. Ironically, by the time OTA was closed, TA – as an import from the U.S. – had already become a major success in Europe. Today the European Parliamentary Technology Assessment Network (EPTA) comprises 13 national parliamentary TA institutions including the TA

body of the European Parliament while there are another five associate members with close relationship to their national parliaments[13]. Parliamentary TA in Europe took up the heritage of the OTA, but today differs from it in many respects, organisationally as well as with regard to methodology and mission (Vig & Paschen 2000).

Different institutional models are applied in different countries, depending on their political and/or parliamentary traditions and cultures (Fig. 1). In some countries (e.g. Finland and Greece) parliamentary committees for TA have been established which, according to their agendas, invite experts to their meetings or organise workshops and conferences in order to enable scientific support. In the case of France, the individual members of the committee carry out TA studies on their own and deliver the results in the form of reports to their Parliament.

In other countries parliaments have chosen a model of institutionalisation that is closer to the OTA model. Here, the Parliament runs a scientific office on a contract basis with a scientific institute (e.g. in Germany and at the European Parliament) or as part of the parliamentary administration (e.g. in UK) to which TA studies are commissioned according to the information needs of the Parliament. These studies may result in short parliamentary briefing notes or in fully fledged TA reports drawing on their own research and also on input from a number of external scientific experts and stakeholders.

A third type of a parliamentary TA body is characterised by close cooperation between parliaments and external independent institutes (and in some cases related to the national academies of sciences) that support parliamentary deliberations with policy reports and the organisation of workshops or hearings. Often this kind of arrangement involves an additional mission of the institute, which opens up the classical (OTA-like) TA setting of experts and policy makers to an additional third party: the wider public. The mission of TA then is not

[13] www.eptanetwork.org

only to support politics by providing in-depth and unbiased analysis of possible effects of S&T on society, but also to inform and intervene in public debates. This kind of orientation of the consulting process towards the public, stakeholders, societal groups or citizens, can be regarded as a European 'improvement' of the classic TA model. This model also viewed societal values and interests as an indispensable prerequisite of TA when evaluating technology impacts. For instance, contacts to societal groups in the form of interviews, workshops, etc. have always been part of TA processes. Nevertheless, in the new 'public' or 'interactive' model of TA, society plays a more active role and participatory methods have been systematically developed and applied in order to give the public a voice in the TA process, while at the same time initiating and stimulating public debates about the issues at stake.

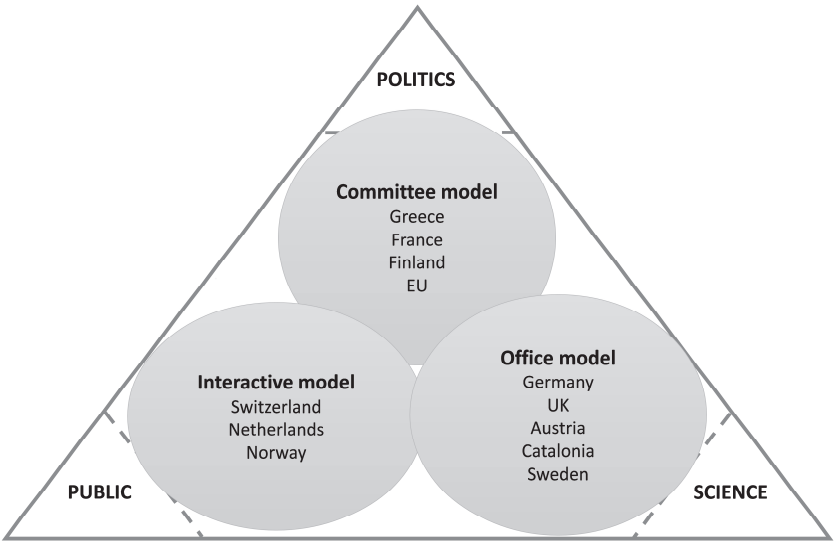

Figure 1: The intermediate role of parliamentary TA in Europe (adopted from Hennen & Ladikas 2009)

Against the background of these three models of institutionalisation – the "committee", the "office" and the "interactive" model – it is apparent that TA in Europe plays an intermediate role with regard to three societal arenas: science, politics and the public sphere. Which of the three models is the focus, varies according to dominant political cultures. However, any TA institution has to position itself in this triangle and can have the role of translator or mediator between science, society as well as policy making at the same time. Working according to the more 'classical' model of scientific policy consulting does not imply a 'closed circle' type of policy advice where experts and policy makers negotiate behind closed doors. The TA process must always be transparent to the general public and especially to stakeholder groups of specific issues. As a matter of fact, any TA study must be available for public use. Further, TA with a focus on intervention in public debates – by e.g. organising citizen conferences or setting up lay panels – cannot function without independent scientific expertise and will be politically meaningless without involvement of related policy making bodies.

TA in public debate (participatory TA)

The search for new forms of governance in the field of S&T is ongoing in Europe, as perhaps everywhere. This includes a redefinition of the role of scientific knowledge and experts in policy making ("democratising expertise") as well as of that of the citizen or the general public. This implies that the role of the citizen does not only comprise civil, political, and social rights, but also rights with regard to the development of S&T. Technological citizenship is related to the tendency of seeing aspects of life that were formerly non-political, as politically relevant now. The development, diffusion, and implementation of technologies is increasingly regarded as a political issue due to their immense impact on society. Lay people are not only affected by S&T as clients or consumers, but also as members of a polity (citizens). This so called "participatory turn" has been an ongoing feature in many Western democracies (Jasanoff 2005). In Europe however, it is closely tied to the establishment of TA institutions in the 1980s and 1990s and has been sustained significantly by parliamentary TA institutions (Joss & Bellucci 2012). Particularly focused on

participatory TA are the Danish Board of Technology Foundation and TA-Swiss, which have established a number of activities organising citizen and stakeholder engagement on TA related issues.

A redefinition of the role of citizens, however, is not only been visible on the national level. In the last 20 years, a series of documents and actions on the European level mark a remarkable shift from the previously predominant traditional Public Understanding of Science (PUS) "deficit model" to a new appreciation of citizens and their views of ethical problems and the risks related to new technologies (Allum et al 2008). There are indications that the predominant technology-driven approach to S&T policy, which includes an instrumental model of TA, has been enriched by efforts to steer S&T in a new direction by making societal needs and demands a part of research agendas. A point in case is the call for dialogue, participation, and empowerment of the European citizen in the EU "White Paper on Governance" in 2001 (EC 2001a). Starting from the observation "that people increasingly distrust institutions and politics," the white paper suggests to "open up policy making" in order to render it more inclusive and accountable. The relationship between science and society is regarded as being crucial in this respect. A report by the white paper working group "Democratizing expertise and establishing scientific reference systems" (EC 2001b) contains the following recommendations: revise the selection of expertise used in the process of policy making, establish guidelines for the selection of expertise, and enable inclusion of a spectrum of expertise in policy advice that is as broad as possible. Most prominent among the recommendations regarding socially robust knowledge for decision making is the creation of opportunities "for informed participation by society in policy making". The promotion of participatory procedures (such as citizens' juries and consensus conferences) is one of the means to be employed to support "public debate, knowledge sharing and scrutiny of policy makers and experts" (EC 2001b: ii). The European Commission took up this reorientation in S&T governance in its Science and Society Action plan (EC 2001c), part of its activities to establish the European Research Area. The ac-

tion plan recommends actively involving people in technological development, "particularly in defining the priorities of publicly funded research" (EC 2001c: 8). To this end, participatory policy making would have "to be widened and deepened to systematically include other sectors of civil society at all stages" (EC 2001c: 14).

These indications that S&T policy in Europe is being opened towards the public have to be viewed in the context of the overall economic objectives which form the guiding perspective of Europe's S&T policy and the European Research Area programme. As Levidow and Marris (2001) have argued, "the rhetoric of openness" does not indicate a shift to a "new contract of science and society" but rather a shift from conceiving the problem of technology controversies as being grounded in the "ignorance of the public" to a problem of trust in institutions (see also Abels 2002). This move is thus a way to re-establish trust in policy making by increased communication without giving up the expert dominated system of advice. Overall then, this is not meant to lead to a reconsideration of the goals and guiding principles of innovation policy, but to be a means "to restore the legitimacy of science and technology" (Levido & Marris 2001: 348).

It is however widely acknowledged by experts as well as by representatives of the European Union that Europe is in need of a reorientation in order to react to criticism regarding the democratic legitimisation of EU policy making and of S&T policy in particular. Recently, new modes of political communication on the Internet, triggered initiatives by the European Commission to promote the use of e-participation as a means of overcoming the so called "democratic deficit" and to improve the connectedness of EU policymaking to the European citizenry. This led to several platforms and internet-fora as well as to the introduction of electronically supported public consultations on EU policy issues and finally, the establishment of the European Citizen Initiative that opened new ways for Citizens to be involved in EU policy making. The ambition, effects, flaws and prospects of these activities have been subject to various TA studies (Lindner et al. 2016; Korthagen et al. 2018).

Moreover, the influence of the concept of Responsible Research and Innovation (von Schomberg 2013; Stilgoe et al. 2013; EC Expert Group 2013) on the current EU research framework program Horizon2020 underlines the relevance of public participation in the context of European R&D policy. "Inclusion" of stakeholders and citizens beyond expert communities and economic actors as well as "responsiveness" to societal needs and demands are cornerstones of the concept and led to their inclusion in calls and funding schemes in Horizon2020 with particular emphasis on participation. The perspectives of public engagement in S&T policy and research on the European level have been subject to several EU funded TA projects[14] .

The widespread use of participatory methods in S&T policy making has however led to criticism among some TA scholars as well as political scientists. The relation and especially the influence of public engagement on policy making, has been subject of criticism in the last years. The criticism is based on more general reasoning about the political role and function of participatory TA procedures as well as on case studies of single participatory processes (for an overview: Hennen 2012). This criticism often refers to the unclear political role and function of public engagement with regard to institutionalised decision-making processes, whereby there is often a lack of commitment by policy makers to adopt the outcomes of public engagement processes. In addition, there is a fear that public engagement is instrumentalised by political interests for pushing through their own agendas.

It is true that due to the mostly informal status of participatory procedures in R&D policy making, participation is – like any other form of policy advice – subject to strategies of instrumentalisation and can be used for 'symbolic politics'. It should however not be ignored that participatory TA, as an element of deliberative democracy, has to act in an environment that is dominated by political cultures, institutions, and powerful actors that are often hostile to any restructuring of science and research policy making. Participatory TA

[14] www.engage2020.eu, www.PE2020.eu, www.CIVISTI.eu

makes up only one aspect of an ongoing movement toward more democratic structures in S&T. Thus, more recently, the tendency to overload participatory procedures with expectations of a reform of representative democracy has thankfully ceased. On the other hand, the role of participatory TA formats to inform policy making by perspectives beyond those of experts or politicians, have come to the forefront. Yet, these participatory procedures are regarded as a new form of governance, but not of political mobilisation (as some would like to see it).

Cross-European TA and European TA Networking

The integration of Europe as a trans-national entity has manifested itself in the European Union for more than five decades now. Meanwhile, the European Commission and also the European Parliament have achieved remits akin to a trans-national government. For many fields of policymaking nowadays, European Directives set regulatory standards for the EU's 28 member states as they have to be implemented by national governments. The EU's research funding programmes are significant drivers of research and technology development. The current research framework programme Horizon2020 comprises an overall budget for research funding of ca. 80 Billion € (2014-2020). It is quite clear that TA in Europe has to be more than just TA in several European countries, it needs to have a cross-European and trans-national structure. The integration of the "TA landscape in Europe" to a "European TA landscape" has been partly supported by the framework programs, which, since their start in the 1980s, included a budget dedicated to research on technology impacts and research ethics that instigated the co-operation of TA institutions across Europe. For many years cross-European TA has been supported by budgets dedicated to so-called ELSA (ethical, legal and social aspects) research in the EU framework programmes. Today the SWAFS (Science with and for Society) programme funds cross-European research on Science and Society problems that is also used by the European TA community. In addition, the European Commission's definition of Responsible Research and Innovation as a cross cutting re-orientation of research towards societal needs and anticipation and reflection on R&D's social effects, has supported the co-

operation of TA actors across Europe. Projects that have been outstanding for cross-European TA activities over the last 20 years have been e.g. EUROPTA (Joss & Bellucci 2002), TAMI (Decker & Ladikas 2004), and recently the PACITA project as described below.

For a number of decades now, one of the focal points for the integration of European TA is EPTA, the network of parliamentary TA institutions (as described above). Many of its projects have been carried out with the support of or have been initiated by members of this network. EPTA has developed from a loose network of mutual exchange on ongoing activities, into a working network and has set up a number of joint research activities that resulted in reports and publications[15]. Barland and Peissl (2015) define cross-European TA "as TA (projects) done by a group of TA institutions across borders". It implies a common objective and cooperation but not necessarily the use of the same method and provide a list of several such projects that have been initiated by EPTA or have been jointly pursued by several EPTA members.

The Science and Technology Options Assessment Bureau (STOA) is the TA unit of the European Parliament (EP) and is a member of EPTA that, by setting up TA projects on issues relevant for the members of the EP, also constitutes a working area that affords cross-European cooperation of TA institutes. The European Technology Assessment Group (ETAG) as a joint endeavour of six TA institutions in Europe has been charged with several TA projects commissioned by STOA[16].

One of the most important achievements in further developing cross-European collaboration and networking in TA has been the EU-funded PACITA project (Klüver et al. 2016) that started from the assumption that TA will need to adapt to the internationalisation of science, technology and policy. The project's overarching goal was to mobilise and expand the European TA community through processes of mutual experimentation and learning. The aim of

[15] www.eptanetwork.org
[16] http://www.itas.kit.edu/etag.php

the project was to foster the development of TA into a Europe-wide support system for broadening the knowledge base of policy making in Europe by establishing a distributed system of 'cross-European TA'. In the four-year course of the project, it gathered a group of fifteen partner organisations from different European countries in a collaborative process. Among these partners, were some established TA organisations connected to parliaments or otherwise formally organised to support national policy (Austria, Belgium-Flanders), Denmark, Germany, the Netherlands, Norway, Spain and Switzerland), while others were organisations with closely related missions interested in developing locally appropriate institutional models for TA (Belgium-Wallonia, Bulgaria, the Czech Republic, Hungary, Ireland and Portugal). Activities of PACITA comprised the joint exploration of opportunities to establish lacking TA structures in various European countries. The project succeeded in introducing TA in these countries by motivating relevant actors to engage in discussions exploring barriers and opportunities for TA. Beyond that, the project carried out a series of summer schools and practitioners' TA training. Three major TA projects on issues of European relevance were selected for setting up collaborative TA projects that were carried out during the project period: aging society, genetic testing and sustainable consumption. Of major importance for fostering the exchange of policy makers across Europe was the organisation of two meetings of members of parliaments active in TA from several European countries. Another initiative was the construction of a European TA web-portal with project databases and contact points, that was organised alongside with the setting up of the German Speaking TA web-portal (Nentwich 2016).

With the organisation of two European TA conferences the project reanimated a tradition of European networking in TA going back to the 1980s and 1990s. A first meeting of the European TA community under the label of 'European Congresses of Technology Assessment' dates back to October 1982 when the Ministry of the Interior of the Federal Republic of Germany hosted a conference that attracted some 60 experts from eleven countries – among

them were representatives of the US Office of Technology Assessment. Meetings on TA held later in Amsterdam (1987), Milan (1990) and Copenhagen (1992) contributed significantly to the conceptualisation, philosophy as well as institutionalisation of TA. These conferences made clear that the European debate on TA took place on several levels – between international groups of scholars, experts, and officials who held a series of meetings during which methods of TA, the utility of its results and the possibilities and problems of institutionalizing TA agencies were discussed. With two conferences held within the framework of PACITA (Prague 2013, Berlin 2015) a major step in further integrating the European TA community was achieved. These brought together researchers from 33 countries, fostered and enhanced the scientific debate about TA as well as the exchange of TA experiences on a European level. Adopting a broad understanding of what qualifies as 'TA' allowed the conferences to address TA practitioners, academics, scientists, policy-makers, and CSO representatives together. The conferences succeeded in offering on the one hand a broad platform for presenting and reflecting project results, its outcomes and new insights. On the other, they helped to set the stage for current and future thinking about TA and its role in tackling the societal challenges ahead. This spirit was taken up throughout the European TA community, which also shows in a further European TA conference which took place in Cork, Ireland in 2017[17] and was not funded through specific public support. There are efforts to continue this series of meetings of the European TA community bi-annually.

Despite the importance of such efforts to keep the European TA community in close contact and in an interactive mode, a stable, permanent exchange platform is missing. While there is sufficient motivation and a need to have a stage for debating TA issues and exchanging information on specific projects, there is still not a concrete plan for a regular European TA Forum.

[17] https://cork2017.technology-assessment.info/

TA in the engineering process (constructive TA)

TA in Europe is mainly related to policy making and thus to governments and public authorities. There have always been voices demanding an embedding of TA directly in research and development processes (Guston & Sarewitz 2002). Especially in the Netherlands, the concept of Constructive TA (CTA) aims to apply TA early on in research and technology development processes in companies and research institutes (Schot & Rip 1997). In this sense, CTA intends to broaden the process of technology development by including a broad scope of voices in the design of new technologies. This is for instance done by organising workshops with stakeholders from a broad scope of involved or possibly affected actors for developing scenarios of future implementation of a technology. The concept of CTA has been applied in the Netherlands by organisations such as the Rathenau Institute or TNO. CTA has mainly been applied in the context of public research programmes such as the Dutch programme on sustainable technology assessment (Vergragt & Jansen 1993) in the 1990s or the Dutch Nanotechnology Consortium in the early 2000s (Rip & te Kulve 2008).

There are also other approaches to include TA into the engineering practice such as the German Association of Engineers which already in the 1990s developed a directive for TA that gives guidance to engineers for reflecting on possible unintended impacts of a technology in order to adapt the design process in a way that allows avoiding such effects as well as taking expectations and fears of society into account (see chapter 2 on TA in Germany in this book).

Another approach to apply TA principles on the level of research and development processes directly is the concept of RRI, which demands the involvement of reflection on ethical questions and the inclusion of affected stakeholders as integrated part of R&D projects. In 2013, the UK Engineering and Physical Sciences Research Council (ESPRC) made a formal policy commitment to a framework for responsible innovation. One of the biggest funders of research in the U.K., committed itself and its funding activities to principles

such as inclusiveness and responsiveness with regard to demands and expectations of societal groups as well as to reflexivity with regard to impacts and ethical implications of R&D (Owen 2014).

Generally, there are indications that industry is at least partly rethinking 'closed shop' or 'closed laboratory' strategies by opening up R&D processes to societal stakeholders and citizens. Several cases of involvement of CSOs as critical partners into the development of new technologies by industry are documented[18]. In these cases, stakeholder involvement is seen beyond a 'product testing' methodology, rather as a means to increase the effectiveness and social desirability of the technologies in question. Naturally, this increases the complexity of the innovation process by adding an external influence in the design stage and risking loss of competitive advantage by decreasing the usual secrecy surrounding product development. It is nevertheless sometimes seen as a risk worth taking for the greater future good. Although this is a new approach with hardly enough history to allow for impact evaluation, it is dynamic and ever-expanding.

4 Perspectives for European TA and Global TA

What we have described here as a "European TA" is in reality the main bulk of applied TA in the world. Few non-Europeans would acknowledge the term TA in their S&T context and even then, they are likely to be directly collaborating with European TA institutes. As such, the matrix of TA roles, which is described in the introduction and has been used in this book by our colleagues to map their national TA landscapes, is indeed a direct representation of European TA. It was developed by the main European TA players to describe their work and it remains still a good description of what TA is about in Europe.

[18] For instance http://www.responsible-industry.eu/ and http://www.rri-prisma.eu/

In order to juxtapose a European to a potential Global TA, one needs to take into consideration the unique aspects of the European TA that result in both pros and cons of its development. The biggest advantage for the European TA is that it can be seen as a microcosm of a global development. Europe is an amalgamation of countries, cultures, norms, values and political systems. Not long ago it was split into the clear sides of 'East' and 'West' that denoted sharply different political systems. Similarly, Europe is divided into a 'North' and 'South' axis that it is not conceptually different (at least in the mind of many Europeans) to that of the global North/South division. In addition, it includes a number of different languages and norms of behaviour that make interactions complex, if not outright difficult for many. All in all, Europe is a small 'global' entity, yet it has nevertheless achieved a certain TA commonality. One might argue that there is not much that non-Europeans can bring into the TA equation that European experts have not already discussed in their effort to unify it.

Nevertheless, European TA did not happen in a vacuum or as a simple desire to create a new idea. It was one of the myriad efforts that took place on the Continent to unify it under a single entity. The attempt to define a European TA must be seen in the context of the European Union and the great need to achieve common definitions and approaches. Without the will of the individual member States to promote and fund such attempts, there would be no 'European' TA. In the same thinking process, it is hard to imagine a similar global initiative that can create a Global TA. We lack a global government and the UN system can hardly qualify as a strong decision-making structure. As such, there is no obvious global platform that would be equivalent to the EU where TA can flourish. An interesting exception is the Technology Facilitation Mechanism that is promoting the UN sustainable development goals via TA processes[19] (See chapter 8 for further description).

[19] https://sustainabledevelopment.un.org/tfm

Another challenge in taking a European TA perspective for a global development is that of current differences in governance structures. Despite the various past differences, Europe is now a pluralistic, liberal democratic system of parliamentary representation. Multi-party free elections are as standard on the Continent as well as open public debates about any S&T issue, regardless of how politically sensitive it might be considered. This is not the case in other parts of the world, representing potential future partners in Global TA. How much of a problem this is, varies on how dependent on the policy system one finds TA to be. While some see TA as tightly interwoven to liberal democracy and its methodologies inspired by democratic values of inclusion and deliberation (Grunwald 2018; Hennen & Nierling 2018 in press) some others believe that even illiberal systems can be fertile grounds for such processes (e.g. Wong 2016). Whether one can achieve true independence of opinion or true public engagement in both systems, is a matter of debate. But it is important to remind ourselves that 'different' is a necessary precondition for negotiation and compromise, and a global approach will certainly require both in great supply.

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