Constructing a Global Technology Assessment – Its Constitution and Challenges

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What should a global TA look like after all? Throughout this book we can read insightful descriptions of the state-of-art in a number of countries across the globe. At a first glance the differences are great and the challenges enormous, but we can also identify commonalities. The differences derive mainly from the decision making structures and the culture of public debates in each country. If for instance, a policy system is not used to multiple inputs, vivid argumentation and conflicting stakeholder perspectives, it will evidently be hesitant to accept a TA that is based on such processes. On the other hand, the commonalities are much more prominent and urgent. They are nothing more than the focu of TA: the consequences of scientific and technological developments on society, the environment and the economy. These are almost identical in all countries and they require urgent common attention. One could argue that the evident political and social differences in the countries represented in this book, pale in front of the need to construct a common methiodology of assessing S&T developments.

The analysis of the individual countries in this book allows us to draw conclusions about a framework on which a possible global TA could be based and the flexibilities that are a prerequisite in creating a common process amongst the many different cultures and societies.The aim is not to iron out differences but rather to specify a normative aspect that the framework can be based upon.

Whether we need a global TA approach is not questioned here. As the first chapter on "The Case for a Global Technology Assessment" shows, there is an increasing requirement for TA to adapt to the simultantuous and worldwide reach of S&T and that some challenges can only be met on a global level. That is our starting point for this book. In this sense, a global TA is needed and will be developed in any case. Our purpose here is to account for the conceptual process of its creation, based on the informed opinions of national experts. This is as close as one can get to a global debate amongst TA experts at present. As such, this book does not present a final answer to questions revolving around global TA. These will have to be re-visited with any newcomer in the debate. They will have to be continuously developed and result in new approaches. This is the nature of TA as an disciplinary concept. What we offer here is a point of departure for this process that will eventually create a global TA.

1   The Creation of a TA Habitat

The first issue of conceptual importance in the development of global TA is what kind of environment one needs to have in order to promote a global approach. By that, we mean what is the single most important denominator for the development of TA in a nation-state that can be extrapolcated at global level. The immediate reply would simply be: the existence of an advanced S&T system. Advanced in the sense of S&T being a policy priority that is translated into a clear governance system. This is naturally a prerequisite but it is not enough.

As we have seen for instance in the case of European TA (see chapter on "European Concepts and Practices of Technology Assessement"), more important than a governance system is the creation of a "TA Habitat" (Hennen & Nierling 2015). This idea of a habitat for TA is useful as it can help determine the elements needed and possibly missing for establishing a functioning TA in

a national context. How decisions are made and on which (public) knowledge these are based or how decision makers are held accountable for these decisions, are questions relevant for identifiying a TA habitat. Other aspects identified as being supportive to the development of TA structures are, the existence of problem-oriented or hybrid research activities (such as STS, environmental research or risk and security research) in the academic sector, a significant public awareness of and interest in S&T issues and, an articulated demand for or need of rational and non-biased advice in matters of S&T development and its societal implications in policy making.

Most of these elements were present when in the 1970ies and 1980ies TA concepts were developing and TA institutions were set up in the US and Western Europe. Political and socio-economic situations differ, to a great extend, nowdays significantly from those times and countries in other regions of the world face different challenges. We nevertheless hold that the identified aspects of a TA habitat to some extend, although with some cultural variation, are necessary to establish an expressed need for as well as provide elements (practical, methodological and institutional) that make TA happen.The absence of these elements can tell us something about the structures, institutions or processes needed for TA to flourish on a national level and what roles and functions it should take on. The question in the context of a global TA level is then, if we can use some of these aspects of a fruitful TA environment for identifiying needs beyond national boarders. In this respect, we observe features and framework conditions that point into the direction of a global TA habitat. There is of course international (global) exchange of academic communities (sustainability research, STS, risk assessment, science ethics) which can be supportive for and interested in setting up global TA activities. There also appears to be something like a transnational public interest in issues such as climate change, biodiversity and others, indicated for instance by globally active NGOs and by web-based international exchange of civil society organisations on S&T matters. And there are also clients on the side of policy making, i.e. all those involved in international negotiations on conventions and treaties or international consultative bodies at the UN, who are in need of

independent support in assessing the options as well as possible problems given by R&D with respect to societal challenges on a global level.

Overall, the creation of a TA Habitat assumes a common agreement on the parameters that are needed in order to develop global TA infrastructures. Every national perspective (including the EU one) in this book has described the key national aspects that need to be taken into consideration for a global development. These aspects form the parameters of global TA and are described in the following.

2 Global TA Parameters

When it comes to the development of a global TA, we can identify a number of parameters that will help us delineate it. But it is important to understand that in a global system, parameters are not fixed as binaries of "xy prerequisite" is there or it is not. Parameters refer to a continuum, whereby the focus is to identify how much of "xy prerequisite" is there. This is a pivotal aspect in our inquiry, since it is important to have adequate flexibility in identifying the necessary preconditions for the development of a global TA. For instance, if one sees Democracy as a binary variable (i.e. a system is either democratic or not), one will inevitably exclude the majority of world nations that do not conform to his/her specific definition of Democracy (usually, the standard pluralistic, liberal, non-religious western type). One the other hand, if one sees Democracy as a continuum (i.e. political systems have "more" and "less" democratic practices), one should then strive to identify the limits in this continuum, outside of which TA is not possible. This still leaves enough flexibility to accommodate a number of top-down and bottom-up systems in the same parameter where TA collaboarions are possible and desirable.

With this in mind, we have identified the following parameters that are necessary in the creation of a global TA. Each of them represents a methodological concept that should be explored when applying a common TA.

2.1   Political System

The first and outmost parameter to take into consideration is the political system of the countries that are part of the global TA effort. They range significantly, even in the small sample of our book, from multi-party to one-party systems, from liberal to authoritarian, from socialist to capitalist, from social welfare oriented to free market oriented, etc. We have seen that, independent of the political system, there is a need for the assessment of the societal embedding of advanced technologies, by e.g. effective risk management or addressing of ethical issues. There is no political system, except perhaps that of pure dictatorship, that can completely disregard legitimising policy measures through rational articulation of problems and taking into account the expectations of affected and concerned publics. Thus, there is an ubiquitous, although sometimes unexpressed, demand for TA. Nevertheless, when thinking about TA's societal and political role one needs to take the differences of political decision making structures and political cultures into account. That will require a political economy analysis that is usually not standard in TA, but nevertheless becomes necessary in this context.

A relevant question on political economy in terms of TA development is: can TA be at all possible in a non-liberal political system? This is of course pivotal, since a negative reply would severely restrict the scope of global TA. The debate on this issue is new and has already produced clear arguments on the negative, i.e. TA is not possible in an illiberal system (Grunwald 2018), and also on the positive, i.e. TA or similar activities are possible in an illiberal system (Wong 2016). Our view is that, both arguments are right and wrong at the same time, since they lack the definition of liberal/illiberal system. For instance, a dictatorship is an extreme example of an illiberal system whereby TA is indeed not feasible as the system would not even allow for basic independent thinking, let alone for meaningful public inclusion. But, is a one-party system prohibitive for TA? We think not. Freedom of expression does not depend on the number of parties running for government but rather on whether

the decision making system allows freedom of expression altogether. For instance, we have examples of public protests in China (i.e. one party system) that, not only have not been repressed, but have also led to concrete policy changes (see chapter on "Technology Assessment in China"). And on the other side, there are serious worries that some European (i.e. multi-party system) governments suppress freedom of expression through media (Hennen & Nierling 2018). Moreover, with the recent success of right wing populist movements in Europe and their apparent disregard of science expertise, there are reasons to fear negative effects on the conditions for TA to fullfill its role and mission, e.g. holding on to TA's role as a "neutral knowledge broker" in policy making (e.g. Hennen & Nierling 2018).

This leads to questions of the normative foundation of TA, which as some argue, has historically been a Western democratisation project, and as such inherently democratic in its methods (Grunwald 2018). Yet, as others argue, it can be worthwhile to look for moral foundations of universal claims (such as the participation of public in S&T decisions) in different contexts. If these different ethical-political traditions (e.g. Confucian thinking) have different values and these are at least on a par with liberal democratic ones, then these traditions should be taken more seriouslyinto account in research on global governance and ethics of specific global S&T developments (Wong 2013). There is still a vivid discussion in Europe whether and to what extend TA is bound to democratic values, i.e. to what extend TA is bound to certain political values or norms (Hennen & Nierling, 2018). It is quite clear from the history of TA, in conceptual discussions and in current TA practices that TA is bound to open, transparent and rational discourse of S&T related problems. The inclusion of all relevant actors' perspectives in the assessment of S&T, beyond the closed circles of S&T experts, is part of it. The issue here is to what extend the political context that TA is applied in, provides room for modes of S&T appraisal that the TA is methodologically and conceptual committed to.

Overall, in order to move forward towards a global TA, it seems unsatisfactory to point to the differences (and there are plenty) in the normative foundations of TA or the political systems surrounding it. The value of the parameter of the political system is enhanced by identifying its limits. Neither a one-man rule nor an anarchic system would be plausible for the development of TA. But many in-between systems would form an acceptable continuum where TA could take place fruitfully in collaborative activities. The necessary conditions would be: freedom of expression and willingness to accept open debates. Freedom of expression is obvious but the latter requires further qualification. A debate is necessary in TA whether it should take place in closed doors amongst a group of experts, or it is acted in the media with a plethora of interest groups and individuals. As we have seen before (see chapter on "The Case for Technology Assessment"), both are valid ways to do TA and both include a number of established methodologies along the continuum of classical-participatory TA. Both incorporate arguments and perspectives that are contradictory and challenging. A system that does not accept contradiction and is weary of challenges, is incompatible with TA.

Furhtermore, one has to be clear that public participation is not the only prerequisite for an 'open system'. Whether participatory TA is the preferred variety of TA chosen or not, it is not a sign of 'openness' or 'closeness' in the system. One has only to review the literature on the impact of participatory TA in policy making to find out that participation is by no means the most successful policy input (Hennen, 2002). As such, there is reason to believe that even in apparently liberal systems, decision making can be closed and elitist. Therefore, openness should be defined as the willingness to accept different perspectives, not simply to accept or not the most public forms of TA.

Concluding, the policy system is an analytical unit in global TA and must be taken into account in every attempt towards global collaboration with the help of political science and political economy. The prerequisites of freedom of expression and openness of the system, for a successful TA application,

must form the constant variables underpinning the creation of an acceptable continuum.

2.2   Science and Technology Governance System

Next to the political system, the governance system of S&T is also a relevant parameter. This refers to the administrative set up around the S&T decision making process, in other words, who decides what, where and at what point. This is an important variable in global TA as there are significant differences among countries in decision making structures that need to be taken into consideration. For instance in Germany, the federal governance system allows for the creation of state-level Ministries of S&T that are active in technology development and require regional TA capacities. As a result, some German TA institutes also have an exclusively regional focus in relation to their national one. India is also organised in a similar manner although there are no regional Ministries. In other countries, such as Australia and China, S&T decision making is mostly centralised under a single decision making structure.

Europe is a unique case in this parameter, as it also represents another level of S&T governance: that of a multi-national (or, trans-national) governance. As we have seen previously (see chapter on "European Concepts and Practices of Technology Assessement"), the European Union is a strong governance entity with significant resources and decision making capacities in S&T. This poses a number of challenges, but foremost, many opportunities of organising governance structures that have not been possible before. As a result, it requires a particular brand of TA that is evident in the multi-national organisation of the European Parliamentary Technology Assessment (EPTA). This is an example of how different countries with different decision making systems can create a common TA. As discussed previously, EPTA can be seen as a microcosm of a global TA, although significant differences between a European multi-national TA and a global level still remain.

For the development of global TA, the next governance level is more appropriate: that of global governance. This should not be seen as a reference to a 'global government'. A global government is not necessary and certainly not desired by most nation states in the world. Rather, governance here refers to global decision making structures in S&T. This is less controversial since there is an acknowledged need to develop such a system and there is also a precedent. The need comes from global issues, paramount amongst them is climate change, that requires common structures in decision making. The United Nations Convention on Climate Change is such an example, whereby countries have agreed upon a common approach and a regulatory mechanism, albeit voluntary. Another key precedent in global governance is the World Trade Organisation that includes strict governance rules of trade with arbitration and penalty mechanisms that do not differ from any standard national governance system.

For TA, the UN system provides an opportunity for global TA through the Technology Facilitation Mechanism (TFM). This is a new international body at the UN where governments, civil society, business, the scientific community, UN agencies and other actors can collaborate, network, discuss and evaluate how different technologies can help or hinder the achievement of the Sustainable Development Goals (SDGs)[1]. TFM is the result of the Rio+20 summit of world leaders in 2012 discussion for the need to explore a global mechanism for technology facilitation. Although there are already several UN bodies whose work impacts the development, transfer and dissemination of clean and environmentally sound technologies, they do not coordinate with each other, and the definition of what is meant by "clean" and "sound" technologies is ambiguous. One aim of the TFM is to ensure coherence, coordination and cooperation among the different initiatives, programs and institutions working on science, technology and innovation across the UN. For this aim,

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[1] For details see UN InterAgency Task Team on STI for the SDGs at: Sustainable development knowledge platform (United Nations): https://sustainabledevelopment.un.org/tfm

the TFM attempts to clarify methodologies for assessing relevant technological developments in terms of their usefulness for the SDGs, that draws directly from TA.

Overall, the parameter of S&T governance is a continuum that spans from regional, to national, to multi-national, to ultimately global governance systems. A global TA can and must function in all of them, by creating regional, national or global collaborations for the assessment of regional, national or global S&T developments. Although the concept "global" directs one's thoughts to global problems, this is not the only focus. There are regional similarities in very dissimilar countries that have much more to share in terms of challenges and assessment needs than the countries themselves. One could think for instance, the regional energy powerhouses in Tomsk, North-Rein Westphalia or Tianjin as needing a common TA programme of the effects of energy transition, that are specific to their significant similarities. On the other hand, the issue of climate change is not regional or national. It requires global approaches and a single decision making mechanism, hence, ultimately a single TA process for the whole globe. In between these two extremes, there are myriad possibilities for TA collaborations at national and multi-national level.

2.3   Socio-Economic Development Stage

As we have seen in the contributions from some non-European colleagues, national S&T priorities are closely connected to development needs. This is to be expected since different countries have different development trajectories that require a different focus in S&T developments. Basic needs such as water, food, housing, etc. are a priority for any society that lacks them and an effort to assess the S&T development that deal with them should also be on top of the TA list. This does not preclude the parallel development of a high-tech sector that requires a significantly different approach in terms of assessment. As a matter of fact, there is hardly a developing country in the world

today that does not need to deal with both low and high technology developments at the same time. At the same time, a developed country could benefit from redirecting its focus to low-tech S&T solutions, especially regarding sustainability aspects, such as energy needs. As such, there is an opportunity for significant developments in TA methodology at global level.

One such opportunity is to be found in frugal innovation. This refers to low-tech innovation to be found in less developed regions of many countries that requests a different approach to assessment than the high-tech innovation that TA is usually focusing on. Frugal innovation is a paradigm that would require different TA methodologies than the current ones, perhaps with greater focus on societal needs, government spending and intellectual property rights. This has been discussed in the context of TA for sustainability and development, which requires new models of TA (e.g. networked, flexible) (Ely et al. 2011). Furthermore, colleagues from developing countries that have worked in the area can provide vital input in the development of TA that captures such innovation potential.

2.4   National Values

Values play the role of organiser of thoughts but also as norms of behavioural guidance. They provide concepts upon which action takes place in society and as such are a key ingredient in every debate whether on S&T issues or otherwise. Naturally, values are influenced by history and culture, both of which have unique national or even local characteristics. Efforts to analyse the incorporation of values in the S&T decision making, have been taken into consideration in the making of this book (Ladikas et al. 2015). Every national perspective has therefore provided an opinion on the main national values that have to be taken into consideration when developing TA. The importance of values in decision making cannot be overestimated and their role in developing a global TA is far from resolved. The reason being simply the apparent incompatibility amongst different national values systems.

The solution to the conundrum of values differences is to be found with the help of yet another continuum. The analysis of the values systems in Europe, India and China has shown that the apparent differences in the expression of values that govern S&T policy making, can be bridged if described on continuum scales (Ma et al. 2015; Chaturvedi et al. 2015; Stemerding et al. 2015; Brom et al. 2015). For instance, the following figure describes the main values of Europe, India and China in terms of the basic conceptual similarities or kinships and affinities:
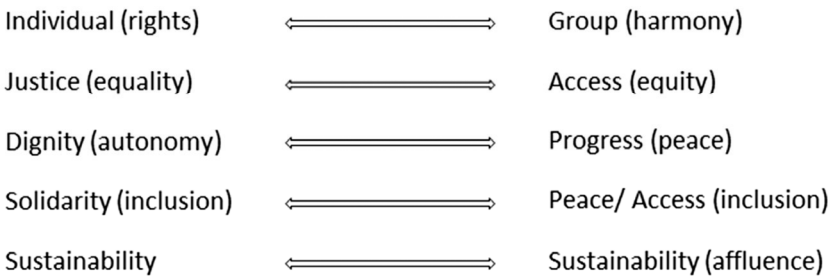
Individual (rights)	⟺	Group (harmony)
Justice (equality)	⟺	Access (equity)
Dignity (autonomy)	⟺	Progress (peace)
Solidarity (inclusion)	⟺	Peace/ Access (inclusion)
Sustainability	⟺	Sustainability (affluence)

Figure 1: Relations between main values

The apparent dissimilarities in the description of national values that are recalled in S&T policy documents in the three regions, are seen in a different light when perceived as being complementary. For instance, the problems of balancing individual and collective interests and rights as well as related values are expressed and addressed by the constitutional protection of individual human rights in Europe. The same dimension and problem of societal integration is addressed in China with the concepts of societal harmony and group rights. This means that both concepts fall under the same category, which also has a lot of intermediate values: individual rights in Europe are sometimes less prominent, e.g. in case of national threat situation; and on the other hand, individual rights in China become more prominent in cases of abuse of power. Overall, the timing and context is more important for the expression of this value than the original intention.

The same holds true for the other values of the graph. For instance, justice in Europe is related to equality, while in India it is seen as access that relates to equity; as access to S&T developments is more or less assumed in Europe, equality before the law is more prominent, while in India access is not guaranteed and therefore justice is a matter of equity between the people of the country. One can continue in a similar manner with the analysis of the other values, but the main point remains that there are far more similarities between national values in the world than one might perceive at first glance. The common understanding of national values affecting S&T policy is a crucial point of the development a global TA.

3 Global TA as Science Diplomacy

Science diplomacy refers to the process of creation of scientific collaborations in order to deal with common policy problems. It is the realm where science and politics overlap and there are plenty of examples in which science and politics are strongly intermingled at internaitonal level. Perhaps the most prominent of all examples is climate change, whereby scientists and diplomats has been working closely together to develop functional solutions based on scientific thinking but accepting the realitis of national politics as well. One can find many more initiatives, ranging from bilateral to regional to global ones and targeting highly poiticised issues (e.g. atomics energy) to purely basic needs targets (e.g. medicines), that diplomacy is a significant part of the scientific collaboration.

Overall, science diplomacy is evident one way or another whenever international collaborations are necessery in achieving scientific results. Regardless of whether there is more emphasis on the politics (e.g. science as foreign policy advisory), or on the science (e.g. policy facilitates common scientific collaborations), science diplomacy is the means to achieve the main aims.

Global TA should be seen as part of this trend with a unique area of functioning. As we have seen in the countries represented in this book, TA as policy advise is close enough to policy making to understand the intentions and agendas of national politicians, and is also close enough to the scientific world to acknowledge the opportunities and limitations of science at national level. This intermediary role between science and politics, results in distinctive opportunities for TA practitioners to function as "science ambassors" representing both science and policy pespectives at international level. Moreover, the core TA function is to explore the implications of scientific developments on society, economy and the environment. This is also the target of any international scientific collaboration that is by default organised around grand societal challenges (e.g. climate change, SDGs, etc.). As such, social impact analysis is a necessary ingredient of any cross border science policy collaboration and TA is a natural expert in it.

For these reasons, a Global TA is a strong developer of science diplomacy and can easily be seen as its natural promoter. Global initiatives such as the TFM discussed above, represent an appropriate stage for science diplomacy based on TA processes. The developmental aims of each nation are a sovereign decision based on internal politics, but the mechanisms of technology transfer depend on international collaborations that are based on both trans-national politics and scientific possibilities. What technology transfer contains and how it can be achieved, is a matter of analysis with an equal dose of political and scientific input. TA can fulfil this role by incorporating diplomats (e.g. science attaches) in its assessment process.

4 Final Thoughts

The analysis of national TA with a view to international that the book has given, provides a step towards the ambitious goal of creating a global level to

TA. There is still a long way to go in order to turn the conceptual insights described above into practical applications in these countries. Through the contextualisation of TA on the various national levels, including its location in the S&T systems as well as its priorities and underlying values, we can add substance to the parameters described above. We can then see that TA in China, for instance, takes place in a complex setting of priorities derived from Confucian values such as virtue and harmony, in a political and economic setting between radical market-driven and top down planning economy.

The same can be said for the other countries described in the book. TA in Australia has to find its way between an economic and political focus on prosperity through innovation and, next to values of equality and freedom, that of sustainability. In Russia we find the legacy of Soviet technocratic approaches to S&T and emerging needs for more effective policies for S&T development, where TA remains unknown, even though the need for it is apparent. Germany represents a country with established forms of TA in a wide variety. Yet, processes of including the public through participation and transformation processes create tensions within the German representative democratic system, which TA has to take into consideration. India's challenges concern very basic needs as well as access and equity or diversity, yet the country also strives towards big science, which still remains a priority. Here TA has to find ways towards resolving these tensions.

This leaves us with a point of departure. Identifying similar values, understanding how TA works along different stages of political or socio-economic realities, helps us find common gorund as a basis for global TA. Overall, TA's aim is to make S&T developments work better for society, based on its needs and expectations. By providing insights and descriptions into the national contexts we can see how this is done in practice as well as what is lacking in the national perspectives. Next to the necessary nation-specifc TA, we get a better understanding of where is the common ground towards a global TA. As such, we have found enough solid ground as well as sufficient challenges to start the development of a global TA. The primary task is the development of

a global TA network. For this, we can rely on the existing bi- or multilateral cooperations across borders and continents. International networks discussing the concept of TA and assessing S&T developments should be joined by those of international policy making addressing issues like climate change, sustainable energy, bio-diversity, and SDGs. Global networking and setting up global platforms for conceptual exchange and joint TA-projects is the task ahead in order to make the dispersed practices of cooperation grow towards a global TA community.

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