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Abstract

The main objective of TAMI has been to create and promote a structured dialogue within the Technology Assessment (TA) community as well between TA experts and policy makers with the aim of improving the effect of TA in Science and Technology policy.

TA in Europe has evolved significantly in recent years by experimenting in and developing new methods of assessing scientific and technological innovations beyond the "classical" expert-oriented approaches. The new methodological variety has created a debate as to the merits and disadvantages of each method which is still far from being conclusive. At the same time, there is a significant change in the manner by which policy is made in the area of S&T. Partly as a result of recent social debates on the consequences of scientific discoveries and partly as a result of the need to modernise policy structures in the area of S&T, there is considerable discussion on the way science and policy intermingle in the public arena (e.g. the issue of 'science governance'). Part of this debate refers to scientific advice in policy-making and ways in which this relationship can improve and become more comprehensive.

It is in this context that this project has functioned and provided some concrete contributions to the debate. TAMI involved a group of leading TA experts from major European institutes (including seven parliamentary offices of TA) who worked upon core-issues in European TA. The process included feedback sessions in which leading representatives of the policymaking community and industry TA took part in the discussions and provided their input in the project.

TAMI revisited the definitions of technology assessment, method and impact in order to ensure a common functional understanding amongst TA experts. There has been agreement of a common definition of TA that reflects also the most recent developments in the European scene. Discussions on TA methods underlined the importance of the process of TA activities, such as scientific analysis, interaction and communication and suggested quality criteria for TA activities. Furthermore, work on the issue of impact resulted in the creation of a typology of impact, which identified 21 main roles or functions of TA where impact can be assessed upon. Every role has been further exemplified by the description of case-studies from around Europe.

In addition, TAMI has explored a series of influencing factors affecting the functions and impact of TA. Issues investigated in detail are: the institutional setting (particularly in parliamentary TA), the effects of organised interests and lobbying activities, as well as similarities with industrial TA.

Finally, TAMI has produced a series of specific recommendations covering the issues of TA assessment procedures, communication aspects of TA and trans-national collaboration.

1. Executive Summary

TAMI aimed at creating a structured dialogue between Technology Assessment experts and decision-makers in Science and Technology area on the methods used in and the impact of current TA activities. Two teams, one focusing on method and the other on impact, have been working together to provide answers to the main issues preoccupying European TA nowadays. Following, is a summary of the results of both groups:

a) Method Group

The method group paper on "The Practice of TA. Science, Interaction, and Communication" elaborated the following results:

The Definition of Technology Assessment

One aim of the TAMI project was to stimulate discussion between the actors in all kinds of Technology Assessment. This involved institutions directly connected with parliaments, as well as university institutions dealing with TA and independent academic institutions. Some of these institutions focus on concrete TA-paradigms, such as "expert TA" or "participatory TA"; others do not restrict themselves in such a way. The different concepts of TA made it necessary to define - in an acceptable way for all participants - what the TAMI consortium meant, talking about Technology Assessment:

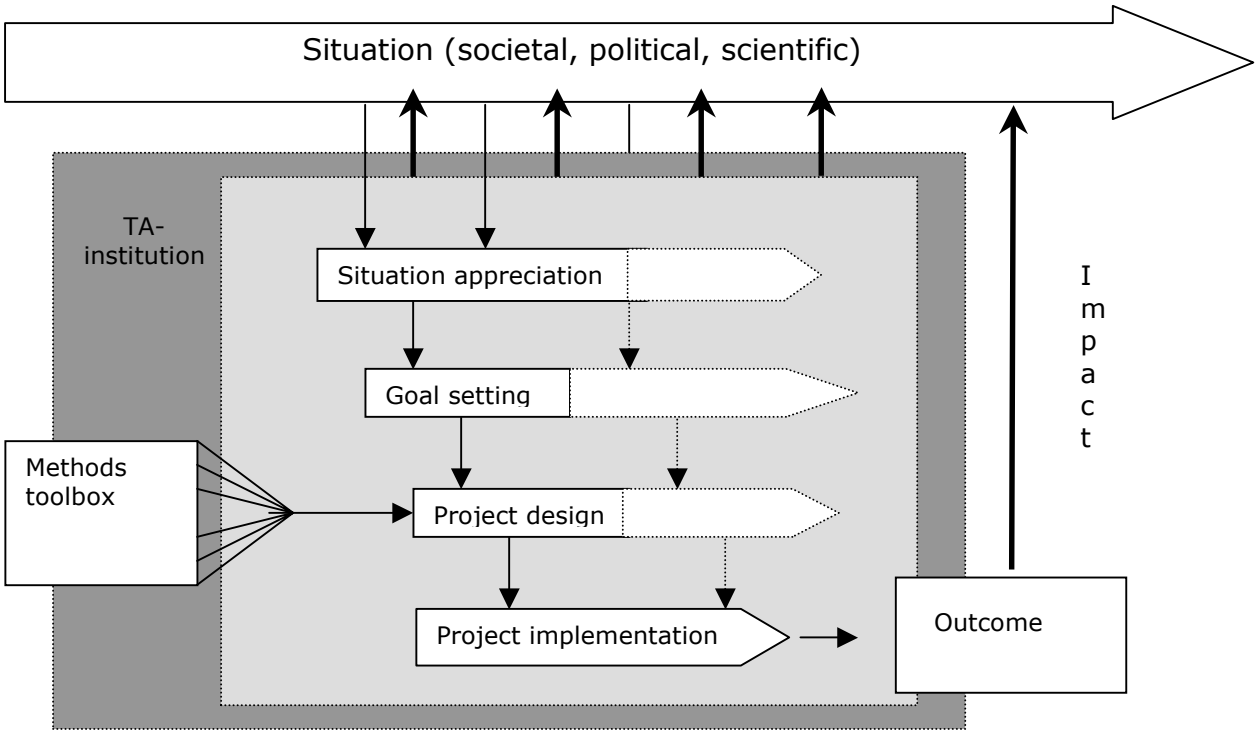
Technology assessment is a scientific, interactive and communicative process which aims to contribute to the formation of public and political opinion on societal aspects of science and technology.

From Method to Impact: A complex relationship

TAMI not only needed a common definition on Technology Assessment, but also base its discussions on a common framework in order to understand the relationships between method and impacts. The following structure was developed in reverse, starting with the fact that impact can only be achieved by concrete TA-projects, which implement or realise a project design.

The design depends firstly on an appreciation of the current situation, which is a necessary step to set realistic and correct goals. Based on this situation appreciation and goal setting, the project design will choose adequate methods from a "methods toolbox". At this stage, one has to justify that the method(s) chosen have the greatest potential to reach the set goals. Moreover, more general criteria concerning good practice in TA must be taken into account. They are, according to our definition and like the methods in the toolbox, clustered in scientific (1), interactive (2) and communication (3) quality criteria, referring for example to (1) scientific reliability in interdisciplinary contexts, (2) social fairness and transparency of the process and (3) flexibility and keeping track to the public debate, diffusion of the results and striving for synergies. Finally, the project design should contain procedures enabling the TA-practitioners to keep track to the social and scientific situation while implementing the

project. In the following sections the crucial steps of the TA-structure are explained in more detail.



The *situation appreciation* refers to a variety of aspects, such as the issue dimension (an issue can be technology -, domain -, or consequence oriented), the political dimension (ranging from issues which have not yet been officially addressed by the government, to those that are in a political deadlock), the social dimension (taking into account the value dimension, the relation to the public, possible technology conflicts and social roles and relationships), the innovation dimension (research and development in the early stages, industrial research, the marketplace, widespread diffusion, embedded technological systems) and finally the general aspect of availability of knowledge.
The *goal setting* includes the whole range of goals (cf. the description of roles in the impact group paper), from gaining knowledge about a technology and its consequences, through rising awareness, accompanying the technological development process, fostering common thinking, resolving a political deadlock, fostering a common dialogue between experts and the public, to informing or integrating the public.
As mentioned above, the development of the *project design* refers to both the greatest potential to reach the goals and the general quality criteria of "good practice" in TA. The method toolbox, as well as the general quality criteria, has been structured according to the scientific, interaction and communication claims of TA. Finally the *implementation* of the project-design takes place by realizing the identified methods in the planned way. This is where discrepancies between (ideal case) methods and their transfer to the real world might appear.

The *institutional setting* influences of course the whole process. Different types of TA-institution (e.g. parliamentary TA-institution, scientific institution, etc.) have to be considered, along with different audiences or target groups and different types of expertise on issues and methods.

Recommendations

The paper developed a common framework to gain an insight into the complex relationship between method and impact. Elaborating on this framework the following recommendations can be made:

- Set proper and realistic project goals and choose the appropriate (mix of) methods based on a sound and detailed situation appreciation.
- Be aware that there is no unique answer to a situation appreciation; in other words, the same issue can be addressed in different ways. For example, depending on its institutional context, one institute might address the lack of knowledge about an issue, whereas the other might focus on stimulating public debate.
- A TA institution should be aware of its method of tackling issues and that this is known and accepted by outside players (e.g. decision-makers). Only under these conditions will it be possible to set the right goals and to define an appropriate project, with the chance to reach a certain audience – and thus achieve a certain impact.
- Gaining any type of impact is not an end in itself. Instead of solving a problem, a TA project could create new problems. In other words, negative impacts may occur. It is important to be conscious of the appropriate type of impacts one wants to strive for.
- Be aware of the fact that no simple linear relation exists between the method mix used and the impact reached. The impact of TA projects also depends on both internal factors (like project management competencies, budget constraints, organisation culture, and institutional arrangements) as well as (mostly uncontrollable) external influencing factors (such as strategies of other actors, timing of the policy-making process, sudden changes in the problem situation). Accordingly, a proper choice of methods does not guarantee reaching the set goals.
- TA projects should keep track with social, political and scientific reality. Situation appreciation must, therefore, be an ongoing feature of project management.
- Allow for sufficient flexibility in the project design and the procedures of the TA institution to adapt to relevant changes – like new scientific discoveries, an increasing (and often sudden and short) media attention, a political intervention, etc. - that may (and most likely will) occur during the duration of the project.

- TA projects have to reach scientific, interactive and communication quality criteria in order to attain legitimate short-term impact and to build up and maintain institutional trust in the long term.
- There might be possible ambiguities or trade-offs between short-range impact and the building of long-term trust and credibility. Creating impact by using invalid or deficient knowledge is, for example, no problem for mass media. They are aiming at creating short-term impact and awareness. TA, however, would endanger its long-term credibility in such a case. One should, therefore, distinguish between impacts on different time scales.
- Communication has to be considered as the key way to achieve impact. Fulfilling scientific and interactive criteria is a necessary, but not sufficient, condition for having an impact.
- Communication goes beyond communicating about the results of a project. Selecting a certain topic for the agenda of a TA institute already sends a message to the outside world.
- Doing TA and assessing societal issues related to science and technology is the core business of TA institutes. This TA identity should be strengthened by developing communication competencies in-house (but TA institutions should not become communication bureaux). Synergies with organisations (such as science museums, debating centres, and media) have to be encouraged, particularly with organisations that specialize in getting messages across.

b) Impact Group

The impact group paper "Towards a Framework for Assessing the Impact of Technology Assessment" elaborated the following results:

The work of the Impact group in TAMI revolved primarily around the issue of meaning of the term and its deconstruction into identifiable goals. There is very little available information on attempts to measure the impact of Technology Assessment in Europe. This reflects the general lack of coordinated action in discussing the goals of TA and the processes by which they can be attained. The knowledge vacuum in this area has consequences for the ability of TA as a discipline to communicate its roles and consequently, its impact in society. Within this background the TAMI Impact group has worked out a comprehensive review of TA's impact, a short summary of which follows below.

<u>Definition of Impact</u>

The term "impact" refers to the expectation which on a general level is held by both TA-practitioners and clients (usually policy makers) as well as observers of policy consulting: TA has to *make a difference* in terms of the quality of decision making processes by adding comprehensive and non-biased knowledge to this process. The implicit expectation is that decision making *with* TA leads to "better" (more rational, informed or legitimate) decisions than would have otherwise been achieved *without* TA. This is however based on an ideal concept of rational decision making (which to

some extent ignores the reality of politics) and the impact of TA in this sense is hardly measurable. Nevertheless this concept is behind all discussions on impact since it is indeed connected with the traditional mission of TA.

For the purposes of the TAMI project, which is dedicated to furthering the discussion between TA practitioners and clients on the relationship between methods applied and impacts achieved, it was decided to use the term "impact" in a more general sense; not relating it uniquely to the specific mission of TA as ”improving decision making in terms of rationality or legitimacy”, but instead applying a broader concept that describes the overall effect of TA in policy making and public debates.

“Impact of Technology Assessment is defined as any change with regard to the state of knowledge, opinions held or actions taken by relevant actors in the process of societal debate on technological issues”

These effects might range from “raising awareness” for a particular issue/problem to “changing legislation”. This concept of impact has been clarified by working out a typology which is made up of three dimensions of impact which can be related to three dimensions of the issue that TA is dealing with.

Typology of Impacts

One could roughly discern three dimensions of impact that TA or policy consulting in general could have: impact in the dimension of **knowledge** used in policy making or public debate, impact in the sense of **forming opinions/attitudes** of actors involved in the debate, and impact in the sense of **initialising actions** taken by policy makers or other actors.

Table: Typology of Impacts

IMPACT DIMENSION ISSUE DIMENSION	I. RAISING KNOWLEDGE	II. FORMING ATTITUDES /OPINIONS	III. INITIALISING ACTIONS
TECHNOLOGICAL /SCIENTIFIC ASPECTS	**SCIENTIFIC ASSESSMENT** a) Technical options assessed and made visible b) Comprehensive overview of consequences given	**AGENDA SETTING** f) Setting the agenda in the political debate g) Stimulating public debate h) Introducing visions or scenarios	**REFRAMING OF DEBATE** o) New action plan or initiative to further scrutinise the problem decided p) New orientation in policies established
SOCIETAL ASPECTS	**SOCIAL MAPPING** c) Structure of conflicts made transparent	**MEDIATION** i) Self-reflecting among actors j) Blockade running k) Bridge building	**NEW DECISION MAKING PROCESSES** q) New ways of governance introduced r) Initiative to intensify public debate taken
POLICY ASPECTS	**POLICY ANALYSIS** d) Policy objectives explored e) Existing policies assessed	**RE-STRUCTURING THE POLICY DEBAT**E l) Comprehensiveness of policies increased m) Policies evaluated through debate n) Democratic legitimisation perceived	**DECISION TAKEN** s) Policy alternatives filtered t) Innovations implemented u) New legislation is passed

These dimensions of impact can be related to three dimensions of the issue that TA-projects usually deal with and that TA is expected to generate knowledge about. TA has to deliver (as comprehensive and unbiased as possible) information on the **technological and scientific aspects** of the issue that is at stake (e.g. features of technology, results/or problems of scientific risk assessment, economic costs, eco-balances etc).

A description of the problem/issue at stake would be incomprehensible without describing the **societal aspects**: TA has to deliver knowledge about relevant actors (their interests, values etc.) and possible social conflicts that can evolve around the technology under consideration.

On the basis of a proper description of the scientific and technological aspects, in connection with a description of the social environment (debate, actors), TA has to analyse the **policy aspects** of the problem, meaning it has to consider the restrictions and opportunities of policy making and has to develop policy options, i.e. explore politically viable ways for problem solving (e.g. legislation, R&D funding, action plans)

and again evaluate options with regard to possible side-effects (e.g. social conflicts) they might have.

Using these dimensions of impact and dimensions of the issue we gain a matrix that shows nine types of impact of Technology Assessment. An inventory of 23 roles or functions of TA that was developed by the members of TAMI-project can be categorised according to these types of impact.

Raising Knowledge

The three types of impact in the column "raising knowledge" are perhaps most directly related to the deliverables of TA. The outcome of a TA-process (e.g. a report) as well as the process itself (participatory procedures, workshops etc) may make policy makers or other relevant actors aware of formerly unknown scientific knowledge on risks, chances, unintended consequences etc. (**scientific assessment**), of interests or perspectives of actors involved (**social mapping**) or of problems or options for policy making (**policy analysis**).

Forming Attitudes/Opinions

Raising knowledge (by output or process) is a precondition for starting learning that might aid the formation of opinions and attitudes amongst actors. Changes in attitude may occur with regards to new scientific aspects that are discussed among policy makers or in public debates (**agenda setting**). The TA-process or outcome might also change the way relevant actors see or deal with each other (**mediation**), or options for policy making might be seen/discussed in a different way, e.g. new options becoming prominent on the agenda of policy making (**restructuring the policy debate**).

Initialising Action

Impact in the dimension of "initialising action" means that a TA process influences directly the outcome of the policy making process. Regarding the scientific aspects of the issue at stake, a TA-process may lead to **reframing of the debate**, e.g. initiatives to further scrutinise aspects of the problem. With regard to the societal aspects (actors, conflicts) policy makers may decide to initialise **new ways of decision making,** e.g. to set up a programme to intensify public discourse or to include social groups in the decision-making process. Apart from such initiatives, which can be seen as new ways of dealing with the problem, it might also be that TA leads to a definite **decision** about new policies (in the sense of closure of the debate): e.g. to implement a technology, or to set up legal rules for implementation.

The three dimensions given above might also be read as an "effect-continuum" starting from "raising knowledge" and leading to "forming attitudes/opinions" and, eventually, to "initialising action/initiative". In the first dimension one could speak of a low level of effect (i.e. a client notices the results of a TA process) which may imply a "fuller understanding of the problem" or "a broader view of aspects related to the problem" without directly inducing a change in attitude or behaviour. This is the necessary first step to a more explicit effect in the dimension of "attitude" and "action": the application of new knowledge stemming from TA studies becomes visible, knowledge is observably applied as argument in the debate and this might have direct impact on decision making in the sense of changing its path and/or

bringing up new political initiatives. The latter two steps obviously imply not only awareness but also *application* of knowledge in a narrower sense and therefore presume an active adoption of knowledge where it has to be integrated into the "belief system" of actors. The application of knowledge in political action is naturally also highly dependent on constraints and opportunities given by the actual policy context (e.g. need for compromises in policy networks, respect for existing policy coalitions, compatibility with existing policy programmes etc.).

Limits of TA's Impact due to other Influencing Factors

Influencing factors on the impact of TA, other than the chosen methodology, denote limits in the conception and execution of the TA process and at the same time present formidable challenges in the final reception of the TA study. The TAMI group has identified three main categories of influencing factors: Institutional Setting, Technology Policymaking Culture, and Structure and State of the Innovation Process:

The particular organisational structure of the TA institute naturally poses certain limitations on the type of work it can undertake and the manner in which this can be done. The overall mission of the organisation and the main target groups for its work constitute the first such limitation (e.g. parliamentary vs non-parliamentary TA); further limitations can be identified as the official relationship between the institute and its "clients", and institutional image and overall state of competition.

Moreover, the opportunities to produce impact are largely dependent on the role of organised interests (scientists, NGOs, business) in policy making. Domination of decision making by a particular group or a coalition of groups restricts the openness for adoption of knowledge and, consequently, the role TA can play. The state of public awareness and public involvement in technology policy might nevertheless present an counterbalance to organised interests and enhance the role of TA.

Finally, the way that the overall innovation system functions presents another factor affecting the impact of TA. In state driven innovation systems the prime driving force behind the adoption of new technologies are public fora. In this case, TA can have more direct influence in policy making and the shaping of technology since it is an accredited public service, free of interests and agendas. In market driven innovation systems, there is no legitimisation for state intervention in technology development on the basis of societal "needs". Therefore, opportunities for TA to affect the process of technology policy and development are restricted. Additionally, the trajectory of the innovation process is important: the earlier TA enters the innovation trajectory, the more possibilities there are to shape the future of the technology at stake but at the same time the more partial and vague the available information is; the later TA enters the trajectory, the more complete and comprehensive the knowledge over the technology is, but at the same time the less chance there is to influence the innovation strategy.

Conclusions

The typology and the set of roles developed in the TAMI project show that, when thinking about impact of TA, there is more to be considered than the direct influence of TA on political decision making (i.e. the lower right box of the typology). TA -

whether "classical" or "participatory" - contributes to social debate and policy making in many ways: by supplying unbiased knowledge, by supporting communication processes, by offering new perspectives on a problem at stake or by opening up new opportunities to restart the debate in deadlock situations etc. The tableau of roles provided by the typology can support self-analysis in the design of a TA project since it provides a structure for clarifying the goals a project may set in a given situation and in relation to the institutional setting, the specific political and cultural features, the state of the public debate and the trajectory of the innovation process.

Given the complexity of the issues and the political environment TA normally deals with, it cannot be expected that an ideal method exists to achieve a certain type of impact. It is nevertheless true that “classical” TA relates more to the first column of the typology while "participatory TA" relates to the second, and this should be taken into account when attempting impact evaluation. The increasing demand in recent years for participatory methods should be regarded as a reaction of TA to a changing social and political environment: the growing demands of civil society to be involved in policy making and the increased need to cope with social dissent and conflicts about emerging technologies.

Within this new climate, TA expands its scope towards direct involvement in the process of opinion forming by acting as a “communication node” without inducing a particular opinion or perspective. However self evident this may be, it is important to stress that whereas TA has methods to raise knowledge as well as to organise, stimulate and moderate debates and communication processes, having a direct impact on decision making is beyond the reach of TA's "method toolbox". TA should be seen as a necessary link in the process of decision making and not as a substitute to it.

2. Background and Objectives of the Project

Technology Assessment in Europe has evolved significantly in recent years by experimenting in and developing new methods of assessing scientific and technological innovations beyond the "classical" expert-oriented approaches. The new methodological variety has created a debate as to the merits and disadvantages of each method which is still so far from being conclusive. At the same time, there is a significant change in the manner by which policy is made in the area of S&T. Partly as a result of recent social debates on the consequences of scientific discoveries and partly as a result of the need to modernise policy structures in the area of S&T, there is considerable discussion on the way science and policy intermingle in the public area. Part of this debate refers to scientific advice in policy-making and ways in which this relationship can improve and become more comprehensive.

TAMI aspired to provide some concrete contributions to this debate and involved a group of leading TA experts from major European TA-institutes to discuss these issues. Such dialogue should provide the opportunity to exchange information and knowledge gathered through many years of European TA.

The main objective of TAMI was to create and promote a structured dialogue within the Technology Assessment (TA) community as well between TA experts and policy makers with the aim of improving the effect of TA in Science and Technology (S&T) policy.

- To deepen and structure the dialogue between the TAMI partners several working meetings have been organised. Four working meetings have been organised in the first project year – five working meetings during the second year. Besides, external experts from industry (e.g. Robin Fears, GlaxoSmithKline, or Ingo Rollwagen, DaimlerChrysler AG) have supported the TAMI work. Policy-makers and NGO´s have been invited for evaluation at the Kick-off and Mid-term meetings as well as at the Dissemination Conference. Through this regular meeting schedule and good interaction with the policy-making community, awareness of TA issues and the problematic/parameters involved was appropriately promoted at the international level.

In detail, the objectives of the project were to:

- Review and evaluate the state-of-the-art of methods and practices used in current European TA

  - The work of the method group started with the discussion and evaluation of the various TA methods applied around Europe. It became clear that different understandings of TA exist. The biggest discrepancy could be recognised between "classical TA" and "participatory TA". Whereas many TA-institutions, e.g. the Rathenau Institute (The Netherlands) or the Danish Board of Technology (Denmark) put focus on consensus conferences, public hearings or science theatre, other TA-institutions underlined the importance of expert-oriented TA. The discussion ended into a common definition of TA.

It was the first time that all major TA-institutions within Europe agreed on one common definition. A detailed account of the discussions can be seen on the paper "The Practice of TA. Science, Interaction, and Communication".

- Review and evaluate impact assessment studies that have already been undertaken by European TA Institutes

  - The impact group noticed that the discussions on impact of TA, usually suffer from a lack of common understanding of TA´s objectives and what can be expected as impact of TA. Unsurprisingly, there is also very little available information on attempts to measure or evaluate the impact of TA in Europe. It was the objective of the TAMI impact group to develop a structured discussion on the objectives, functions and effects of TA and prepare the ground for future attempts to evaluate TA procedures and their impact on related decision making processes. Before starting the discussion on the evaluation of impact studies the term "impact" had to be specified. The group defined impact as any change with regard to the state of knowledge, opinions held and actions taken by relevant actors in the process of societal debate on technological issues. This concept does not escape problems of measurement or visibility of impacts. Nevertheless, one might succeed in developing a platform for self-reflection among TA-practitioners and clients on the relationship of TAs mission, its methods (i.e. what TA does or can do) and the role TA might play in the context it is working in or is expected to support. A detailed exploration of the issues can be found in the paper "Towards a Framework for Assessing the Impact of Technology Assessment".

- Compare major European S&T policy structures and parameters affecting them

  - This aspect has been analysed by a paper on "Shaping the Impact: the Institutional Context of Technology Assessment". The paper analysed, from an institutionalise perspective, the emergence, nature and ways in which Parliamentary "scientific and technological advice" activities are carried out in different European countries. It is argued that the connection of Technology Assessment with the political process can only be understood if this type of information resource is regarded not only as an input in the decision-making process but also as a legitimising mechanism. Some local pre-conditions are important for the emergence of these practices, as well as the existence of some political entrepreneurs willing to advance the initiatives within their respective political systems. It is argued that differences in impact are to be analysed in the context of the rules of the political game and the types of incentives that TA organisations face.

- Identify "best practices" in TA that maximise impact relative to policy needs
  Use Examples.

  - After defining impact the group started looking at the various kinds of impact. The group worked on a two-dimensional typology box relating the dimension of impact to the dimension of issue. The dimension of impact

shows what kind of "impact" (e.g. "raising knowledge", "forming attitudes" and "initialising actions") a TA-institution wants to reach. The dimension of issue categorises the "area" of impact, such as "technological aspects", "societal aspects" and "policy-aspects. Using these dimensions of impact and issue the matrix shows nine types of impacts of Technology Assessment. An inventory of 21 roles or functions of TA in policy-making that was developed by the members based on their experience as TA-practitioners as well as by referring to existing case studies (best practices) on the political role of TA procedures can be described according to these types of impact. A detailed description can be found in the paper "Towards a Framework for Assessing the Impact of Technology Assessment".

- Create a common reference system for the Method, Impact and Policy components of TA.

  - Summarising the results - the impact group has identified criteria to measure policy impact, classified different levels of impact and different political contexts. The method group has identified criteria to enable comparison, classification and evaluation of TA-methods and criteria for the legitimisation and policy relevance of TA results. A first step towards the synthesis of the two groups results was developed in the paper "Conclusions, Recommendation & Wider Perspectives" which is co-authored by all TAMI members and provides specific recommendations for actions.

Objective	Status
▪ To create and promote a structured dialogue within the Technology Assessment (TA) community as well between TA experts and policy makers with the aim of improving the effect of TA in Science and Technology (S&T)	+
▪ Review and evaluation of the state-of-the-art of methods and practices used in current European TA	+
▪ Review and evaluation of impact assessment studies that have already been undertaken by European TA Institutes	+
▪ Compare major European S&T policy structures and parameters affecting them	+
▪ Identify "best practices" in TA that maximise impact relative to policy needs	+
▪ Create a common reference system for the Method, Impact and Policy components of TA.	+
▪ To set up a virtual desktop to ensure the internal communication flow	+

3. Scientific Description of the Project Results and Methodology

The methodology used to achieve the objectives of the project is the so-called "project group principle which is a procedure, based on the concept of rationality, to organise a structured dialogue between experts. The final report has been written in common authorship, which means that the authors are in charge of all parts of the report. The target of this procedure is to reach trans-subjective results. This has been operationalised by the creation of the "draft reports". Every participant has presented a draft report at the beginning of the project (was enclosed in the progress report as well) which describes in general the perspective of the problem. All participants committed themselves to develop these draft reports referring to the ongoing discussion in the project group. In this way, all draft reports became the product of all participants and the common authorship has been realised.

The two groups, method and impact, started to draft papers first within their groups and, after finalising these first drafts, a cross-over meeting was organised. At the cross-over meeting the method group evaluated the drafts of the impact group and the impact group those of the method group. Besides, both reports have been evaluated from external experts at the mid-term meeting. The final results have been presented at the dissemination conference in Brussels, the 27th November 2003.

In the following these final results are described in detail:

a) Results Method Group

Introduction

TAMI reflects on the activities of Technology Assessment institutions and their effectiveness. The central question therefore seems to be: which methods should TA use in order to optimise impact? This question sounds quite easy. Nevertheless this paper shows that reflecting on the impact of TA methods is a very complex endeavour. The goal of optimising impact of TA activities requires a comprehensive reflection on TA processes, TA quality criteria and, the institutionalisation and mission of TA. This paper strives to provide a common ground for such a broad reflection.
Section 1 provides a general definition of Technology Assessment. Based on this definition, a common framework to reflect on the relationship between method and impact is developed in section 2. Elements in this framework to consider are for example the institutional setting and the various phases of a TA project: situation appreciation, goal setting, project design, and project implementation. The following sections deal with those various elements. Section 3 distinguishes between various institutional settings in which TA projects are being designed and implemented. The institutional setting is discussed first because it influences choices made in every step of the TA process. Sections 4 to 7 describe the four phases that were introduced above. Section 4 discusses various dimensions or aspects that need to be considered when appreciating a situation. Attention is given to the issue dimension, the political dimension, social dimension, innovation dimension and the availability of knowledge. Section 5 described various possible categories of goals. Section 6 deals with the project design phase. A method toolbox consisting of three classes of TA methods – scientific, interactive, and communication methods – is introduced. In line with these three classes of methods three types of quality criteria are treated: scientific, interactive and communication quality criteria. These criteria refer to different sets of requirements that TA has to cope with, that are, TA has to comply with scientific and democratic demands and needs to have an impact on the political and societal debate. Section 7 deals with the project implementation phase. Finally, in section 8 an overview of the findings is given and some conclusions are drawn with respect to the relationship between methods and impacts.

1. TA Definition

Obviously, the way by which TA methods have to be or could be mapped depends on the preceding understanding of TA. Even the scope of the notion "TA method" depends on the underlying TA definition. The basic TA definition is decisive concerning both of the aspects: which methods have to be taken into account, and in which way they could or should be classified.
TA is a generic term for non uniform, partly even contradictory approaches and activities and therefore the definition problem occurs (Grunwald 2002). It is not obvious and self understandable what the "common" should be, if one views technology forecasts, risk communication, problems of legitimisation, innovation funding etc. One of the main conflicts in the discussions on TA is based on the fact that everybody wants to have his/her own question concerning future technologies in the centre of the definition of TA. However, by doing this they usually pressure other aspects to the brink or even out of the TA-definition. This, of course, meets with stiff opposition from other TA-actors.

It is not very helpful to go on with the discussion on that level. A definition of TA could be based on many different categories and if there is no consensus about these categories than not only the definition is not consensual but moreover there is no chance for a rational dealing with this problem. Possible definitions are:

- Definition via the tasks and functions of TA. Focussing on the contribution of TA to the social problem solving.
- Definition via certain special aims, e.g. early warning against technically induced risks (in the beginning of TA) or currently the stressing of innovation funding.
- Definition via the methods used. The kind of methods (e.g. scientific or participatory) used in TA are taken as defining categories
- Definition via the subject-matter. What is investigated concretely by TA and on which aspects of technology is it related to?
- Definition via the addressees. Which persons, groups or social subsystems should be addressed and advised by TA?

It becomes obvious very soon that definitions on the basis of these criteria on the one hand side will overlap but on the other hand will lead to diverged assignments. If one wants to have a common definition at all, and a common project on TA is a good reason to go for such a definition, because one has to identify what should be considered and what should not to be taken into consideration, than a not too narrow definition according to this end is necessary. However, one should not forget that this definition has to be scrutinized in the context of the TAMI-project. The main criterion can be formulated in a means-end situation: Is the definition adequate for the purposes of TAMI?
The following proposal is based on the first mentioned category focussing on TA's contribution to the social problem solving:

> *Technology assessment (TA) is a scientific, interactive and communicative process which aims to contribute to the formation of public and political opinion on societal aspects of science and technology.*

This definition contains two substantial distinctions. Firstly, TA is dealing with contributions to the public and political opinion forming and not with the decision making itself. TA offers knowledge, orientation or "approaches" to overcome social problems (e.g. unintended consequences, loss of confidence, problems concerning legitimisation). TA is neither able nor legitimated to solve these problems. This is part of society by means of their institutions and decisions processes. There is a difference between advising and shaping: TA is not shaping of technology but providing the knowledge for and advising to shaping of technology.
Secondly, science, interaction and communication are of crucial importance and form the three pillars of TA. *Science* provides knowledge about consequences of technology, conditions of implementation and mechanisms of controlling the technology development ("scientific methods"). The social relation to technology is characterized by problems of legitimisation, conflicts and loss of confidence. This is where TA offers and organises *interaction* between the opponents, the stakeholders etc. in order to overcome these problems. Examples for these "interactive methods" are risk assessment, mediation and participation of citizens. *Communication* is relevant for the distinction "public" or "political" opinion forming. "Successful" communication in these fields has to meet different requirements, obviously. Therefore, communication is moreover directly connected to "stay in touch" with the

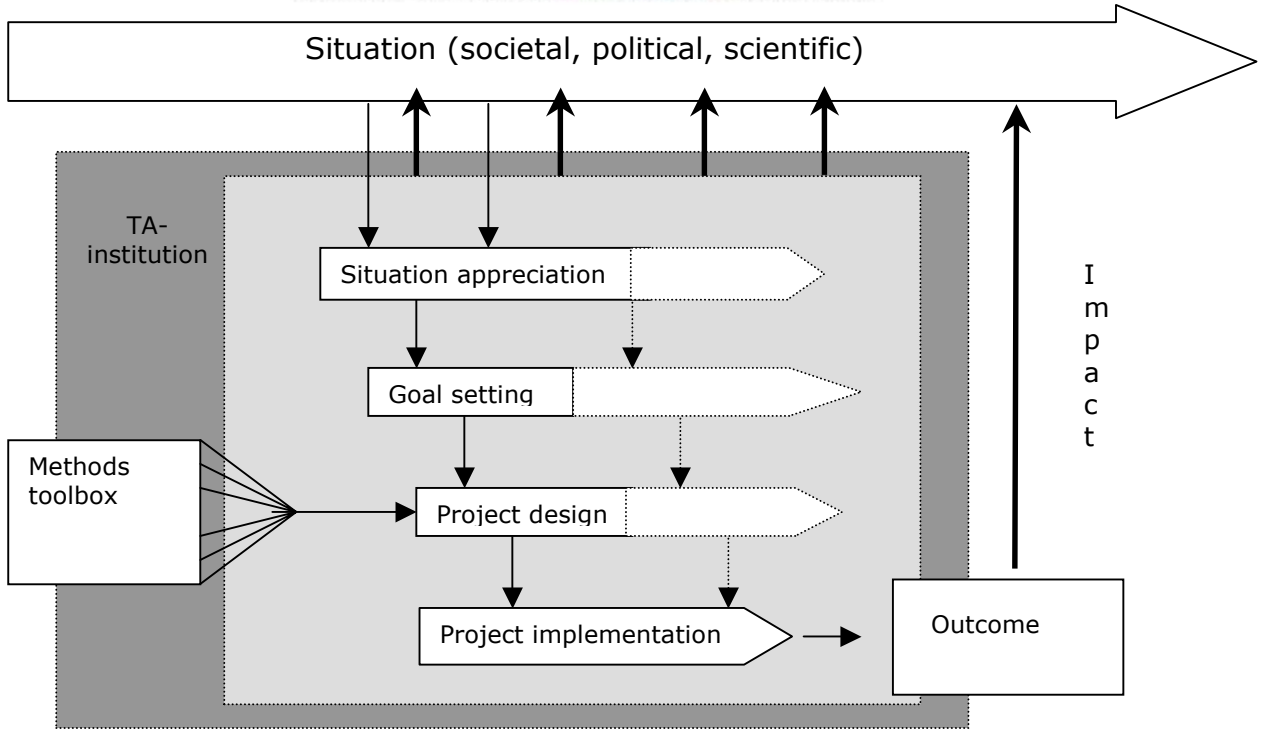
social surrounding. "Communicative methods" like newsletters, interactive websites, science theatres etc. are used to realize that.
The attribute "societal" refers to aspects of technology which are relevant for society. This includes for instance ethical, economic, environmental, social aspects of technology.
The attribute "technology related" refers to the question of which notion of technology is relevant in TA. Probably all attempts to develop a comprehensive notion of technology have to combine the substantial (artefact/tool) and the procedural (technical procedures) aspects of "technology". Often TA refers only and directly to artefacts/hardware and deals with the "more detailed analysis of the place of 'things' in chains of action" (Handlungsketten) (Wagner-Döbler 1989, p 25; in the same sense Ropohl 1979/1999). Relevant questions concerning this aspect are (a) how do human beings get the artefacts, (b) how do human beings behave relative to a artefact, (c) how do human beings get rid of the artefacts. Technical procedures and software are also part of the technical "world". Surgical operation techniques, programming and techniques of knowledge management can also be in the focus of TA. This procedural aspect of technology should not be disregarded. Objects of TA are in this sense of technology:

- ways of acting, in which technology is developed or produced
- ways of acting, in which technology is used
- ways of acting, in which technology is removed from the context of use (recycling, disposal)

The attribute "science related" takes into account that already scientific findings can lead to TA-relevant questions. The difference between scientific application oriented research and the early stages of a new technology/procedure are fuzzy (this is also the reason why "science and technology" is often used as fixed, inseparable expression). Therefore e.g. TA-projects focussing on the "early warning" aspect are science related. Scientific research can also be on the agenda of TA, when they reach a certain order of magnitude. Huge high energy particle colliders, fusion laboratories are examples for that.

2. From Method to Impact: A Complex Relationship

TAMI, as a network of reflection on the relation between method and impact not only needs a common definition on Technology Assessment, but it should be able to base its discussions on a common framework. Having such a framework is a necessary step in order to work with common notions and to understand the relationships between method and impacts.
As a first general feature, one has to acknowledge that the relationship between method and impact is of very complex nature. Of course, TA practitioners must choose the right methods to get some impact. But, how to choose the right methods? What are the criteria to be used? And are things so simple that one has only to pick up the right methodology? Things are much more complex.
Figure 1 tries to systematize the relevant variables intervening in the relationship between method and impact. According to this scheme, the possible impacts of TA activities depend on many variables, related to the TA institution itself, to the situation (or context), to the goals or objectives of the TA-project, to the selected method(s) and to the project management.



First of all, TA activities are always located in a specific societal, political or scientific situation, which is to some extent objective and given. A law may be under preparation, a large public protest might be under way, the main political actors are maybe trapped in conflict without solution in sight, and so on. This situation is the starting point for the TA-project but is, off course, not static, it evolves. This means that the situation appreciation must be regularly undertaken. It is necessary to keep track in order to react or to adapt the project to the evolving situation. But, secondly, this also means that in doing a TA-project, one might already have a certain „impact" on the situation. A major participatory event in the course of a project and the media attention around it might already influence decision-makers to take action before the report with the final conclusion is made public. Bringing together some experts around a topic might create new insights and new networks between these experts. If they take these back home, one can expect some impact on current situations. Therefore the situation appreciation is an ongoing process during the TA-project and might lead to an adaptation of the TA-project design.

After the detailed situation appreciation is made, it can be used as the basis for goal setting. Before entering the designing phase of the project, it's already necessary to think about the kind of (final) impact expected from the project. The type of impact one reaches for influences the design (including choice of methods) of the project. This "chain reaction" of situation appreciation, goal setting and project-design is taking place after the first situation appreciation at the beginning of the TA-project and might take place as a result of the ongoing situation appreciation during the TA-project.

The own TA ‚philosophy' of the institution will be of major importance in setting the goals. Each TA institution understands its mission in relation with its own specific organisational, cultural and political context. Some TA institutions situate themselves more in the knowledge production area (giving input to policy making), for others

their mission lies more in the attitudes/opinion formation, where the process of participation and interaction is more important.
In order to operationalise TA activities, a set of methods is available (in a kind of "method toolbox") and can be picked up. Methods are manifold and can be used to collect data, provide knowledge, organise TA relevant communication, gain ideas for conflict resolution, uncover the normative structure of technology conflicts, etc. Rather often, the specific goals can only be reached by using a combination of different methods or by creating new ones. Therefore a TA-Institution develops a project-design consisting out of the methods with the highest potential of success. Obviously a project-design must not contain several methods, if it appears that one method, e.g. an eco-balancing is promising. The highest potential to reach the goals identified before is only one criterion for the combination of the TA-methods. The project design takes also into account general quality criteria of TA like scientific reliability, fairness of interaction, etc. Moreover, the project design is influenced by the institutional setting: the mission of the institution, its tradition or history, its formal status, etc. This results in the fact, that some methods of the method toolbox are preferentially used for project-design. For example, a TA institution whose mission is to gain interdisciplinary knowledge on new emerging technologies, might not have consensus conferences in its methods toolbox.
The realisation or implementation of the project design makes it to become a real world project. At this stage one does not talk about ideal methods anymore but about actions actual taking place. Here, variables such as project management, independence, communication and other quality aspects are intervening. This phase is certainly a crucial one: even though a TA institution makes a "correct" appreciation of the situation, sets the "right" goals, chooses the "right" set of methods and designs a "perfect" project, the whole project may fail if it has a bad project management or misses one of the above mentioned general quality criteria of TA.
Once the project is over, it produces outcomes, from which an impact is expected. As stated before, however, it is not only the final outcome which "produces" an impact, but also the activities during the process or the simple fact that the project is underway can have some impact.
According to this structure, the discussion of impacts related to methods needs to consider all phases of a TA project, from the idea to its realization. This rather linear scheme can, however, be non-linear, as a constant and regular checking with the current situation has to be considered. In this respect, goals might evolve during the project, some additional phases might be added in the project design, and so on. However, the more the project is advanced, the more difficult it will be to modify it.
In the following we will use this structure to discuss the relation between method and impact. Accordingly, all phases of a TA project - from the idea to its realisation – will be considered. We will discuss the different steps to better understand how methods lead to impacts. But before we describe the various phases, some introductory remarks on the institutional setting will be made in which TA projects are being shaped, since the specific institutional setting influences all those phases.

3. Institutional Setting

TA organisations have many different institutional settings, which vary from country to country and organisation to organisation. The specific institutional setting will affect the kind of activities they will set up and, consistently, the kind of impacts they might (and can) achieve. As such each institutional context leads to a certain extent 'unique'

project design. It can be said that the institutional setting of a TA organisation both enables and constraints the goal setting, the range of topics and methods chosen and type of impacts that are aimed at and / or can reasonably be expected. Moreover, the way quality control mechanisms are set up may differ from one TA institution to another. In this section we will make some remarks on the type of institutional settings, the target groups, and expertise with regards to issues and methods of TA organisations in various organisational contexts.

3.1. Types of Institutional Settings

Without trying to be complete the following organisational settings can be observed: scientific organisation, parliamentary TA bodies, consultancy agencies, and dialogue platforms. These various settings do not exclude each other. For example, a science-oriented institution may simultaneously fulfil counselling tasks.

In the case of TA as a scientific institution, the organisation is part of the academic system, with emphasis is put on scientific activities and scientific contribution to TA. Within parliamentary TA, the TA organisation belongs (or is subordinated) to the Parliament. In such a setting, TA activities are mandated by Parliament (individual members or commissions) and their results are intended to feed the legislative process. In independent public institution TA is organised, with the aim of counselling on science and technology issues. In this setting, the TA organisation has a certain freedom to choose its activities and projects, but it must take into account its potential clients in order to get any impact. In this setting, an appropriate appreciation of the situation is especially important.

3.2. Addressees or Target Groups

A crucial dimension to differentiate between institutions is the addressee of the TA organisation. For example, parliamentary TA organisations are usually confronted with concrete questions from the parliament. Obviously the situation appreciation focuses around these questions, since the goals to be reached are more or less defined by Parliament. Nevertheless a situation appreciation has to be done, because the selection of the method refers to both the goals and the situation appreciation. As a result of the latter additional goals might need to be taken into account. The chance for concrete (political) impact seems higher, since the parliamentary TA organisation reacts to demands of the parliamentarians and the addressee thus is willing to consider the end results and (in some cases) may even need these results to make decisions. On the other hand, being closely connected to Parliament may also limit the play (i.e. scope of issues and methods) of a TA institute. TA organisations not directly connected to the Parliament are having a relatively harder job in selecting the topics parliamentarians are interested in and ensuring that the relevant target groups – policy makers, lay people, stakeholders - are interested in a specific issue.

3.3. Types of Expertise on Issues and Methods

Another aspect concerns the variety of expertise on TA issues and methods that is available within a TA organisation. For example, one institute might focus on interdisciplinary expert discussions, while others specialise in participatory methods. These types of specialisation and former experiences of a TA institute influence the goal setting and enables and constraints the various topics and methods used.

4. Situation Appreciation

Technology Assessment addresses many different issues linked to technological advances and is thus confronted to a variety of questions to work on, with their own characteristics. TA might address questions related to nuclear energy, stem cells, privacy in the information age, waste management or sustainable development, just to cite some examples. Moreover, the same issue can lead to a quite different questioning in different contexts. The way to tackle the issue might depend, for example, on the technological development, on the political context or on the general mandate of the TA institution. In this respect, a sound appreciation of the situation is an important step towards achieving any impact. The right appreciation of an issue and its context will help a TA institution to fix realistic and appropriate goals for a given project, and then use the appropriate methods in order to set up a TA approach able to realise these goals. It might be useless to launch a consensus conference on new technological developments without having, for example, previously considered what the technology can achieve (e.g. can xenotransplantation diminish the lack of available organs?) and their implication on law (is it authorized, do we need a revision of the existing laws, etc.?). On the contrary, a scientific study on a long discussed technology might bring fewer added values than a participatory project. It is thus important to get tools in order to better apprehend the kind of situation a TA project is addressing, in order to implement the right method with the right goals and get the more impacts out of it.

Practically, the situation appreciation is part of the pre-phase of a TA project. Usually a kind of discourse analysis is used in order to draw a "map" of the ongoing debate. Who are the relevant actors and which arguments do they use? Which positions do they take against each other? Moreover a media analysis to investigate positions in the debate and the public resonance to a specific topic can support such a discourse analysis as well as expert interviews and expert or stakeholder surveys, which shall help clarifying arguments and positions. The analysis of relevant documents complements the situation appreciation. The situation appreciation is of crucial importance for the following TA-project, because improper assessments will lead to projects contributing to solutions to irrelevant problems. However, due to practical reasons a balance between "quick" and "detailed" has to be realised. Moreover a monitoring of the situation is relevant during the whole project in order to keep track with changes in the environment.

Examples: The Situation Appreciation in Practice

Drawing a Map of the Existing Debate on GMO's

In May 2002, the viWTA started with a project to give new impulses to the existing debate on GMO's in agriculture and food. Before making the methodological choices, a situation appreciation study was conducted. The situation appreciation study had four main goals:

- to list all relevant actors that are connected with the debate on GMO's in Flanders (social map). The authors of the study came up with more then one hundred organisations;
- to give an overview of the positions of the different actors. This work was based on a discourse analysis of websites, press releases, magazines, interviews,…
- to analyse the ongoing debate on GMO's in Flanders. Which arguments do the different stakeholders use, what do they think of each other. This part of the study showed very clearly that several stakeholders had a completely wrong idea of the positions of other stakeholders and especially of the position and opinion of the public.
- to map all existing and coming legislation on regional, national and European level that has to do with GMO's

The conclusions of the study lead to the decision of organising a consensus conference and a stakeholders' forum in the course of the project. The consensus conference would aim for a clear and subtle view on the opinion of the public. The stakeholders' forum (to be held at the end of the project) was meant to create an opportunity for stakeholders to exchange and discuss views and positions. The study made it also possible to inform and involve all the relevant stakeholders. In this way, it became possible to build up a broad societal support for the project.(Goorden et al. 2003)

Situation Appreciation of the Polarised Discussion on Cloning
In the autumn of 1997, the Dutch Minister of Public Health, Well-being and Sports asked the Rathenau Institute to contribute to the societal debate on cloning. The reasons were the public reactions to the birth of the cloned sheep, Dolly. Since the weight of the political debate was height and the public discussion so polarised the Rathenau Institute decided that an open and transparent process was needed to appreciate the situation and accordingly determine the project activities. To do this, the Rathenau Institute organised a hearing in the old conference room of the Lower House on March 26, 1998. At the hearing a panel of (former) Members of Parliament questioned researchers, representatives of biotechnology companies and interest groups, and ethicists about the state of the art of the technology, the possibilities of application, the arguments for and against certain applications of cloning and the reasoning behind these arguments. The hearing clarified three relevant issues for debate: cloning of stem cells, cloning of animals for the production of medicine, and animal cloning in animal husbandry. On these topics expert meetings, open to the public, were organised. Also two meetings were held to obtain more insight into the way various religious and political traditions deal with the ethical problems surrounding cloning. To further the public's input to the cloning debate a lay panel was set up. The panel could take part in all of the other activities organised by the Rathenau Institute and was also given the time and money to develop its own activities (e.g. questioning experts, visiting firms, etc.). (Biesboer et al. 1999)

In the following, an attempt is made to systematise the dimensions to consider when appreciating a situation. In this paragraph we treat the (1) issue dimension, (2) political dimension, (3) social dimension, (4) innovation dimension, and (5) the availability of knowledge. This systemisation should be understood as a checklist and a rough guide of what should be taken into account. In order to point out the relevance of the situation appreciation for the following steps "goal setting" and "project design" many references concerning and anticipating these steps are already made in this paragraph.

4.1. Issue Dimension

The first - and trivial - dimension is the issue a TA project addresses. Looking at the working programmes of TA institutions, we can see that the issues addressed are variegated: the themes are manifold and framed in different ways. In this context, when appreciating the situation, it might be important to be aware of the way the issue is framed. The following typology tries to systematise the different kinds of issues TA projects are addressing:

- *Technology oriented issue*
  This is the traditional – and maybe the more widespread – way of doing TA. The consequences of a technology already existing or just being developed or of a techno-logical trend are interdisciplinary analysed or put under discussion among experts and/or laypeople. Many technology-oriented projects address questions related to new developments in biotechnologies/biomedicine and in information and communication technologies. Other important issues are new materials, transportation systems, waste-treating technologies and energy supply techniques.

- *Domain oriented issue*
  Technology intervenes in many domains of our life, like health, work, entertainment, mobility, etc. In this respect, the Technology Assessment community is also interested in evaluating or discussing how a certain domain of human activity is affected by new technologies. Classical examples of such projects are e-commerce or e-health. But more focussed projects can also be taken into consideration, such as road pricing or call centres.

- *Consequence oriented issue*
  The topic of interest might rely on certain consequences of technologies. In this context, the project will not mainly address the technology, but will put the

emphasis on societal trends or changes that are technology related. Typical examples are projects addressing the questions of privacy, sustainable development, gender division, North/South relationship, etc.

In all these different types of issues the situation appreciation includes investigating the relation between the specific TA issue and the specific context the TA project has to face. This usually will allow identifying the TA relevant aspects of issue and context in more detail. This fact, however, makes obvious that an individual TA-project touches all the above mentioned dimensions. A project that is domain oriented must, of course, consider the technologies involved and look at the consequences. A technology-oriented project must consider the domains that are affected by the technology under scrutiny and the consequences it may have. Finally a consequence oriented project must be aware of the different domains concerned by the problem and the technologies involved.
Nevertheless this typology is helpful in order to identify where the project starts from and what its initial perspective is. This influences the goal setting of the TA-project and the project design.

4.2. Political Dimension
Issues addressed by Technology Assessment are generally politically relevant. This relevance, however, might change depending on the stage of the policy-making process we are in, and the kind of political debate which is going on. In this section we distinguish between three phases: agenda setting, policy making and implementation phase. Finally, we discuss the situation in which the political debate and policy-making process is blocked.

- *Agenda setting phase*
  In this phase government has not yet officially addressed the issue. Still, an issue may be virulent among expert, citizens or interest groups. These may be aware of or sensitive to certain potential risks related to a new technology – for example environmental or health risks of new materials ("whistle-blower-effect"). On the contrary, some experts could have visions from unexpected utilities or chances of innovative technology. Anyway, in such cases there will be a high degree of ignorance and low awareness in general.
  In this type of situation the goal of a TA project might be to assemble the knowledge available and to identify the areas of ignorance in order to be better capable of assessing the risk under consideration. In the case of proving the suspicion true the "early warning" function of TA applies. The aim is to put the issue on the political agenda or to raise awareness in the political system concerning the issue under consideration. In other cases TA might lead to an early recognition of chances of new technologies.

- *Policy making phase*
  In this phase an issue is already on the political agenda, and at the stage where fundamental decisions have to be taken. In this case, a TA project might help to structure the debate, to make plural and comprehensive information available, to highlight and to assess the alternatives and the actions to be taken, to make the decision-making criteria transparent et cetera, in order to fulfil its task of supporting decision-making.

- *Policy implementation phase*
  In this stage of the policy cycle, there is a clear policy on the issue at stake (e.g. fostering e-learning), but the policy has still to be implemented. In this respect, TA might offer inputs on the ways to implement given policies related to technology in order to contribute to an efficient way of "domestication" or "embedding" the respective technology into society.

- *Political deadlock*
  Sometimes a debate on a certain issue is in a political deadlock; no solution is in sight. For example: the European debate on genetically modified food or the debates on nuclear waste disposal sites in many countries. Here, the role of TA in contributing to the management of conflict might be to contribute to overcome the blockade by communicative measures and by systematic analyses of possible alternatives which could open new ways of thinking and new paths to overcome the deadlock-situation.

Interestingly, the phase and character of the policy debate might change in the course of the TA-project, especially for long and complex projects. As a matter of fact, when a project lasts several months – or even a couple of years – the chance that the political situation evolves has to be taken into consideration and be integrated in the project design. In specific cases there might be a need for integrating special monitoring tasks into the project in order to prevent overlooking such changes or noticing them too late. This calls for an ongoing situation appreciation process. On the basis of this, the initial project design may be modified. Because political changes can happen suddenly, the project design needs some flexibility in order to react to such unexpected events (see section 6.3.3).

4.3. Social Dimension

Another characteristic of a TA issue is the social dimension of the issue under consideration. We start the discussion of the social dimension with some general remarks about the role of values in TA. Next and related to that we will treat the following (to a certain extent overlapping) issues: public awareness, possible technology conflicts, and roles of various relevant actors and their relationships.

- *Value dimension*
  The value dimension is inherent to every technology as has been shown by TA in the last decades. However, there are differences in how deep ranging the relevance of values in a concrete case and situation is. The probability of the emergence of conflicts depends (among other factors) on this relevance of values. For example, technologies affecting deeply anchored values concerning the beginning and the end of human life, are often highly controversial in a pluralistic society. Other technologies, which might be considered under more economic issues (like the substitution of classical materials by new ones), perhaps complemented by ecological aspects, can be judged in a more neutral way though showing also normative aspects. One of the tasks of a situation appreciation is, therefore, also to identify the relevant (perhaps hidden) values involved and their capability to leading to technology conflicts.
  A possible goal of the TA-project is then the investigation of the TA issue with respect to the specific "framing" which has been chosen, and the search for alternative framing. The aim should be to make the particular values transparent

which are underlying the specific framing of an issue in order to make an open and transparent debate possible and to avoid biases in the TA resulting from the framing of the issue to be dealt with.

- *Relation to the public*
  An adequate situation appreciation process should address the way the public is aware or perceives a certain issue. Questions to be considered here are:
  - Does the issue already raise interest within the public? Are there reports or discussions in the mass media (newspapers, TV, internet)? Which role do the mass media play?
  - How is the interest expressed if existing? Is there fascination, rejection, mistrust against experts or against the political system, fear against the future, need for open debate, etc.? Are the chances or the risks of science and technology in the foreground?
  - Who is leading the social discussion? Are large organisations (parties, churches, social movements) aware of the issue? Is there sufficient (whatever this means in detail) willingness among stakeholders and people affected to participate in a public debate?

- *Possible technology conflicts*
  With respect to the social dimension of a TA issue it is important to identify potential conflicts surrounding technology at an early stage. A situation appreciation in this respect should include the aspects of societal acceptance, power and communication. Relevant questions, therefore, are:
  - Is there evidence for social acceptance problems of certain technologies? Could the debate even run into a blockade situation? How serious are positions of rejections to be taken?
  - Has the debate so far been compatible to the requirements of social fairness or is there evidence for a severely unbalanced distribution of power in the public communication? Is the legitimisation of certain positions or even of democratic institutions in dealing with the respective technology been questioned?

- *Social roles and relationships*
  The design of a TA study may decisively depend of the assessment of the roles of experts, decision-makers and laypersons and their mutual relations in the respective field. Has there been evidence for mistrust against experts and decision-makers? Does the expert dilemma (a situation in which experts are confronted with counter experts, science becomes politicised and the values behind science become explicit) apply? If these questions are answered with "yes" this will have an impact on how to conceptualise the TA project, for example concerning the use of participatory instruments.

In all these fields, the way an issue is discussed in the public might evolve during time. A scandal, a new scientific finding might deeply affect the social debate and, thus, the TA project on the issue. This shows the importance of keeping in track with developments in society and to be open for adaptation or reaction.

4.4. Innovation Dimension

Analogue to the metaphor of the policy cycle, TA may play different roles in different stages of the innovation cycle. Some TA projects are rather prospective, in a sense that they explore technologies in the development stage, possible social practices that these technologies would imply and societal goals that are not yet discussed (take, for example, the TAB study on nuclear fusion research).

In other cases, TA projects will address questions related to existing technologies. Here, TA may focus on the shaping of technology. For example, do we want the Internet to be better controlled or let as a free space? A TA may also consider the practical implications of the widespread use of a new technology how to actualise this technology to the present situation. For example, what about the multiplication of In Vitro Fertilisation in industrial countries?

Along the development path of a specific technology, TA has different entry points. TA relevant questions are different in the various phases of the innovation cycle, as well as there are different stakeholders and social groups to be involved. Accordingly, fitting TA questions to the development phase of the respective technology and to the corresponding decision-making requirements is an essential element of a situation appreciation. Following the widely used model of the innovation chain, and adding the notion of an embedded technological system, we could identify the following different functions of TA.

- *Research and development in early stages*
  TA at the early R&D phase takes the function of a "science assessment". In the foreground are chances and risks of the developments, topics of public promotion of research and possible regulation needs.

- *Industrial research*
  Research for new products or processes under the rules of competition at the marketplace is much closer to having a direct impact on society. In this phase those impacts and consequences of technology and ways of dealing with them are the main subject of TA.

- *Marketplace*
  Sometimes, when products enter the marketplace the public discussion really starts off. A prominent recent example of this is the introduction of GMOs on the European market in the mid-1990s, which led to fierce political debate and eventually a temporary moratorium of GMOs in Europe. TA has responded to this situation with public participatory events to clarify what 'the public' actually thinks about the issue and why.

- *Widespread diffusion*
  Some technologies rapidly enter the market and have a high diffusion rate. For example the rapid market introduction of mobile phones. This led to public discussion about health effects of mobile phones and its related infrastructure. TA task is to acknowledge, discuss and clarify these voices or warnings and give them a proper place within the political debate. In many cases, for example asbestos and PCBs, early and even 'loud and late' warnings were ignored by decision-makers (Harremoës et al. 2001).

- *Embedded technological systems*
  Sometimes the limits of success of technological systems that are already deeply embedded in society are coming into view. An example of this is livestock farming in the Netherlands. The goal is to move towards a more sustainable and animal friendly system. In such a case, established institutes are often too closely related to existing interests and are not able to break up existing practices and look for new ways. In the event of a looming crisis, TA may help to look for new ideas in order to innovate the system.

4.5 Availability of Knowledge

TA has to provide knowledge and perform knowledge management. Knowledge generation in TA shows specific difficulties because anticipatory and therefore hypothetical knowledge is required. The design of a TA study depends on the amount and quality of knowledge already available in the respective situation and on identified knowledge deficits and gaps. Therefore, an exploration of the availability of knowledge is belonging to each TA pre-phase. Different points of departure in this field are:

- high-quality knowledge available, high degree of consensus among experts and scientists;
- high-quality knowledge available only in some relevant fields concerning the issue under consideration, with other areas of ignorance or high uncertainty;
- there is knowledge available about gaps of knowledge ("gewusstes Nichtwissen" "acknowledged Ignorance"), for example due to some suspicions about technology risks without undoubted empirical evidence (like is the case of Electro-Magnetic Fields);

Obviously, the portion of TA related to knowledge generation and knowledge management – compared to the portion of discourse and communication – will be different in these different types of situations – which then will have a large impact on the design of the respective TA project.

5. Defining the Goals of a TA-Project

After the appreciating of the general situation, the goals of a concrete TA-project have to be defined. It is also possible that a TA institution decides to stop the process here, because it considers that the situation does not correspond to the kind of situation it can contribute to (compare the paragraph on "institutional setting"). If it decides to continue on, then many different kinds of goals might be possible. We can, however, systematize the kinds of goals around the following goal categories (clusters)[1]:

- *Scientific assessment*
  This is typically seen as the condition sine qua non of technology assessment. Different technical options have to be identified and assessed in comparison. This needs the gaining of knowledge about these technical options. Moreover knowledge about the societal, political, ethical consequences of these alternatives must be developed and presented in a comprehensive way.

[1] These goals of TA-project can be compared or are mainly identical with the "roles" of TA identified from the impact analysis perspective.

- *Social mapping*
  If the situation appreciation led to the identification of a social, political, ethical, etc. conflict the analysis of this conflict and its transparent description becomes to be a goal of the TA-project.

- *Policy analysis*
  This goal becomes to be relevant if a topic is already on the political agenda. Within the preparation phase of a political decision the exploration of the respective objectives is essential. After a political decision it might be a goal to assess the consequences resulting from this decision.

- *Agenda setting*
  If a new technological development is not considered so far by the politicians or by the public it might be a goal to raise awareness for the technology and its consequences in order to put it on the political agenda or to stimulate a public debate about it. It might be sensible to support this process by illustrating the relevance of the technology through the development of visions and scenarios about it.

- *Mediation*
  After realising a blockade situation a TA-project might aim at overcoming this blockade situation. This can be realised by stimulating a self-reflection process of the actors or by the development of bridge-building alternatives. The more general goal behind that is to enable the opponents to overcome the blockade.

- *Restructuring the political debate*
  TA-projects might aim to influence the ongoing political debate. It might be a goal to increase the comprehensiveness of the debate, to evaluate the existing policies through a new discussion process or to reach for a kind of democratic legitimisation of political decisions.

- *Initialize new R&D policy:*
  It might be a goal of a TA-project to develop recommendations for new topics on the research agenda for example if an identified problem causes further research needs. Also the development and assessment of various options might lead to recommendations for a re-orientation of research policy.

- *New decision making processes:*
  The situation appreciation might result in the finding that a special decision situation needs new decision preparation procedures. It might be a goal then, to recommend an alternative way for governance. In a broader sense also the initializing and intensifying of a public debate might be a possible goal of a TA-project.

- *New policies*
  It might be a goal of a TA-project to recommend concrete policy activities. A new technology might lead to the fact that existing laws need extension or modification. Another possible goal is the evaluation of different technology policy alternatives.

Of course, a TA project might address several of the above mentioned objectives. For example, a TA project might aim at improving knowledge on a new emerging technology and informing the public about it. Moreover, this list is not claimed as to be complete. Goals have to be defined in accordance to the situation the TA Institution has to cope with. Imagine a situation which is according to the above mentioned dimensions[2] technology oriented, the issue is not yet officially addressed by government, there is low public interest so far and the technology is still in the labs of applied research on a prototype level. The facts available about this technology are mainly disciplinary, i.e. provided by the developers of the new technologies. Therefore one goal of a TA-project could be to analyse the social shaping of this technology, i.e. how the technology becomes a part of our culture. In an other case the appreciating of the general situation might show that the issue is in a political deadlock, that the public mistrusts the decision makers and that the social discussion is more than lively, influenced by the media, that the NGO's have already formulated their positions and that the questions are related to existing technologies. In this situation, it might be relevant to bring the opponents together, involve the relevant NGO's and stakeholders, and organise structured discussions in order to overcome the blockade. But it might also be of interest to start an interdisciplinary research project in order to acquire arguments to get the debate down to a more rational tier. Both can of course be done in the same project[3].

6. The Project Design

Based on the specified goals, a project design has to be defined. This project design is essential in order to reach the goals, and consequently some impact. A TA-project design is developed out of different methods found to be most promising to fulfil the forthcoming tasks. In the first part of this chapter, we will give an overview of the "method toolbox". Through the years, the TA community constantly tested new methods, improved existing methods and widened its set of methods. The selection of methods will need to be in coherence with the defined goals of the TA-project. In the second part, we will highlight the most relevant principles in selecting methods.
But a project design is more then just choosing the appropriate methods. In this phase, it is important to think about the quality requirements each project has to meet. Since we defined TA as a scientific, interactive and communicative process, the necessary steps need to be taken to guarantee the quality of these three pillars of TA. In the third part, we will describe the different quality criteria that have to be taken into account.

6.1. The "Method Toolbox": Three Classes of TA Methods

According to our structure "from method to impact" (fig. 1), we see a TA-method as a structure, composed out of multiple elements (techniques, instruments), that serves the scientific, interactive and communicative goals of a TA-project, picked up in a

[2] see the previous paragraph "Situation appreciation"
[3] An example for this situation could be a TA-project dealing with the climate change problem. On the one hand side it is necessary to scientifically scrutinise the variety of climate models, which are the basis for the prognosis of future climate change. A scientific questioning would also consider economical, legal, ethical consequences of the different options to act. On the other hand these options to act influence the every day life of the citizens, for example when the reduction of CO_2 is aimed at, which needs reorganisation of every day habits. This justifies participatory TA in order to find the "factual accepted" solutions.

"method toolbox". This method toolbox contains all kind of methods which can be justified as to be helpful to reach a specific outcome and, thus, the set goals (or sub-goals) of the TA-project. This outcome may be a product as such, like for instance a study, a set of future scenario's and so on, or it might be the (consequence of the) process like for instance the creation of a network, a debate in parliament, etc. Based on this definition, a TA project is seen as a combination of different methods, which have to be structured in a "project design".
When looking at TA projects, one sees that many methods are used and it might be difficult to describe them in detail. Nevertheless, some methods constitute the core of the TA method toolbox, whereas new methods are constantly tested. In fact, the TA method toolbox expands with time and with new institutions joining the TA community.
Looking back to the TA history, we can trace back the first expand of the method toolbox when *classical or scientific methods* have been supplemented with *participatory or dialogue methods*– which broadly corresponds to the exportation of TA from USA to Europe. Scientific and dialogue methods complement each other well and they are now considered as current TA practice. This extension of methods has also led to a broadening of the kind of quality criteria a TA project should meet. Besides scientific quality criteria for the output of the TA project, quality criteria for the TA process have been formulated (part 3 of this chapter).
Over the last few years, however, the TA community has become to realise the importance of communicating to the outside world about the TA approach and methods, process and output. Although communication tools have been always used in TA projects, these are now considered by some TA institution as a true integral part of doing TA, belonging to the TA project design. In other words, so called *communication methods* are under development now. These "new" kind of methods complement scientific and interactive methods in the current TA practice[4], so that a TA project can be seen as a combination or mix of instruments from three classes of methods, i.e. scientific, interactive, and communication methods.
From this general history of TA, we can deduct three classes of methods characterising the "method toolbox":

- *Scientific methods*
  Scientific methods are developed in disciplines of natural or social sciences applied to TA problems, in order to collect data, to allow prediction, to make quantitative risk assessments, to allow for the identification of economic consequences, to investigate social values or acceptance problems, to enable for eco-balancing.
  This class of methods includes:
  - Delphi method, expert interviews (for collecting expert knowledge)
  - Expert Discussion
  - Modelling, simulation, systems analysis, risk analysis, material flow analysis (for understanding the socio-technical system to be investigated)
  - Trend extrapolation, simulation, scenario technique (for creating knowledge to think about the future)
  - Discourse analysis, value research, ethics, value tree analysis (for evaluating and uncovering the argumentative landscape)

[4] As well as there is a grey zone between scientific and participatory methods, there is also overlap between participatory and communication methods. Nevertheless, to conceptualise the meaning of communication it is relevant to distinguish between these three classes of methods.

- Etc.

- *Interactive methods*
  Interactive, participatory or dialogue methods are developed to organise social interaction in order to make conflict management easier, to allow for conflict resolution, to bring together scientific expertise and citizens, to involve stakeholders in decision-making processes, to mobilise citizens for shaping society's future, etc.
  This class of methods includes:
  - Consensus conference
  - Expert hearing
  - Focus group
  - Citizens jury
  - Future search conference
  - Scenario workshop
  - Perspective workshop
  - Etc.

- *Communication methods*
  Communication should be seen as a two way process. On the one hand side communication methods are used to communicate the corporate image of a TA institute, the TA approach, the TA process and product to the outside world in order to increase the impact of TA. On the other hand communication is an important feature for the TA-Institute to keep in touch with the outside world and by that keep track with reality.
  This class of methods includes:
  - Newsletter and focus magazine
  - Opinion article
  - Science theatre
  - Video presentation
  - (Interactive) websites (e.g. local questionnaire, debate forum, video, ...)
  - Networking
  - Accompanying
  - Dialogue conferences
  - Etc.

Examples of TA Methods

The Delphi Method

Delphi involves a survey of experts. Delphis focus on forecasting technological or social developments, helping to identify and prioritise policy goals, or determining expert opinion about some aspect of affairs that cannot be measured directly by conventional statistical means. Delphi was designed to provide the benefits of a pooling and exchange of opinions, so that respondents can learn from each others' views, without the sort of undue influence likely in conventional face-to-face settings (which are typically dominated by the people who talk the loudest or have most prestige). Each participant completes a questionnaire and then is given feedback on the whole set of responses. With this information in hand, (s)he then fills in the questionnaire again, this time providing explanations for any views they hold that were significantly divergent from the others'. The explanations serve as useful intelligence for others. The idea is that dissenting views that are based on privileged or rare information can thus be weighed up by the entire group.

Modelling and Simulation

Within the project "Global sustainable development – perspectives for Germany" (Coenen/Grunwald 2003) input-output analyses on the basis of statistical data available have been used for a macroeconomic environmental-economic simulation, by means of which various scenarios of future development have been computed (using and furthering the model "Pantha Rei" developed at the University of Osnabrück). In this manner, sustainability-relevant developments including the implementation of new energy technologies have been projected into the future in order to get anticipative knowledge about the future development of sustainability deficits and problems, according to different overarching scenarios. The future development of sustainability indicators has been calculated for the societal fields of activity (like mobility and traffic, housing and construction, nutrition and agriculture) as well as macroeconomic interrelations have been taken into account system-analytically. Furthermore, the consequences of possible political strategies and measures towards sustainable development have been estimated. In this way, modelling and simulation can help recognising and assessing future developments – of course under the condition of un-certainty.

Consensus Conferences

A consensus conference is a public enquiry centred around a group of 15-30 citizens who are charged with the assessment of a socially controversial topic. These lay people put their questions and concerns to a panel of experts, assess the experts' answers, and then negotiate among themselves. The result is a consensus statement that is made public in the form of a written report directed at parliamentarians, policy makers and the general public that expresses their expectations, concerns and recommendations at the end of the conference. The goal is to broaden the debate on a given issue, include the viewpoints of non-experts, and arrive at a consensus opinion upon which policy decisions can be based. Consensus conferences usually have two closed, preparatory weekends (only the lay panel and their coaches) and a 3-day intensive programme that is open to the public.

Scenario Workshops

Scenarios consist of visions of future states and paths of development, organised in a systematic way. They can be either extrapolative or normative, but should enable participants to build internally consistent pictures of future possibilities and are useful for envisaging the implications of uncertain developments and examining the scope for action. Scenario analysis engages a group in a process of identifying key issues and then creating and exploring scenarios in order to explore the range of available choices involved in preparing for the future, test how well such choices would succeed in various possible futures, and prepare a rough timetable for future events. The method was designed to challenge the mind-set of participants by developing scenarios of alternative futures in order to understand how the world might unfold and how that understanding can be used in strategic planning. Tools & techniques often used: brainstorming, group support facilities such as the Group Decision Room software, models.

Science Theatre

It is not easy to address complex scientific issues in a for (young) people understandable way. Science theatre can bring up dilemmas and question around scientific topics in a personal or emotional and comprehensible manner. The play emphasises societal issues surrounding a scientific topic. After the play, the various actors stay in their role and enter into a discussion with the audience, which is led by a professional discussion leader. Of course several preparations are made before the science theatre combined with ethical debate can be performed. A scenario writer first has to write a script. A reader's commission of scientists advises the author about the scientific topic that is central to the script. After rehearsals the Theatre Company that performs the play can start its tour. When young people are the target group, normally some hundred secondary schools are visited. To help teachers in preparing their students for the play and the ensuing debate, a teacher's manual is written that introduces the play, the various involved issues, positions and arguments.

6.2. Selection of the TA-Methods

After the situation appreciation and the goal setting the development of a TA-design starts. As highlighted above, it is composed out of different methods. The main criterion for the method composition process is the development of a TA-design, which

can be justified as the one with the highest potential for reaching the identified goals. However, in addition to this main criterion also more general aspects concerning "best practices" in TA will be taken into consideration. Therefore the selection of the relevant methods to develop a concrete TA-approach is based on both the justification for reaching the goal and the necessary condition to reach high quality TA-results. Here also, the need to keep in track with the evolving societal, political and scientific situation has to be taken into consideration.

Justifying the selection of the relevant methods is done referring to the goal setting after the situation appreciation. In the case of a project aiming at creating knowledge, one could start with identifying the relevant scientific disciplines, selecting the experts out of these disciplines, organising and moderating of the expert communication process, etc. Another option would be to establish where knowledge is needed and launch an interdisciplinary study aimed at collecting knowledge via bibliography research, interviews, etc. If the situation appreciation shows that the different involved actors are in a conflict or a deadlock, one would start with identifying possible stakeholders, maybe identifying citizens concerned from the new technology under scrutiny, organising and moderating the communication process, selecting ways how the scientific knowledge is transferred into the discussion process, etc.

Referring to the three classes of methods in the so-called "method tool box", it has to be underlined that there is no need to combine methods out of the three classes in order to design a "complete" project. "Complete" in the sense of most promising refers to the situation appreciation and the following goal setting, only. There might be cases in which pure scientific inquiry or an individual newspaper article seems to be most effective. The other way round it is not the case that a project design should contain only one method out of each class. An expert hearing followed by a citizens jury or a Delphi process combined with an expert discussion afterwards might be identified as most promising project design. However, as mentioned above, the project design is developed referring to more general quality criteria as well, for example to transparency, inter- and transsubjective validity, neutrality, etc.. In the following these general quality criteria are described referring to the three classes of TA-methods.

Examples for Combinations of TA Methods

Project "Towards a societal agenda for food genomics"

The specific application of genomics in research in agriculture, foodstuffs and nutrition is called food genomics. Although many scientists expect that the societal impact of food genomics research will be huge, the understanding and awareness of (possible) social and moral aspects is still in its infancy. In the Netherlands, it was mainly policy makers and scientists from public and private research institutions which defined the direction of genomics research; other societal actors were sparsely involved in the debate. To change this and to contribute to the understanding and awareness of societal issues related to food genomics, the Rathenau Institute set up in 2002 the TA project "Towards a societal agenda for food genomics", which comprised of several types of activities. A scientific study was done to map food genomics research in the Netherlands, and its potential applications. Five social essays were written to explore the societal impact of food genomics on the entire food chain. The drafts of these essays were discussed in an expert workshop that confronted the essayists with scientists involved in food genomics research. The final versions were discussed during a working conference with a broad audience, consisting of policy makers, business people, scientists and members of societal organisations. The results of the studies, the essays and the discussions were presented during a public hearing, in which five parliamentarians questioned ten scientific experts and representatives from industry and societal organisations. (van Est et al. 2003)

Co-operative Discourse

The model "cooperative discourse" is a hybrid model of citizen participation named by Renn and Webler (1998) consisting of three consecutive steps: (1) The *identification and selection of concerns and evaluative criteria* is accomplished by asking all relevant stakeholder groups to reveal their values and criteria for judging different options. To elicit the values and criteria the technique of value-tree analysis has proven appropriate. The resulting output of a value-tree process is a hierarchically structured list of values representing the concerns of all affected parties. (2) The *identification and measurement of impacts and consequences related to different policy options* is the following step. The evaluative criteria derived from the value-tree are transformed into indicators by a research team. Experts from varying academic disciplines and with diverse perspectives on the topic of the discourse are asked to judge the performance of each option on each indicator. For this purpose, a modification of the Delphi method has been developed and applied. The desired outcome is a specification of the range of scientifically legitimate and defensible expert judgments and a distribution of these opinions among the expert community with verbal justifications for opinions that deviate from the median viewpoint. (3) The last step is the *evaluation of potential solutions by selected citizens as jurors and representation of interest groups as witnesses*. These panels are given the opportunity to evaluate and design policy options based on the knowledge of the likely consequences and their own values and preferences. The participants are informed about the options, the evaluative criteria, and the performance profiles. The representatives of interest groups and the experts take part in the process as witnesses; they provide their arguments and evidence to the panels who ultimately decide on the various options.
The model has been applied with several modifications to studies on energy policies an waste disposal issues in Germany, Switzerland and USA.

6.3 Quality Criteria

Designing a TA project is not only about choosing the appropriate method or about planning steps, but it is also taking into account quality criteria related to any Technology Assessment activity. Such quality criteria are of crucial importance in order to reach the set goals, i.e. to get the intended impact. Due to the specific nature of Technology Assessment, different types of quality requirements referring to the project design can be established. More precisely, as a scientific, interactive and communicative process, Technology Assessment has to cope with requirements referring to:

- the scientific quality of the project
- the design of the interaction process about technologies and their consequences
- the diffusion of the work and of the results to the outside world.

6.3.1. Scientific Quality Criteria

Technology Assessment is rooted in the scientific activity. For its contribution to be of any value, it has to meet certain scientific quality criteria. TA has to provide knowledge about scientific and technological developments, about their consequences and about ways to cope with their possible risks and maximise their advantages. In this respect, TA projects must be scientific reliable. Moreover, due to the very special nature of TA looking at technologies embedded in their social and political environment, TA projects must meet quality criteria coping with a multi faceted setting. Let's discuss this point first.

- *Interdisciplinarity*
  The necessity for interdisciplinary research results out of the issues TA is tackling (Decker 2001). Only in very rare cases one individual discipline is able to deliver scientific knowledge in a comprehensive manner. In all other cases, teamwork of the relevant scientific disciplines is necessary, in which the scientific boundaries have to be overcome in order to contribute to the solution of a concrete problem. One has to identify and to justify how the disciplines should organise their work in order to reach compatible results and how deep or broad a scientific analysis should be designed in order to meet the relevant aspects of the project. The organisation of an interdisciplinary scientific project is a complex enterprise, which needs:
  - *Disciplinary statements on the topic*
    Notions and underlying disciplinary assumptions have to be identified in order to find a common language, in which identical notions mean the same.
  - *Determination of the project relevant framework*
    A (sometimes hypothetical) predefinition of what is relevant for answering the question/problem (the border-line/cutting-off of the project/problem) has to be made in order to reduce reality to a manageable volume
  - *Combination of the scientific perspectives*
    It has to be identified which cross-correlations are relevant to solve the problem on the agenda and how can these interdisciplinary cross-correlations be reached in detail. Which questions from other disciplines have to be answered? How deep and how broad should the respective input from each scientific discipline be? It is a kind of "pragmatic compatibility" (Decker and Grunwald 2001) one reaches for.

- *Scientific reliability*
  High quality of the scientific inputs is a necessary condition for TA. The relevant trends in each discipline must be represented and the statements must be on the actual state of the art. A TA-project which obviously neglects a relevant scientific perspective will be labelled as "biased" before the results have been presented. Moreover, as TA is usually addressing controversial issues, it often faces situation where experts interpret scientific facts in different ways, so that their opinions differ. It can also face situation where experts "mix up" their scientific statements with their personal (political, economical, etc.) preferences and strategies, but might disguise their personal preferences with scientific arguments. All these elements make scientific reliability a decisive and necessary quality criterion for any TA project.
  In order to achieve scientific reliability, the following procedures can be implemented:
  - *Extended peer reviews*
    Peer reviews are a well accepted tool to evaluate disciplinary research. Second and third expert opinions have to be taken into account, especially when contradicting thesis are followed within a scientific discipline. In case of a TA project, the peer review has to be extended in order to match the interdisciplinarity requirements. This means that peer reviewer will evaluate if the relevant questions concerning the issue have been asked crossing the disciplinary boundaries and if the answers met the relevant aspects of the

respective disciplines. This evaluation process has to be taken seriously to avoid a kind of "science light"[5].These extended peer reviews can occur at the end of the project (classical peer review) or can be organised in order to "accompany" a project (for example, in a kind of "accompanying group" where experts of the involved disciplines would be invited).

- *Expert confrontation*
  When a situation appears where scientists hold different values or interpret facts differently, a direct confrontation of the experts may resolve this so-called expert dilemma (Nennen and Garbe 1996). With such a confrontation, and given that "good will" is present, experts should be able to identify their different underlying assumption and their weighing of arguments.

Examples of Realizing Scientific Quality Criteria in Practice:
Evaluation Loops within Expert Discussions
The so-called project group principle (Decker and Neumann-Held 2003) of the European Academy GmbH is in general an interdisciplinary expert discussion accompanied by several interdisciplinary evaluations. Since these evaluations take place during the whole discussion process they can be described as "loops" which the discussion processes has to pass. At the beginning of the project an interdisciplinary expert group (the scientific council of the academy) scrutinizes the work programme, i.e. the main questions to be answered, the scientific disciplines identified to be relevant, the way it is planned to overcome the disciplinary boundaries. Since "corrections" of the main focus are hard to do during the discussion process a Kickoff-meeting is organised at the beginning of the project to put the perspective of external experts on record. During the discussion process a Midterm-meeting takes place during which external experts comment on the work in progress and get the chance to ask for additional aspects not taken into account by the expert discussion so far. Finally, another expert group (the scientific council) scrutinizes the whole discussion process taking into account all "interim-evaluations". This group makes the final decision if the project is acceptable or needs further revision. By these evaluation loops it might be possible to overcome the so-called expert dilemmas like expertise and counter-expertise or the covering of personal interests by scientific statements by these expert confrontations and extended peer reviews.
The Group Delphi
The CTA Baden-Württemberg has developed a method called the group Delphi (Webler et al. 1991; Renn et al. 1999). It is similar to the original Delphi exercise but based on group interactions instead of individual written responses. During a group Delphi all participants meet face to face and make the assessments in randomly assigned small groups of three and four. The groups whose average scores deviate most from the median of all other groups are requested to defend their position in a plenary session. Then the small groups are reshuffled and perform the same task again. This process can be iterated three or four times until no further significant changes are made. At the end of a Delphi process one gets either a normal distribution of assessments around a common median, a two- or three peak distribution (signalling a majority and one or more minority votes) or a flat curve (which means that knowledge is insufficient to make any reliable assessment). The advantage of Delphi is that a serious effort has been invested to find the common ground among the experts and to find the reasons and arguments that cause differences in assessments. The disadvantage is that Delphis depend on the quality and completeness of the expertise and information brought into the process. There are several positive experiences with Delphi processes, in particular with group Delphis.

6.3.2. Interactive Quality Criteria

Regardless, whether TA wants to contribute to a public debate or a decision making process, chances for reaching impact are higher if the project can prove a high degree of legitimacy. Looking at the different stages of development in a TA-project (situation appreciation, goal setting, project design, project implementation, etc.) we cannot negate that the legitimacy of each stage depends very much on how the existing differences in social values are integrated. In this respect, social fairness, process fairness, argumentative quality and transparency are key quality criteria for TA projects.

[5] "Science light" refers to the fact, that in interdisciplinary discussions in which each discipline is represented by one expert without evaluation, everything what this experts mentions is taken for granted.

- *Social fairness*
  The selection of the institutions or persons who will contribute to the project, i.e. interact with each other, is of crucial importance. According to the situation appreciation, the set goals and the chosen method, a TA project might be based in an interaction between experts, between stakeholders or between scientists and ordinary citizens, just to cite some examples. It is thus very important that, with respect to the aims and design of the project, that the appropriate groups of participants might be invited. For example, in the case of a project aiming at gaining knowledge about a new technology and its consequences, it might be appropriate to invite experts only. The question will thus be which disciplines or scientific institutions have to be represented. In a project aiming at solving social conflicts, it is crucial to invite stakeholders or citizens. The task is to identify which are interests at stake and which persons have the legitimacy to represent these interests. This can be realized either by democratic elections, by authorization of groups by concerned people or groups or by formal procedures of equal opportunities (ex. random selection).

- *Process fairness*
  In a TA project, procedural fairness has to be implemented, i.e. that fair rules have to be established in order to allow all participants to be heard and considered. More precisely, process fairness implies to:
  - *Meet dialogue standards*
    All invited participants should be allowed to bring an input and to be listened to. More precisely, independently from their charisma, knowledge on the issue or social status, participants have the same rights to make assumptions, express opinions and formulate proposals.
  - *Establish democratic decision procedures*
    To get fairness during a TA project, decisions on the content should be of collective nature, which implies a voting modus. The decisions can be taken with simple majority votes, absolute majority votes, multiples majorities or consensus. Decision procedures can be the same for the whole dialogue or be established from case to case.
  - *Set an agenda*
    It must be clear for all participants which points will be discussed. Participants should also have the opportunity to modify the agenda, or even to set the agenda themselves. But finally decisions on the agenda or the procedure must be consensual.
  - *Support towards the competence of the participants*
    This means that the information and knowledge handed over to the participants is understandable, i.e. all participants should understand all used concepts and definitions. If necessary, a translation should be available. There is not only attention for the transfer and acquisition of knowledge needed, but also for the acquisition of interaction skills by the participants. This concerns talking skills, group-working skills, etc.

- *Transparency of the interactive processes*
  Technology Assessment evolves often in very controversial fields, where different kinds of values or interests are at stake. This means that power relations are

present: interest representatives or holders of certain kinds of values will try to get their point of view in the discussion and in the final recommendations. Arguments might be a way to achieve this goal, but many other means are available, like persuasion, negotiation, threats, etc. Technology Assessment has to cope with this reality: when entering highly controversial fields like genetic testing or e-surveillance, TA is entering a political field with all its power relations. TA practitioners must be aware of these power relations, and especially make them transparent, so that the participants themselves know who is representing whom. But transparency is even more important for those who are not part of the interaction, but might be concerned by the results of the TA project. Only with transparency can they understand how the project got to a certain result and thus check whether the process has been biased or not. In this respect, transparency means:

- *Transparency about interests and values*
  It is desirable, that each participant declares its interests. This means for example that each participant should declare its institutional affiliation, its function or its job. It is also important that other mandates (in politics or in associations) are explicitly declared, as far as they are connected to the discussed issue. Additionally it should be made transparent whether statements are based on scientific knowledge or rather on values or personal interpretations.
- *Documentation about all steps*
  Each step and decisions of the interaction should be documented, for example in minutes or reports. The public and interested persons should have access to these documents. In some cases, the most important steps and decisions could even be made available in a kind of annex to a final report or on the World Wide Web.

- *Argumentative quality*
  At each stage within a TA-project claims are put forward and arguments are used. For instance: every TA-organisation needs to motivate every time the choice for the topic or focus for a new TA-project; in a dialogue between experts and members of a lay panel, knowledge, uncertainity, opinions and beliefs are confronted among the participants. Probably the statements of the experts will be more 'scientific' in comparison with these of the lay panel, but they all need to be justified with arguments. These arguments have to meet certain standards, that is have a certain syntax. According to the argumentation theory, a claim must be based on ideas (grounds), must explain why theses grounds lead the speaker to conclude the claim (warrant), must give reasons why the receiver should believe the warrant (backing), and must contain qualifiers defining the scope of application of the claim ("if", "as long as", etc.) (Toulmin 1958, Freeman 1991).

Of course, it is impossible (and even not desirable) to check the syntax of every individual argument used in the course of a complete TA-project. This would involve to interrupt every discussion between people, to check all arguments in every document made, to proof every statement of each expert. But, it must be possible to validate the quality of the arguments at decisive or importants moments in a TA-project: in the publication of an expert report, in the recommandations of the laypanel in a consensus conference, in outlining the policy options in an advice to the Parliament and - why not - in choosing a method for a specific TA-project or in selecting

collaborating experts. The argumentative quality is probably the most important aspect if one seeks influencing the policy making process. If a TA-project is short on argumentative quality why should policy makers listen to it?

Examples: Interactive Quality Criteria in Practice

Process fairness through a declaration of intention: the Swiss "PubliForum" example

For each of its consensus conferences (called "PubliForum"), TA-SWISS sets up a "declaration of intention", in which the aims and the procedure of the project are stated. This declaration of intention contains also a list of standards for a "fair and transparent PubliForum", with statements such as "every opinion and position has to be considered by participants"; "organisers should clearly indicate how the PubliForum results will be used", etc. Moreover, special rules for each involved actors (laypanel, experts, facilitator, organisers, accompanying group) are formalised. These rules specify the tasks, rights and duties of the respective groups or persons (Joss and Brownlea 1998)

Social fairness through participant selection: the Danish "Future search conference" example

In 1998 the Danish Board of Technology organised a "Future Search conference". The method is suitable for breaking the ice in a (political) locked situation and the topic in Denmark was about traffic in Copenhagen. The Future Search guides the participants through a process where they based on history and analysis of the present day situation create common pictures of the future and make concrete action plans to reach these goals. Therefore, it is of vital importance for the success that the "whole system" is present through the three-days conference, meaning that all stakeholder groups (e.g. environmental groups) and groups with influence on decision-making (e.g. politicians) participate to ensure the foundation for action afterwards. In the Danish case eight groups were identified: Business/economic life, politicians, officials, experts, environmental organizations, organizations of cars and road traffic, citizens using cars, citizens using bicycles and public transportation.(Weisbord and Janoff 1995; Gram 1998)

Ensuring argumentative quality by making explicit, discussing and checking various policy options and problem definitions: The Gideon Project on sustainable crop protection

In the mid-1990s an evaluation was planned of the Dutch governmental multi-year plan for drop protection. In order to provide the members of Parliament with information on opportunities and threats for achieving sustainable crop protection the Rathenau Institute started a project, dubbed Gideon. The project was set up as an 'interactive' TA (Grin et al. 1997) consisting of various activities that involved many stakeholders. Various stakeholders had different ideas on what the goal of reducing the dependence on pesticides meant and how this objective could be obtained. A key characteristic of the methodology, therefore, was to make explicit and discuss both policy options and problem definitions. During all activities (amongst others in-depths interviews, future-oriented workshop, work conference, open day) it was tried to include a large variety of perspectives. Moreover, the support within the field for the findings and results as formulated by the project team were constantly checked through interviews and debating events. (van Est et al. 2002)

6.3.3. Communication Quality Criteria

These criteria relate to communication of the TA approach, process, and product into the outside world, for example relevant target groups. Below, some communication rules or impact stimulation criteria are formulated.

- *Flexibility related to the ongoing debate*
  Flexibility is needed during the project implementation and dissemination phase. The original situation appreciation might change. Such changes might concern the political agenda (e.g. a law is postponed or advanced), the public debate (e.g. a "scandal" raises interest for an issue, an issue has a "media peak" for a few weeks) or the scientific community (e.g. new findings). In order to achieve an impact, the TA project has to adapt to these changes. To achieve flexibility one should consider the following issues.
  - *Adaptability*
    The project design must allow space for some modifications during the performance. Highly complex and interdependent project phases might endanger the need for adaptation. Such projects are difficult to adapt to new situations, as a change in an initial phase might have consequences on the subsequent phases.
  - *Flexible institutional procedures*
    Project and institutional procedures (e.g. quality control procedures) must be treated with some openness. For example, in many TA institutions a

formal decision of a Board must be taken before publication. Such procedures might be slow and, if necessary, ways have to be found in order to be in tune with a new political, societal or scientific agenda. In justified cases rules are there to be broken.

- *TA institutes and practitioners should be open minded and focus on achieving impact*
  TA institutions and project staff must be open for short-term changes. Professionals must be open-minded and engaged in impact achievement.
- *Opportunities to create impact after the project should be looked for*
  Changes in the situation might happen after a project is over. In this case, it might be useful to actualize a project. This does not only mean to "sell" a finished project report, but maybe to amend the project to the new situation.

Examples: Flexibility Related to the Ongoing Debate in Practice

The TA-SWISS study on stemm cells: coping with an accelerating political agenda

When TA-SWISS started its study on human stem cells in summer 2001, the Swiss Government had already decided to work out a law on research involving human subjects, in which the issue of embryonic stem cells would be addressed besides other issues. A first draft of this law was expected for the end of 2002. Knowing that this first draft would be revised after having been consulted by political parties, cantons and interested and affected groups, there was a good chance for the TA-SWISS study to be considered when writing the final law project. And of course, it might be used by members of Parliament when they would have to discuss the law.

But in fall 2001, the Swiss National Science Foundation approved funding for a research project, the aim of which is to study the use of human embryonic stem cells for the regeneration of cardiac muscle cells. This gave high priority to the regulation of stem cell research in Switzerland, to avoid that such research projects would take place in some sort of "legal grey area". The Swiss Government decided to draw up a separate bill on these issues in a fast-track procedure. The deadlines were shortened and it appeared that the consultation of the first draft of the law on embryo and stem cell research would take place before the TA-SWISS study would have been published - a problem when knowing that this consultation phase is an important step in the Swiss political decision-making system, where TA-SWISS can get some impact.

The TA-SWISS steering committee thus decided to accelerate the work on the TA study on human stem cells and to publish mid-term results, even though the project was not completed and did not go through all phases of quality control. (For example, the time schedule did not allow to submit the draft report for peer review). This procedure not only implied an infringement of TA-SWISS internal procedures, but also flexibility from the side of the project management and the authors of the study, as the mid-term results all of a sudden gained political relevance (Hüsing et al. 2003).

Competing for political and media attention: The Sustainable Water Management Project of the Rathenau Institute:

The Rathenau Institute's project on "Sustainable Water Management" ran parallel (in time) with activities of several committees, most notably the Committee of Water Management in the 21st Century (WM21). The Dutch cabinet as a result of the flooding problems over the past decade had set up this committee during the course of the project. The 'competition' for (media and political) attention with other committees made it hard to have an impact and to measure the effects of your own project. In case of the Sustainable Water Management project the project managers worked very hard – some even cancelled their vacation – to publish the results (in a report titled "Cashing in on the Blue Gold") on the night before the WM21 brought out its advice. If the results had been published later the WM21 advice had probably taken away all media attention. Now the Rathenau Institute received at least as many media attention as the WM21. (Van Rooy and Sterrenberg 2002)

- *Keeping track with social, political and scientific reality*
  As described above, the first step of a TA project implies an appreciation of the social, political and scientific situation. According to this appreciation, the project goals will be set and the relevant methods chosen. The social, political or scientific situation, however, can change in the course of the project, so that adaptations - or at least awareness of these changes - are necessary. Thus the necessity to keep in track with the context in which the TA project is evolving becomes a central issue. Three ways of keeping track with social, political and scientific reality can be distinguished:
  - *Doing research*

Research is a good way to reflect on and keep track with the context in which the TA project is being realised. This implies to monitor the specialised and daily press, as well as to reflect on the observed changes.

- *Meeting with experts and stakeholders*
  Regular meetings with representatives and experts to present and discuss project design and outcomes are important for two reasons. First, these 'opinion leaders' can act as a kind of "support" for legitimization and the valorisation of the project results. Second, these persons are gatekeepers, who can be helpful to make contact with the "work floor".
- *Meeting the "work floor"*
  Meeting the work floor is a tough and confronting, but very good way for continuously adapting the project to reality. This should be done at every important stage of the project. Formal or informal interviews or organising discussion sessions can be used for this. To organise these things often the consent of the above-mentioned gatekeepers is needed.

It should be noted that the above three activities cannot always be clearly distinguished. For example, there is a strong link between interviewing a manager for a research project and asking comments on a project design. In reality, both activities are often combined. It is important to realise that the 'respondent' is not only a source of knowledge but also a kind of 'project consultant'.

Examples: Keeping Track with Social, Political and Scientific Reality in Practice

The "Midway conference" for meeting with experts and stakeholders

A midway conference is a communicative method, which is often used as part of the scientific "expert discussion" at the Danish Board of Technology. This conference is arranged to discuss the very first draft of project results. Invited are a broad number of experts and stakeholders related to the topic. The midway conference includes presentations from opponents and is formed as a dialogue between the participants and the expert group responsible for the draft. Even though the expert group has already produced their first draft, the input from the midway conference often leads to the necessity of rather comprehensive edition. Therefore the name.

The "Accompanying Group": an instrument that goes further quality control

For each of its projects, TA-SWISS constitutes an accompanying group in charge of reviewing the project from beginning to the end. In case of an interdisciplinary project (i.e. a "TA Study"), the accompanying group is in charge of controlling its scientific quality: it will meet for several times in order to discuss the research questions of the project, the intermediary results, as well as the conclusions and recommendations done by the authors of the study. Accompanying groups are also set up in cases of participatory projects. In this case, they will mainly be in charge of controlling the interactive quality criteria.

Besides this primary role of quality control, the accompanying group is also a decisive element for TA-SWISS to communicate with the outside world and keep in track with reality. As a matter of fact, accompanying groups are formed of scientists from various disciplines, as well as from interest representatives. These personalities can give valuable information about scientific and technological developments related to the subject or about societal and political issues. They can also act as "multipliers" towards decision makers and other relevant actors (TA-SWISS 2003).

- *Political embedding*

Presenting interesting outcomes of a TA-project is often not sufficient if one seeks to create impact in political decision making process. Many TA-scientists try to make contributions to the societal and political agenda setting. Unfortunately those attempts remain unsatisfactory quite often and political decision making processes seem to be unaffected by TA-project outcomes. Thus part of the value of a TA-project can be seen as the extent the project outcomes lead to political reality. In order to improve the likelihood of reaching this objective the whole process of a TA-project (situation appreciation, goals setting, concept and design, realisation) should be embedded in the political decision making process. TA contributes to this decision making process by offering helpful information for the decision makers like for example value balanced advices or arguments discovered by competent assembled and fairly grouped

discourses. The embedding includes permanent information of the political decision makers and the societal environment surrounding them. A flexible project design is helpful in order to integrate important changes of the appreciated political and societal situation in the further project realisation. An offensive public relations work might be helpful to some extent.

Example: political embedding in practice
The Publiforum on transplant medicine: a joint venture
The PubliForum on transplant medicine, organised by TA-SWISS, was co-financed by 2 other institutions: the Ministery of Health and the Swiss National Foundation for research. The two partners contributed to the project planning. The Ministry of Science was, at that time, writing a law on transplant medicine and the Swiss national foundation for research had launched a research programme on the issue of transplants and implants. Both institutions were interested in integrating the views of the citizen in their work. This was especially the case of the Ministry of Health, who reported on the results of the PubliForum in the message accompanying the law it addressed to Parliament (Bütschi and Mosimann 2001).

- *Diffusion of results*
  In order to play a role in the social reality, convincing policy makers with the results (for instance: in writing policy advises) is far not enough for a TA-project. Change is only possible if the 'policy network' or 'the public' sees the need for it and wants it. This leads to the following suggestions with respect to communication:
  - *Publication of easy accessible media*
    Scientific reports are relevant for scientists and for knowledge keeping purposes in the TA institute. For addressing other target groups than scientists and the TA community, one needs to make understandable, attractive media with comfortable access.
  - *Communication strategy with all kinds of media*
    Good media communication is very important. Not only with scientific journals or quality newspapers, but especially with ordinary, popular newspapers and journals, as well as with radio and television and especially internet media.
  - *Informal and continuous communication*
    TA-practitioners' job isn't finished when the survey is done and the results are published. Then the real works gets started. In this respect, in order to achieve some impact, it is important to talk with people, and discuss with them about the results. Not one time, but over and over and in a way that people can understand. In other words, TA is also happening out of the office and out of the meeting rooms!
  - *Attractive products and communication tools*
    In order to get a broader audience, it might be useful to develop attractive products and communications tools, like personal presentations, (simulation) games, theatre, movies, flashy slides or DVD-presentations, events and expositions.

Examples: Diffusion of Results in Practice

Combination of Press conference and workshop

The Europäische Akademie GmbH presents the reports of their project groups in a two step process that fits the broad group of addressees the Academy is aiming at. The presentation starts off with a press conference and continues with a short workshop that allows for a closer look at the report and a more intense discussion, particularly of the policy recommendations. In order to allow for a participation of the relevant decision makers and interest groups the presentations are held in Brussels and/or Berlin respectively.

Pork Plaza : a video movie to foster debate on the future of pig farms

To foster a broader debate – i.e. also involving non-specialists – about the future of Dutch husbandry, in particular pig farming, the Rathenau Institute produced in 2002 the video movie Pork Plaza. In the movie two future scenarios are shown : organic farming and the so-called pig flat, in which the whole production process (from seed to stake) is organised within a factory which has multiple levels. This video was and still is being used for discussion within secondary schools, universities and interest groups. The video has also been used by specialists, for example, within the ministry of agriculture.

CD Roms as part of the viWTA project on GMO-food

The viWTA-project on GMO-food consisted of three main activities: (1) a preliminary study describing the stakeholders, their positions and the ongoing debate on GMO's in Flanders, (2) a consensus conference and (3) a stakeholders forum. For the invitation for the stakeholder forum, we made a CD-Rom with an animated photo coverage of the consensus conference. A voice-over described the whole process, seen from the point of view of the members of the lay panel. All related documents (report of the lay panel, information brochure, etc.) were consultable on the CD-Rom. The response to the invitation was very high and there were a lot of positive comments on the user friendly way we presented the results. (http://www.viwta.be/content/nl/inf_publieksforum.cfm?favlang=nl)

Conferences as a way to disseminate results of TA projects

TA-SWISS regularly organises one-day conferences dedicated to disseminate and discuss the results of its studies. These conferences are intended to experts, decision makers and/or stakeholders. In order to enhance the visibility of the conference and to foster commitments from the participants, TA-SWISS favours joint-ventures with relevant actors and institutions. For example, TA-SWISS recently organised a conference on the chances and risks of telematics in the area of transports ("Chancen und Risiken der Verkehrstelematik") after having published a study on the issue. This was the opportunity to discuss the results of the study with transport experts and stakeholders. TA-SWISS also organised a seminar with doctors and nurses intended to discuss the recommendations the citizens made during the PubliForum on transplant medicine. Participants really appreciated the seminar, as nurses and doctors rarely have common conferences to discuss societal issues related to transplantation medicine.

- *Striving for synergies*
  As noted before, TA projects can be conceptualised as a combination of scientific, interactive, and communicative methods. These three classes of activities supplement each other. It is very important to look for synergy between them. From a communication point of view it is also interesting to co-operate with other organisations, which bring in other types of experiences and relations with other types of networks.
  - *Combining science (content) and communication*
    There are various ways in which science and communication can strengthen each other. For example, adding an opinion poll to the public panel may strengthen both the results of the public panel and create interesting, ready material for the press. Organising a scientific conference can well be combined with making TV program. The TV program could invite the same experts, but will question these experts from a different perspective. Another interesting option is to get your message through by using media interesting forms like literature (collection of short stories), film or theatre (*Pig in the Middle*). Finally, you could link the presentation of project results or debates with other happenings.

  - *Co-operating with other organisations*
    An effective way to bring in knowledge and social connections is to co-operate within TA projects with other organisations. It can be very helpful to (temporarily) attach the people from other organisations to the project team of the TA institute. As a matter of fact, the cooperation institute has its own network and addressees and can thus multiply the diffusion canals. Here,

however, special attention must be given to the partners, who should fulfil the same conditions as TA institutes, i.e. credibility and independency.

Examples: Striving for Synergies in Practice

World Exhibition, Conference, and Television Show
During the World Exhibition in 2000 in Hanover, Germany, a series of conferences, open to the visitors of the Expo were organised under the heading Global Dialogue. From July 11-13 the theme was Science and Technology – Thinking the Future. At the end of each conference day, a television show was broadcasted from the Expo. This show would discuss themes similar that had been discussed during the expert workshops, and would invite distinguished scientists that visited the conferences.

Conference and Exhibition
The Akademie für Technikfolgenabschätzung in Baden-Württemberg combined its conference Zur Zukunft des Menschen: Gentechnologie, Nanotechnologie, Künstliche Intelligenz with the exhibition Erde 2.0, which was targeted at a large public.

Science Museum and TA-Institute
In co-operation with the science museum Nemo in Amsterdam the Rathenau Institute organised on November 1, 2003 the technology festival Homo Sapiens 2.0. This is a large public festival on the possibilities and risks of all kind of existing and future technologies that may 'improve' men's physical, mental or abilities, looks, et cetera.

Theatre as an input for scenarios discussion
The viWTA plans for 2004 a project on 'the future of elderly in the technology society'. Threesome scenarios on the outlook of the information society within 20 years and the way elderly will deal with all these changes will be developed. Once the scenarios are written, a theatre company will be asked to make an adaptation of the scenarios for stage and several performances will be organised for a specially invited public of older people. After the performances, a discussion with the public will be initiated in order to find out what their favourite scenario would be. The analysis of these discussions can form the basis for a back casting exercise.

7. Project implementation

The project implementation phase is the realisation of the project design. The distinction is sensible in order to identify discrepancies between the ideal case usually in mind when developing a project design and the real case, which usually cuts back the ideal case. The quality of a TA-project can be acquired referring to both the adequate choice of methods and their realisation. If the decision is for example that a citizen jury would be the best method to reach a certain goal, one refers to the ideal case "citizen jury" in this decision process. The realisation might be deficient in two ways. Firstly, it could happen that the goal (e.g. reaching a decision by the jury) could not be reached due to irresolvable conflicts within the jury. Secondly, it could happen that the project management was not able to combine an unbiased jury. In the first case the deficit would be referring to the original goal: The citizen jury had been chosen in order to reach a certain goal within the whole TA-project design. This goal was not reached. In the second case a deficit according to the above mentioned more general quality criteria occurred. On first sight the goal has been reached, i.e. the citizen's jury came to a common decision. But on second sight it was realized that the jury was biased. The project management failed to combine an unbiased jury and therefore was not able to meet the general quality criterion (implicitly co-notated to the method "citizen's jury") "neutrality".
The general quality criteria mentioned in chapter 6 (selection of methods) are of crucial relevance in the implementation/realisation phase, too. During the design phase the designer refers virtually to these quality criteria, by selecting methods *in order to* reach e.g. scientific reliability or social fairness. During the project implementation phase these quality criteria *are used* to evaluate the ongoing process.

The project management will be confronted with the need to re-design the project in the following cases. The project design must consider cases like these in a flexible way:

- Referring to the individual goals each selected method within the project design should reach
- Referring to the general quality criteria, if deficits occur during the ongoing process
- Referring to the above mentioned "keeping contact" to the ongoing social debate. It might be necessary to adapt the project design to changes identified.

8. Summary and Conclusions

The TAMI method group aims, at a very general level, at improving Technology Assessment (TA) and its use for policymakers by looking at the level of methods to be applied and at the relation between method and impact during many phases in a TA project. The results are based on discussions and thinking relying on the TA experience of the institutions and persons involved. Technology Assessments is regarded by the TAMI network as a scientific, interactive and communicative process with the aim to contribute to the public and political opinion forming on science and technology related societal aspects (cp. the TA definition and its explanation in part 1). Experience in TA practice has shown that there is no single and one-best solution of doing TA projects. In contrary, due to the large variety of problems to be tackled and situations to be taken into account, different types and mixes of methods have to be used. The success and impact of a TA project decisively depends on the appropriateness of the method mix used. The TAMI method group focussed its attention on the dependency of the success of a singular TA project on many phases (situation appreciation, goal setting, project design etc.) and on quality criteria in order to provide knowledge on how to further the choice of adequate methods in those phases.

8.1. Functions of methods for reaching TA goals

TA projects shall reach certain goals which are depending on the situation and the problem to be dealt with (cp. part 4). Methods to be applied are part of the design of the TA project. They are regarded as means which shall serve certain functions in the TA project and which shall contribute to the success of the respective project. Most important functions of methods are, due to the several aspects mentioned in the TA definition:

- *Creating and providing relevant TA knowledge* (on impact and consequences of science and technology, on material and energy flows, on societal framework conditions, on actor constellations etc.). This knowledge can be used in the respective TA, for example, for early warnings against risks, for early detection of chances, for identifying obstacles to innovation processes, for creating awareness, for supporting societal learning processes or feedback loops, for motivating and informing public involvement etc.
- *Involving stakeholders and people affected in the TA process* (for early detection or prevention of possible conflicts, for raising awareness, for enabling social learning processes etc.),
- *Motivating and structuring interaction and communication* (for supporting decision-making and opinion-forming, for analysing the value dimension, for identifying alternative solutions to the problem under consideration, for testing ways of conflict resolution etc.).

- *Ensuring transparency, reliability and validity of the results* (to open the TA results for criticism, to allow transparent discussion, to allow everyone to prove in which way and under which premises and circumstances the results have been produced etc.).
- *Communication of the results* to the specific customers (like parliaments) or to the broader public.

In the specific context of a TA project these different functions will get different importance, and there will be different mixes of functions the method mix to be selected shall serve.

8.2. The method toolbox

The question arises which methods are we talking about? Which methods are included in the TA toolbox? The answer can be given according to experiences in the past with certain methods. It can, however, not be concluded that there will be a fixed boundary of the TA toolbox. New challenges for TA might cause the need for new methods to be used. In TA history, the TA toolbox has been increased by more and more elements, and even new types of methods enriched the toolbox. A first wave of changes supplemented the *scientific methods* with *interactive methods (like participatory or dialogue methods).* They complement each other well and are now considered as current TA practice. Furthermore, the TA community has become aware of the importance of communicating to the outside world about the TA approach and methods, process and output over the last few years, so that *communication methods* are under development now. They complement scientific and interactive methods in the current TA practice, so that the methodical mix used in TA projects can be seen as a combination of scientific, interactive, and communication methods. According to the institutional setting of the TA institution, to the problem to be dealt with and to the respective situation parameters this mix might include all three categories or only one or two of them. Also the relative importance of the three categories will vary from case to case.

In order to illustrate the content and the composition of the TA toolbox, the most important (mostly used or of high importance in the TA discussion) elements shall be mentioned briefly.

Scientific methods: Usually they have been developed in disciplines of natural or social sciences and then been applied to TA problems. These methods are dedicated to collect and evaluate data of any kind, to allow prediction, to make quantitative risk assessments, to allow for the identification of economic consequences, to investigate social values or acceptance problems, to enable for eco-balancing etc. Methods of this type are the Delphi method, expert interviews for collecting expert knowledge, modelling and simulation, cost/benefit-analysis, systems analysis, risk analysis, material flow analysis, trend extrapolation, scenario technique for creating knowledge to think about the future (currently often combined with participatory elements in technology foresight exercises, TATuP 2003), discourse analysis, value research, ethical analyses, value tree analysis.

Interactive methods: They shall organise social interaction in order to make conflict management easier, to allow for conflict prevention, detection or resolution, to bring together scientific expertise and citizens, to involve stakeholders in decision-making processes, to mobilise citizens for shaping society's future or to mobilise "local" knowledge. To this method type consensus conferences, co-operative discourses, public expert hearings, focus groups, citizens' juries are belonging, currently in part

supported by using electronic media. There may also be different mechanisms of recruiting the participants.
Communication methods: These are used to communicate the corporate image of a TA institute, the TA approach, the TA process and product to the outside world (policymakers, stakeholders, the general public) in order to increase the impact of TA. Communication methods also help keeping track with an eventually varying socio-political environment. Newsletters, opinion articles, science theatre, (interactive) websites and various types of networking are belonging to this class.

8.3. How to select the appropriate TA method

A main step in designing a TA project is to select the methods to be used and to clarify their interfaces and their integration in a coherent method mix. The question how to optimise this step in order to arrive at the desired impact later on is at the heart of the TAMI programme. The objective for the method composition process is the development of a TA-design, which can be justified as the one with the highest potential for reaching the identified goals of the entire process. If an error or a misconception would occur at this point of a TA project there will, possibly, only be few chances to modify the method mix at a later stage of the project without a considerable loss of resources and time. However, in order to maintain and to increase the chances to adapt the respective project to changing socio-political framework conditions or situations it is sensible to implement entry-points for flexible response on such changes.
TA activities are always located in a specific context defined by the issue to be tackled, the institutions involved, the societal and political climate, the need for opinion-forming and decision-making, the constellation of the relevant actors, the potential for social conflict, just to cite some examples. Also, the way of implementing a TA project and to communicate about it might play a decisive role in reaching an impact.
Following the previous chapters, a TA issue can lead to quite different questioning in different contexts. The way to tackle the issue might depend, for example, on the technological development, on the political context or on the general mandate of the TA institution. An adequate appreciation of the situation is therefore an important step towards achieving any impact. The right appreciation of an issue and its context will help a TA institution to fix realistic and correct goals for a given project, and then use the appropriate methods in order to set up a TA approach able to realise these goals. A situation appreciation consists of analysing several aspects which depend on the respective case. Relevant to TA are – mostly – the following aspects:

- knowledge aspects: Which knowledge (about impacts and consequences of technology, about reactions of stakeholders and the public) is already available? Where are important areas of uncertainty and ignorance?
- thematic aspects: which TA relevant properties does the topic under consideration show? What kind of problem (technological or scientific development, social problem, decisions to be made) has to be addressed?
- actor aspects: which actors are already involved? How are they organised and what can be said about their interrelationships? Which role does the public play?

One of the main findings of the TAMI method group is to put emphasis to the importance of this situation appreciation. In an ideal case, there are two types of situation appreciation. At first, it should be a separate stage in the pre-course of TA projects, because of its relevance for the latter success but also in order to make the

design and the premises and presupposition as transparent as possible. Secondly, it is of high importance to permanently monitor the societal situation during the course of the project in order to keep track with possible modifications of the initial situation appreciation – in order to enable adequate and early reactions.

8.4. Quality criteria

In implementing the methods TA practitioners have to be aware of the necessity to fulfil a certain set of quality criteria. These have been ordered in TAMI following the above-mentioned types of methods.

Scientific quality or *reliability* of TA knowledge and orientation often seems to be a necessary but not sufficient prerequisite for a "good" TA. Bad or invalid knowledge will be uncovered as being bad or invalid, and the consequence will be a loss of credibility and of impact. Scientific TA as interdisciplinary research is confronted with two categories concerning the reliability of scientific statements: the reliability of the respective disciplinary inputs (according to the familiar disciplinary quality criteria) and the reliability of the *integration* of the interdisciplinary results (composed out of the disciplinary inputs).

Interactive quality criteria are related to the design of participatory or dialogue TA-processes. They are, according to TAMI discussions, social fairness (*fairness of the project structure, fairness during the process),* argumentative quality, plurality, transparency as well as support towards the competence of the participants. They are essential in ensuring and demonstrating the legitimacy of the TA process which is decisive for the acceptance of the results in the outside world (Grunwald 2000). Prominent aspects of realising these criteria are approaches how to identify or select the participants, and how to define the rules of the process.

Communicative quality criteria are the flexibility related to the ongoing debate, the necessity to keep track with social reality, the diffusion of the TA results and striving for synergies. Their observance shall guarantee that there is a feedback between the TA practitioners and participants on the one side and the outside world on the other, in order to avoid a mismatch between external expectations and the results provided, and in order to prepare the addressees for the coming results and to increase the external resonance (and impact).

TAMI emphasises the importance of quality assurance in TA in order to gain trust and credibility in the long run. The three types of quality criteria together define the professional standards and ethics of the current TA community. These standards have been developed over time. For example, one might say that in the 1970s emphasis was laid on scientific quality criteria. Fulfilling those criteria was expected to be sufficient in order to generate an impact. After interactive quality criteria have gained weight during the 1990s, TAMI introduces a third set of communication quality criteria to indicate that communication activities and the question of how to increase impact are in the centre of attention of current TA organisations. Having an impact is important but TA should never go for easy publicity. Increasing impact can be strived for through strengthening communication competencies and activities, but not at the cost of scientific and interactive quality criteria. As such the three types of quality criteria together enable and constrain short and long-term impact, and the way in which these impacts should be reached. Which criteria are most relevant in specific exercises depends on the concrete challenge, the goals and the respective situation.

8.5. Recommendations concerning the relationship between method and impact

In this paper we have set up a common framework to get an insight into the complex relationship between method and impact. Elaborating on this framework leads us to the following list of recommendations.

- Set proper and realistic project goals and choose the appropriate (mix of) methods based on a sound and detailed situation appreciation.
- Be aware that there is no unique answer to a situation appreciation, in other words, the same issue can be addressed in different ways. For example, depending on its institutional context, one institute might address the lack of knowledge about an issue, whereas the other might focus on stimulating public debate.
- A TA institution should be aware of its way of tackling issues and that it is known and accepted by outside players (e.g. decision-makers). Only under these conditions will it be possible to set the right goals and to define an appropriate project, with chances to reach a certain audience – and thus a certain impact.
- Be aware that gaining any type of impact is not an end in itself. Instead of solving a problem, a TA project could create new problems. In other words, negative impacts may occur. It is important to be conscious of the appropriate type of impacts one wants to strive for.
- Be aware of the fact that no simple linear relation exists between the method mix used and the impact reached. The impact of TA projects also depends on both internal factors (like project management competencies, budget constraints, organisation culture, and institutional arrangements) as well as (mostly uncontrollable) external influencing factors (such as strategies of other actors, timing of the policy-making process, sudden changes in the problem situation). Accordingly, a proper choice of methods does not guarantee reaching your goals.
- Ensure that your TA project keeps track with social, political and scientific reality. Situation appreciation should, therefore, be a constant feature of project management.
- Allow for sufficient flexibility in the project design and the procedures of the TA institution to adapt to relevant changes – like new scientific discoveries, an increasing (and often sudden and short) media attention, a political intervention, etc. - that may (and most likely do) occur during the duration of the project.
- TA projects have to reach scientific, interactive and communicative quality criteria in order to get legitimate short-term impact and to build up and maintain institutional trust in the long term.
- Be aware that there might be possible ambiguities or trade-offs between short-range impact and the building of long-term trust and credibility. Creating impact by using invalid or deficient knowledge is, for example, no problem for mass media. They are aiming at creating short-term impact and awareness. TA, however, would endanger its long-term credibility in such a case.

- One should, therefore, distinguish between impacts on different time scales.
- Consider communication as the key manner to achieving impact. Fulfilling scientific and interactive criteria is a necessary, but not sufficient, condition for getting an impact.
- Realize that communication goes beyond communicating about the results of a project. Selecting a certain topic for the agenda of your institute already signals a message to the outside world.
- Realize that you are doing TA and assessing societal issues related to science and technology is your core business. Strengthen this TA identity by developing communication competencies in-house, but do not become a communication bureau. Look for synergies with organizations – like science museums, debating centres, and media – that are specialized in getting messages through.

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b) Results Impact Group

1. Introduction

Any discussion about the mission of TA and its relation to policy making will inevitably soon touch the question of the effects that TA might or should have on decision making as well as on the content and path of political and social debate on technology issues. TA as an endeavour that is meant to explore the possible impact of technology on society in order to support policy making will naturally be asked to bear witness on its own impact as an indicator as whether or not it really fulfils its ascribed mission and tasks. Discussions on impact of TA, however, usually suffer from a lack of common understanding of TA's objectives and of what can be expected as impact of TA. Unsurprisingly, there is also very little available information on attempts to measure or evaluate the impact of TA in Europe. This reflects the past lack of coordinating action in discussing the goals of TA and the processes by which they can be attained. The knowledge vacuum in this area could influence the ability of TA as a discipline to communicate its roles and consequently, its value in society. It was the objective of the TAMI impact group to develop a structured discussion on the objectives, functions and effects of TA and prepare the ground for future attempts to evaluate TA procedures and their impact on related decision making processes. Being aware of the complex nature of the issue of impact evaluation, the group did not aim at developing a detailed scheme or set of criteria for future evaluation procedures but instead, at providing a frame of reference on the relation of objectives, methods and impacts of TA. The discussion among the group members - the outcome of which is presented in this paper - evolved around the question of which kind of impact can realistically be expected from TA as a particular branch of policy consulting taking into account its mission and methods, the nature of the issues it is dealing with and the characteristics of the field of policy making it is acting in. The result of this process of self-reflection among a group of TA experts from many European countries is mainly a matrix of TA impacts that helps to clarify the role of TA in technology policy and the related impacts that can be expected.

2. The Application of Knowledge in Policy Making

The question of the impact of TA can be regarded as sub-case of the general question of impact of scientific advice on policy making. The conceptualisation of the relation between scientific knowledge and policy making as discussed among scholars of policy analysis during the last decades, has undergone a fundamental change which can be characterised as a constant dissolution of what could be called a "rationalistic" concept of scientific knowledge. Central to this rationalistic concept - which is also often implicitly or explicitly referred to in discussions on the role of TA in policy making - is the notion that science provides in depth analysis of the problem at stake and explores viable ways (if not the one best solution) to deal with the problem. The results of scientific analysis are evaluated by policy makers with regard to their costs and benefits and finally are implemented in political programmes or legislation. In its strong technocratic version this concept implied the "dream of the abolition of politics" by scientific knowledge, rational policy making would simply have to follow the solutions provided for by science. This "first face" of policy analysis obviously neglected the fact that the definition of the problem at stake as well as the search for solutions is dependent on values and interests involved and that neither science can

provide a one best solution nor will policy makers act according to the rational choice model of decision making (Torgersen 1986).

In recent decades, social studies of science and technology have shown that - particularly in the field of technology - scientific knowledge is necessarily incomplete, provisional and underdetermined with regard to the complexity of the problems of policy making. Ethical questions growing out of scientific development as well as the assessment of risks for human health and environment cannot be reduced to scientific facts and be dismantled of the values and interests that have to be taken into consideration in policy making (see e.g. Beck 1985, Functowicz & Ravetz 1992; Nowotny, Scott & Gibbons 2001). There is no clearly defined boundary between facts and values in policy consulting and what is going on in policy advice is not "speaking truth to power" but rather a negotiation about the most practicable and socially acceptable definition and solution of the problem in the light of different and contradictory scientific insights as well as the given policy frame (Jasanoff 1990).

In policy analysis a "post-positivistic" (Torgersen 1986, Héretier 1993) conceptualisation of the policy making process accommodate the fact that policy making is not describable as rational decision making. "Garbage-can theories" - originally developed in organisational theory (Cohen, March & Olson 1972) - reject conventional 'policy cycle' models which envisage policy development processes as underpinned by the logic of problem solving. Policy making is regarded as being chaotic, random and frequently non-rational. There is only a loose relationship between problems and policy solutions, since the latter is not driven by rational handling of well defined problems but bounded by given institutional structures, ideas and interests (Kingdon 1984). Post positivistic concepts stress the relevance of the complex influences of social actors engaged in policy networks on the policy making process (van Warden 1992, Scharpf 1993) and the relevance of strong "belief systems" held by competing "advocacy coalitions" (Sabatier 1988), which frame decision making and are not easily to be changed by input of scientific knowledge but only in long term learning processes.

Thus it would be naive to expect to track down the path of insights of a TA procedure all the way down to its final impact on decisions taken. Information, data and arguments provided by TA or any other process of policy consulting cannot be regarded as "magic bullets" whose impact in legislation, regulation, budgetary decisions or the design of political programmes is directly observable. This is usually reflected in studies on the utilisation of results of TA by policy makers (Berg et al. 1978, Paschen et al 1991). Based on interviews with TA experts and their clients (i.e. policy makers) as well as on general experiences in the field of TA those few available studies show that what can be expected is "conceptual use" (Caplan 1979) of scientific knowledge by policy makers but not "instrumental use" in the sense of using TA results directly as a "guideline" for political action. "Conceptual use" of knowledge includes: awareness of the complex interconnection of the problem under consideration with different fields of policy making, possible effects not being taken into account and change in the policy makers view on priorities for political action (Berg et al. 1978). The factors restricting the application of TA results in policy making discussed among TA experts are manifold (for an overview see Paschen et al. 1991); they include practical problems like restricted resources, timing for dissemination of results and interaction between TA analysts and their clients, or individual factors like lack of experience of scientific staff of a TA organisation with routines of the policy

making process. A general and structural restriction however is given by the different "logics" or "rationals" of scientific analysis and political action:

- Since policy making is dominated by conflicting interests, values and beliefs, scientific knowledge has to pass through this filter and thus is modified and selected according to interests and opportunities and not applied according to scientific criteria of rationality. It is more likely for scientific knowledge to be strategically used (or not used) during processes of negotiation and bargaining according to different interests, values and beliefs.
- Scientific advice (and TA in particular) often increases complexity of decision making since it provides a full and unbiased picture of the problem (including different social perspectives and areas of uncertainty). Thus, TA cannot easily be used to foster views held by actors and almost never can provide recipes for problem solving (as often might be expected by policy makers). Instead of direct application of scientific advice, there might be long term effects on the general perception of problems and practical ways of problem solving. "Knowledge, including scientifically-produced knowledge, flows into the decision making process through obscure channels from many different sources, and this results in a more general awareness of the way the world appears and is structured." (Albaek, 1995: 85).

Besides those general structural restrictions to the application of "knowledge", there are some other problems which make it difficult to identify whether knowledge has been applied or not, or to "measure" its impact. To mention only one, single processes of policy consulting (such as a TA-project) are always only one voice in a concert of consulting processes going on[6]; this necessarily restricts the influence of individual reports and makes it almost impossible to retrace arguments processed in policy debates or the outcomes of policy making processes to one particular study. Single TA studies rarely induce totally new insights or ideas into debates and policy making, instead they strive to provide a comprehensive or multi-perspective view of the problem.

3. Definition of Impact

Given the aforementioned problems of relating the results of a TA-process directly to perceived changes in policy making or changes in public debates on technology development, it might be wise to take leave of the term "impact" in order to avoid the notion of a direct and visible influence of TA-activities on policy making and public debate. For the sake of evaluation of TA-procedures it might be more appropriate to apply more open or "soft" concepts such as "success" or "resonance" that preclude the normative and demanding connotations of "impact".

All of the three terms - success, resonance and impact - have some common connotations since they denote a kind of "effect" of a TA-process. Referring to "effects" of a TA-procedure, one might say that the process has been "successful" once the client finds the information helpful, which in the same way could be seen as an "impact" of a TA-process, and of course indicates that the process or report found "resonance" at the client's side. However, all three of them have particular connotations as well:

Success is a highly subjective concept. Whether a TA-project has been successful or not depends on the expectations of the observer. From the point of view of

[6] For a detailed account of the effect of professional lobbies in policymaking, see "Organised Interests in S&T Policy; The influence of lobby activities" at the Supplement Papers section of this book

organisations, the survival of the organisation in a difficult environment can justifiably be regarded as "success". Of course this does not necessarily imply that the work of the organisation has had any particular "impact" on its environment. TA-studies are often appreciated by policy makers as helpful for decision-making processes. In terms of customer satisfaction, this can be seen as "success". It might however have no impact (see below) in terms of "influencing the path of decision making".

The term *resonance* as it was applied in a recent project on Participatory TA in Europe (Hennen 2002) is an attempt to avoid the normative connotations of the term "impact" (which stems from an ideal concept of policy consulting) and apply instead a neutral concept that is suitable for the purpose of empirical description. Resonance in this sense describes any kind of observable reaction to a TA process in its societal environment. Resonance does not refer to "making a difference" in the above sense but is more generic as it includes a scope of possible "effects" ranging from e.g. "Report or TA-process being mentioned in a debate or in a newspaper" to "impact" in the sense of e.g. "a change in the political agenda" or "new legislation caused by TA".

The term *impact* refers to the expectation which, on a general level, is held by both TA-practitioners and clients (e.g. policy makers) as well as observers of policy consulting. TA has to *make a difference* in terms of the quality of decision making processes by adding comprehensive and non-biased knowledge to this process. The implicit expectation here is that decision making *with* TA leads to "better" (more rational, informed or legitimate) decisions than would have otherwise been achieved *without* TA. This is however based on an ideal concept of rational decision making (which to some extend ignores the reality of politics) and the impact of TA in this sense is hardly measurable. Nevertheless this concept is behind all discussions on impact since it is indeed connected with the traditional mission of TA.

For the purposes of the TAMI project which is not dedicated to gathering data and/or empirically exploring the effect of a TA procedure in its environment, but rather to furthering the discussion between TA practitioners and clients on the relationship between methods applied and impacts achieved, it was decided to use the term "impact" in the sense of "making a difference" (in a more general sense however, that does not relate it to the hardly measurable goal "improving decision making in terms of rationality or legitimacy"). Impact is understood as an effect of TA (its results and the process) on what is "known", "debated" and "done" in debates on technology policy issues. Hence,

> *"Impact of TA is defined as any change with regard to the state of knowledge, opinions held and actions taken by relevant actors in the process of societal debate on technological issues"*

This concept does not escape problems of measurement or visibility of impacts. Nevertheless, one might succeed in developing a platform for self-reflection among TA-practitioners and clients on the relationship of TAs mission, its methods (i.e. what TA does or can do) and the role TA might play in the context it is working in or is expected to support. The range of possible or conceivable impacts covered by this approach is in a way as broad as possible: from raising awareness for a particular issue/problem to changing legislation. It is by opening up a comprehensible tableau of impacts in the sense of "making a difference" that we hope to support the understanding of what and under which particular condition can realistically be expected as a contribution of TA to policy making as well as public debate.

4. Typology of Impacts

This approach has been clarified by working out a typology which is made up of three dimensions of impacts which can be related to three dimensions of the issues that TA is dealing with.

One could roughly discern three dimensions of impact that TA or policy consulting in general can be expected to have: impact in the sense of **raising knowledge** on issues among policy makers or in public debate, impact in the sense of **forming opinions/attitudes** of actors involved in policy making and the debate, and impact in the sense of **initialising actions** taken by policy makers or other actors.

These dimensions of impact can be linked to three dimensions of the issue that TA-projects usually deal with and TA is expected to generate knowledge about. TA has to deliver (as comprehensively and unbiased as possible) information on the **technological and scientific aspects** of the issue that is at stake (e.g. features of technology, results/or problems of scientific risk assessment, economic costs, eco-balances, etc.). A description of the problem or issue at stake would be incomprehensible without describing the **societal aspects**: TA has to deliver knowledge about relevant actors (their interests, values etc.) and possible social conflicts that can evolve around the technology under consideration. On the grounds of a proper description of the scientific and technological aspects and in connection with a description of the social environment (debate, actors), TA has to analyse the **policy aspects** of the problem; i.e. has to consider the restrictions and opportunities of policy making and has to develop policy options, such as exploring politically viable ways for problem solving (legislation, R&D funding, action plans). At the end, it has to again evaluate policy options with regard to possible side-effects (e.g. social conflicts) they might produce.

Generally it is possible to translate the term "impact" (of TA, of policy consulting) by "application of knowledge/information". The above given three dimensions then might be read as an application-continuum leading from "raising knowledge" to "forming attitudes/opinions" and to "initialising action/initiative". In the first dimension one could speak of a low level of application in the sense of "client taking notice of results of a TA process", which on the side of the user may imply a "fuller understanding of the problem" or "a broader view of aspects related to the problem" without directly (or visibly) inducing a change in attitude or behaviour. This is the necessary first step to a more explicit application in the dimension of "attitude" and "action": the application of (new) knowledge stemming from TA studies becomes visible (in the agenda and in policies) and knowledge is observably applied as arguments in the debate, and this in a further step might have visible impacts on decision making in the sense of changing the path of policy making and bringing up new political initiatives. The latter two steps obviously imply not only awareness but *application* of knowledge in a narrower sense and therefore presume an active adoption of knowledge by the user - it has to be integrated into the "belief system" of actors as "conceptual knowledge" (see above). The application of knowledge for guiding political action is apart from its adaptability to the knowledge and interest structure of actors highly dependent on constraints and opportunities given by the actual policy situation (e.g. need for compromises in policy networks, respect for existing policy coalitions, compatibility with existing policy programmes etc.).

It is therefore appropriate to differentiate the three dimensions in terms of level of impact: With regard to the influence of TA on the policy making process it is more likely (and can be regarded as a relatively minor effect on policy making) to make

actors aware of possible unintended consequences of technology, perspectives of actors and policy options ("raising knowledge"), than to induce a change in the agenda or political initiatives (e.g. new legislation). The three dimensions of the typology should not however be read as a continuum in time, i.e. that first a TA project is carried out, then the results are delivered to the client and the public where they may induce a learning process which again may lead to new initiatives in policy making or to decisions that close the debate. Impacts in all three dimensions may result throughout the entire TA process. Already at the beginning of a TA process, discussions between TA-practitioners, the client, stakeholders and experts about appropriate problem definition, questions and problems that should be scrutinized, may induce a learning process and result in a change of attitudes or opinions of relevant actors. Since a TA-Process usually implies communication between the TA-institute and the client throughout the whole process and (in particular when communicative methods like workshops, participatory procedures are part of the process) a change in attitude and opinions and even effects on ongoing decision making may be induced in any phase of a TA-project.

Table: Typology of Impacts

IMPACT DIMENSION ISSUE DIMENSION	I. RAISING KNOWLEDGE	II. FORMING ATTITUDES / OPINIONS	III. INITIALISING ACTIONS
TECHNOLOGICAL /SCIENTIFIC ASPECTS	SCIENTIFIC ASSESSMENT a) Technical options assessed and made visible b) Comprehensive overview on consequences given	AGENDA SETTING f) Setting the agenda in the political debate g) Stimulating public debate h) Introducing visions or scenarios	REFRAMING OF DEBATE o) New action plan or initiative to further scrutinise the problem decided p) New orientation in policies established
SOCIETAL ASPECTS	SOCIAL MAPPING c) Structure of conflicts made transparent	MEDIATION i) Self-reflecting among actors j) Blockade running k) Bridge building	NEW DECISION MAKING PROCESSES q) New ways of governance introduced r) Initiative to intensify public debate taken
POLICY ASPECTS	POLICY ANALYSIS d) Policy objectives explored e) Existing policies assessed	RE-STRUCTURING THE POLICY DEBATE l) Comprehensiveness in policies increased m) Policies evaluated through debate n) Democratic legitimisation perceived	DECISION TAKEN s) Policy alternatives filtered t) Innovations implemented u) New legislation is passed

Using these dimensions of impact and issue we derive a matrix that shows nine types of impacts of Technology Assessment. An inventory of 21 roles or functions of TA in policy making that was developed by members of the TAMI-project on the basis of

their experience as TA-practitioners as well as by referring to existing case studies on the political role of TA procedures (cf. Buetschi/Nentwich 2002) can be described according to these types of impact.

4.1. Raising Knowledge

"Raising knowledge" can be seen as the "classic" mission of TA as a particular branch of policy consulting. The establishment of TA in the 1960's and its development in the following decades was to a great extend encouraged by policy makers perceiving a lack of access to reliable scientific information on modern technologies that were growing in importance for almost every field of policy making (National Academy of Sciences 1969, Hetman 1973, Vig & Paschen 2000). The perceived deficit referred to knowledge on hard scientific facts (on features of technology), the socioeconomic context relevant to the implementation of technology, social needs and interests often causing conflicts in implementation, as well as on viable and socially accepted policy options to shape or steer technology development.

The three types of impact in the column "raising knowledge" are directly related to the content of a TA process and to the "deliverables" of TA. The outcome of a TA-process (e.g. a report) as well as the process itself (participatory procedures, workshops etc) make policy makers or other relevant actors aware of new aspects of the problem/issue at stake such as scientific knowledge on paths of technology development, risks, chances, unintended consequences etc. (**scientific assessment**), interests or perspectives of actors involved (**social mapping**) and problems and options of policy making (**policy analysis**).

Providing knowledge on scientific, social as well as policy aspects of technology in the sense of "making the client more aware" is closely associated with the quality of TA as a scientific process but nevertheless not restricted to a particular type (i.e. classical scientific policy consulting type) or method of TA. The quality of the knowledge provided may depend on scientific standards of the TA process as well as on the level and quality of inclusion of stakeholders and societal groups in it. Quality of the output - no matter if this may be a written (scientific) report or the results of workshop - is a prerequisite for "raising knowledge". It is however not a warrant: whether the results of a TA process are taken into consideration or not, depends to a large extend on factors such as visibility, timeliness of the process as well as on contextual factors which are out of the reach of a TA institution (see below, section on influencing factors).

4.1.1 Scientific Assessment

Scientific assessment comprises two classic roles of TA that are related to its function of making scientific knowledge as comprehensive as possible available for decision makers.

Technical options assessed and made visible (a)

With regard to the rapid development of science and technology and the overall dependence of social welfare on the application of R&D, there is a need for policy makers to be informed about what is about to come and to compare different possible paths of technology development. To make technical options visible and to assess the viability of different technological paths by means of foresight studies or scenario writing, is a prerequisite for rational decision making in innovation policies.

Comprehensive overview of consequences given (b)
Technology foresight is in most cases not a TA task in itself. It is however a prerequisite for providing a **comprehensive overview on consequences** connected with a technology. The awareness of the fact that scientific progress is often connected with unintended consequences for society, economy and environment, was the reason for a growing demand to apply scientific methods in anticipating long term consequences. To this end TA draws on a range of scientific procedures such as risk assessment or economic modelling. The added value of TA lays in a comprehensive overview of possible effects – not only economic cost-benefit calcualtions – as a fundamental prerequisite for policy making (OECD 1983, Paschen & Petermann 1991).

4.1.2 Social mapping

The assessment of pros and cons of technological innovation has to be grounded as much as possible in scientific data. This is however necesarily connected with value judgements. Technological controversies make it obvious that differenet social groups arrive in different evaluations depending on their interests, preferences and values.

Structure of conflict made transparent (c)
For the decision maker it is necessary to know about the **structure of conflicts** around a technology at stake, in order to strive for consensus or compromises and for a decision that - since different interests and values are taken into account - can hopefully meet acceptance and can be regarded as legitimate. TA might supply this knowledge by means of social research (surveys, discourse analysis, focus groups, etc.) as well as by participatory methods: i.e. giving every relevant group a say in the process (workshops, advisory boards, etc.).
The analysis of differing preferences, interests and values which are behind conflicting expectations and demands can expand the understanding of the social context of policy making and may provide opportunities for conflict resolution. It can also be seen as an integral part of the assessment of risks and benefits since such assessment depends on values held by the assessor. Discourse Analysis used to clarifying the interconnectedness of scientific arguments and expert judgements in debates revolving around ethical beliefs and world views, may separate facts from values and establish awareness of the fundamentally political character of technology debates which on the surface might appear as debates on scientific facts.

4.1.3 Policy Analysis

TA in general is policy analysis as it aims at improving the "quality" of policy making by analysing the contextual boundaries and opportunities as well as the goal setting of policy making. With regard to technology policy this necessarily includes what is called here "scientific assessment" and "social mapping". However, raising knowledge on scientific and social aspects of an issue can be seen as precondition for the conduct of "policy analysis" in a narrower sense - i.e. the evaluation of options for policy making addressing the question: Which goals and measures are available and at which costs are they achievable?

Policy objectives explored (d)
In case of emerging new technological options it is often unclear what objectives policy makers can or should go for. Additionally, there is usually dissent among relevant actors on the usefulness of applying or the direction of shaping upcoming technological options. It is one of the classic tasks of TA to explore policy objectives with regard to their viability, social acceptability, the instruments at hand and the possible side-effects that might appear (e.g. the technological field of genetic engineering opens up a broad scenario of applications). With regard to policy making it is crucial for TA to structure the field by discerning applications that are likely or unlikely to be realised within a certain period of time as well as by exploring the degree to which a wide range of social needs is met by different technological options. Based on this, TA tries to evaluate different objectives that policy makers might go for as well as opportunities and costs (economic and social) to achieve these objectives (funding of research for particular applications of technology, legal regulation to exclude unintended effects).

Existing policies assessed (e)
In most cases political and social debates have already come up with a range of policy options. Those options are often based on conflicting preferences - e.g. economic vs. environmental. It is then a crucial task of TA to contribute to decision making by assessing existing policies with regard to different preferences and assumptions they are based on as well as to explore probable effects and the effectiveness of instruments (legal regulation, voluntary agreements, financial measures like environmental tax etc.) for different policy options. It might also be that an evaluation of different national policies with regard to a technology is needed to benchmark policies and deliver information on options for an internationally sound system of regulation.

4.2 Forming attitudes/opinions

Raising knowledge is a precondition of changing opinions and attitudes of actors. If this is achieved, the structure of debate and the policy making process has also changed in a way. Changes in attitude may occur with regard to new scientific aspects which are now discussed among policy makers or in public debates (**agenda setting**). It may happen that the TA-process or outcome change the way relevant actors see each other or deal with each other (**mediation**) or that options for policy making are seen/discussed in another way resp. new options are prominent on the agenda of policy making (**restructuring the policy debate**).
An impact in the dimension "attitude and opinions" implies that TA induces a kind of learning process among actors and thus affects the ongoing social debate. In this respect it is important to stress the difference regarding mission and methods between the two major TA-paradigms, since this reflects a difference in intervening in the process of opinion forming. According to the "classic" (OTA like) TA approach, the mission of the TA-institute is mainly[7] to scientifically analyse the issue at stake and deliver unbiased and as comprehensive as possible knowledge about the technical, social and policy aspects of the issue to the client (policy maker). This usually results in a written report, which is delivered to the client at the end of the project. So it is mainly by communicating the *outcome* of the TA-project to the client and the public

[7] The two TA-paradigms have to be understood as „ideal-types". Most TA institutes include (with different weighting) methods of scientific policy consulting as well as methods of public TA.

that the TA-institute intervenes in public discourse and thus may induce an impact in terms of agenda setting, mediation and restructuring the policy debate. TA institutes following the paradigm of "public TA" intend (and are expected) to directly intervene in or organise "the public debate". Thus the whole TA-process is regarded as an integral part of the societal debate and communicative and/or participatory procedures are not only applied as instruments to gather knowledge or communicate results but also as the core of the project and an end in itself. So "public TA" directly intervenes in the ongoing process of opinion forming, that is made up by the societal debate, and PTA has developed particular methods to do so. The classical TA-process is working somewhat "detached" from the debate and is only intervening indirectly by communicating the results "from outside".

4.2.1 Agenda setting

The knowledge on technical and scientific aspects of the issue at stake provided by a TA process can affect the agenda of public and political debate by expanding the scope of aspects taken into account in the political and public debates or by shifting the attentiveness of debates to a new problem.

Agenda-setting in political debate (f)

When the results of a TA-process are regarded as something that needs to be considered politically - either because results are seen as supportive for ongoing policy making processes or either because they are taken up by relevant actors or found resonance in the public (media) - TA can change the agenda of political debate on the issue or even initialise a political debate on another issue not been considered as relevant for politics so far. This does not necessarily result in political decisions but at least in stated political awareness. TA institutes working on behalf of Parliaments can contribute in several ways to the agenda setting processes in the Parliament. In some cases, written or oral comments are asked on governmental policy papers, in other cases the TA institute is invited to give comments during a hearing of a specific parliamentary committee and in other cases a committee might ask the TA institute to provide additional information on a specific issue.

Stimulating public debate (g)

TA can be understood as a formal (organised) procedure of debate on technology that is related to the informal modus of technology assessment that is going on in societal technology controversies (Rip 1986, Hennen 1999). Even if a TA-institute's mission is restricted to policy consulting, a TA process can have an impact on public debate in the sense that a new issue is taken up by societal actors and the attentiveness for the general public is stimulated. When TA-organisations have the mission to **stimulate debate** - they take over the task to directly set the agenda of a debate by means of organising public events.

Especially in the case of new emerging technologies with a high degree of uncertainty about effects and ambiguity on their moral acceptability, stimulating debate among organised actors (scientists, NGOs, representatives of political parties) as well as among the general public can be necessary to explore the pros and cons as well as possible areas of dissent and conflict, and thus inform policy makers about the need and options for political intervention. In the early stages of technology development where debate is restricted to closed circles of experts, stimulating public debate can

be necessary in order to avoid a narrow conceptual framework that over or under includes problems.
In case of vivid debates already going on in public, it can be a task of TA to stimulate the debate in the sense of expanding the scope of actors involved in it or in the sense of contributing to it by expanding the scope of issues tackled, or social perspectives represented. This might be achieved by feeding in additional (unbiased) information or by facilitating transparent and balanced discussions by means of organising events with open access for any relevant actors and equal opportunities to get their arguments through.

Visions or scenario's introduced to actors (h)
Scenario writing or other methods to explore future developments (e.g. "Delphi" procedures) are used frequently in strategic policy making and TA in order to cope with long-term developments and explore long-term effects of policies (e.g. the future of energy production and health care). Those methods are applied to explore possible paths of policy making in a given complex situation and to establish consensus on measures to be taken.
These techniques can contribute to changing attitudes and opinions of actors by supporting them to relate their perspectives and strategies to an expanded time horizon (long term effects of strategies and scenarios of social development they have to adopt their strategies to) or by exploring alternative paths to achieve policy objectives by confronting them with new challenges or with perspectives and strategies form other branches of policy making. An impact of this kind is most likely to be achieved in a "context of discovery", i.e. in the first stages of discourse, when problem-definitions are not settled yet or a process of searching for operationalisation of common generic objectives or "Leitbilder" is going on (like e.g. in the case of "Sustainable Development"). Another case in point would be a situation where opinion making and decision making is paralysed and new perspectives are needed (see also "blockade running").

4.2.2 Mediation

The need for independent and well-balanced information refers not only to (interdisciplinary) scientific analysis but also to the often conflicting and sometimes incommensurable opinions and interests held by societal groups. Providing for an ample picture of perspectives of actors and involving every important group of actors in the TA process by open and transparent procedures can lead to a process of mutual learning about perspectives and interests which again may induce new ways of communication and joint problem solving among actors.

Self-reflection among actors (i)
As a prerequisite to establish common learning it is necessary that actors are able and willing to reflect on their own perspectives and interests. There is no way to force actors in doing so, as long as they see opportunities to end up as a winner in a conflict (by means of power). However, TA procedures, by confronting actors with criticism or forcing them to argumentatively substantiate their perspective (in the light of scientific results or societal values) may support readiness to modify one's own aims and expectations in order to make them more compatible with the needs of society or other groups. In local or regional planning processes often appear manifest conflicts based on perceived violation of interests. These conflicts are often not (or not to a

great extend) connected with fundamental value conflicts and debates about the appropriateness of normative frames (as is the case in debates of generic new technologies, e.g. biomedicine). Participatory TA processes here provide an arena where actors either are given the opportunity to negotiate aims and conflicting interests to find a compromise or agree on compensation for violated interests. In case of completely new technologies with uncertainty on effects as well as ambiguity with regard to ethical aspects, TA can induce self-reflection by establishing an arena of discourse - i.e. a procedure which provides for equal opportunities of articulation but restricts the modus of communication to arguments - thus "forcing" the participants to stick to standards of discourse ethics (Habermas 1991, von Prittwitz 1996).

Blockade-running (j)
Good chances for willingness amongst actors for self-reflection are usually given when all relevant actors see themselves caught in a deadlock. No actor may see a chance to get his or her position through without paying a high prise in terms of economic costs or a massive loss in societal capital (image, trustworthiness, etc.). Or each actor defends a rigid political line so that no dialogue seems to be possible and no solution can emerge.
TA as a non-partisan procedure can contribute to blockade running by providing neutral ground for dialogue or by bringing in new ideas for problem-solving or a new problem definition which may help actors to reframe their position. It is necessary however that a commitment of all relevant actors to the TA or mediation procedure is achieved. Even though involved actors might agree on a common solution, this solution might be rejected by actors not involved in the mediation process. These actors might be other interest groups which, for different reasons, did not participate in the participatory process. The rejection can also come from organisations involved in the process, since not all their members went through the mediation and negotiation process.

Bridge-building (trust-building) (k)
One decisive prerequisite for blockade running and co-operation among actors is the establishment of trust. Mutual trust in technology debates is often a highly needed but at the same time always precarious resource of problem solving. Reasons for the lack of trust in technology controversies are manifold: conflicts about technologies often are based on mutually exclusive fundamental world views; technology risks are not equally distributed, so that particular groups see themselves as victims of technology policies whereas others benefit strongly. In those cases actors may see themselves as enemies with no overlapping interests that could provide ground for co-operation. TA can contribute to (re-) establishing trust by providing a platform where actors can meet and discuss in some distance from public arenas (where they usually stick to strategies of strongly promoting their interests). To succeed in being accepted as a mediator in these cases it is of course necessary that the TA-institute has established a non-partisan and competent image.
With growing importance of S&T for societal development the issue of trust (res. lack of trust) in experts is moving to the centre of technology debate (Giddens 1991). Scientists often regard lay people's lack of understanding complex scientific issues as being responsible for the loss of trust in expert-knowledge and growing criticism on experts. Social studies on science and technology however show that scientific

knowledge and expertise undergo a process of "normalisation" i.e. no longer can lay claim to unquestioned authority. The more relevant expertise becomes for policy making, the more uncertainty and tentativeness of scientific knowledge with regard to societal demands of problem solving is revealed. It cannot therefore be expected to (re)establish trust in expert-knowledge (in the sense of unquestioned authority of science). New arrangements of dealing with uncertainty between science and society have to be found (Nowotny, Scott & Gibbons 2001). TA processes can contribute in this particularly with participatory procedures where scientists and non-scientists co-operate with regard to problem definition, interpretation and evaluation of data and knowledge in the light of societal demands and social perception of problems.

4.2.3 Re-structuring the policy debate

Changing the agenda of public and political debate - by introducing additional analytical knowledge and improving the willingness or ability of actors to reflect on vested interests and settled perspectives - may contribute to open up the policy making process by inducing new policy options. TA then can give way to reframing the debate on policy options - the exigency, the goals and ways of political intervention.

Comprehensiveness in policies increased (l) policies evaluated through debate (m)

It is often the case that technology policy debates are dominated by interests and perspectives of particular actors (industry, a scientific discipline). Dominant interests or dominance of a particular group of experts in public debate and policy making can be barriers to an open process of problem-definition and search for policy options. Administration routines and strict division of tasks and competencies among expert groups (or disciplines) may hinder an open debate on policy options. This restricts policy making to a particular problem-definition and accordingly to a particular perspective on problem-solving, disregarding other possible solutions (e.g. technical versus non-technical), side effects on other areas of society (e.g. economy - environment) or interests of other groups. This may cause sub-optimal strategies for problem solving and/or opposition against strategies by afflicted groups. By broadening the perspective, TA might help to avoid these problems. Comprehensiveness might be increased by taking rationales of several perspectives into consideration (social, economic, etc.), or by taking into consideration the viewpoints of a multitude of actors. The latter may lead to an evaluation of conflicting policy options by relevant actors that clarifies areas of consent and dissent among actors and give way to fine tuned policies with regard to different interests.

Notwithstanding the fact that providing "comprehensiveness" is one of the central tasks of TA in general, it may be mostly achieved by "problem-driven" TA projects, i.e. when scrutinising alternative ways of problem-solving is the focus of the TA-process. An example is the search for strategies to overcome traffic problems in a city / region. The discussion might be dominated by experts for technical solutions (build new roads, additional underground-line, etc.). A TA-process including other expertise for regional planning might show additional or alternative ways of problem-solving, avoiding negative effects (economic, ecologic) of the existing dominant strategies. It may become apparent that a long-term strategy for decentralisation of industrial and services or for a mix of working and housing areas could reduce traffic problems.

Democratic legitimisation (n)

Apart from providing for comprehensiveness with regard to contents (description of the problem, un-intended consequences analysed, perspectives considered) a TA process can contribute to policy debates on a meta level of "political culture" when the openness and fairness of the process succeeds to establish the notion among actors that the decision making process met the rules (or ideal) of open democratic deliberation.

This role can also be labelled "Legitimisation by process" (Luhmann 1969). Often controversies on technological developments and their implementations are caused by fundamentally opposing interests and ethical perspectives of actors. Usually then there is no "win-win" solution or consensus possible. A TA process can at least ensure that the perspectives of all relevant interest groups have been acknowledged and appropriately scrutinised. So, even if some actors might not agree with the results of the TA-process or the respective conclusions and decision of policy makers, they might still acknowledge that the process has been "fair" and "democratic".

In case of very contradictory positions in political debates, however, the willingness to take part in the TA-process as well as the willingness to accept the TA process as a means for democratic decision making may be weak. It is known from participatory TA procedures that stakeholders may regard commitment to the TA-process as being restrictive to their strategic position in the political debate. Commitment to a formal process of "discourse" can (from a stakeholders' perspective) be seen as "dangerous" since the outcome cannot be predicted (van den Daele 1995). So the process may be blamed for not having been democratic in hindsight.

A general problem in this context is that actors (in most cases those with weak power in formal decision making processes) often connect their participation in a TA-process with the expectation to directly influence decision making. In case they cannot see any influence on established decision making processes, the TA-process is criticised as being "pseudo-democratic".

The commitment to and acceptance of the process as a contribution to democratic decision making is more likely in cases where a willingness to "joint problem solving" already is established among stakeholder groups (e.g. because the issue is new and positions are not fixed yet, or because all stakeholders feel the need to overcome a blockade in decision making).

4.3 Initialising action

Impact in the dimension of "initialising action" means that a TA process influences the outcome of the policy making process. Regarding the scientific aspects of the issue at stake a TA-process may lead to **new R&D policies**, i.e. initiatives to further scrutinise aspects of the problem (e.g. research programm to explore the risks of deliberate release of GMO). With regard to the societal aspects (actors, conflicts) policy makers may conclude from a TA-process to initialize **new ways of decision making,** e.g. to set up a programm of public discourse or include social groups in the decision-making process. Apart from such initiatives which can be seen as new forms of dealing with the problem it might as well be that TA leads to a definite **political decision** (in the sense of closure of debate): e.g. to implement a technology that whas scrutinised with regard to ist pros and cons, or to set up legal rules for implementation.

The impact dimension of "initialising action" represents in a way the end of a policy-making process, or the (provisional) end of a policy making cycle (which often at the

same time marks the start of a new one). Taken properly it is somewhat inaccurate to speak of a "role" to play for TA in this dimension. Whereas TA "plays a role" in the realm of the other two impact dimensions, i.e. having the mission as well as tailored methods for raising knowledge and intervening in the process of opinion forming, there is no mandate for TA to directly take part in decision making in the sense of doing politics. Quite the contrary: policy makers would regard it as an illegitimate intervention, if TA would try - as it were - to prescribe what kind of decision has to be regarded as appropriate given the achieved state of knowledge and debate so far. Nevertheless TA is expected to contribute to policy making and thus to make a difference in terms of having an impact on decisions taken with regard to the issue at stake. However, since TA takes a role in raising knowledge and organising debates, it is in a way visible as player in this process, whereas TAs influence on decisions taken is much more unlikely to be observable and is much more dependent on a lot of intervening factors.

4.3.1 Reframing the Debate

An implicit expectation held by policy makers with regard to TA is that in-depth analysis of the problem at stake will lead to reducing complexity of the related decision making problem by sorting out what is "right" and "wrong" and thus showing which policy options are reasonable to go for. This in some cases may be achievable. More often however analysis of the debate amongst experts on e.g. risk assessment, costs and benefits of a particular technological option, reveals the complexity of the problem and the inherent uncertainty of scientific knowledge and thus expands the frame of problem perception. A reaction to this may be to start an initiative to further scrutinise the problem under a new perspective and hopefully establish more secure ground for decision making. TA then contributes to initiatives by policy makers or other actors to continue the assessment of the problem on a new level of knowledge about the "factual" or "material" aspects of it.

New action plan or initiative to further scrutinize the problem at stake (o)

R&D policy making has to deal with high degrees of uncertainties with regard to future outcomes, while at the same time usually stakes are high (investments, opportunity costs) and decisions are urgent (Funtowicz/Ravetz 1992). New technologies or research areas are often promoted by powerful scientific communities that might over-estimate chances and under-estimate risks. TA has the mission to broaden the discussion, include views of other expert communities, and give a comprehensive view on possible effects of implementation of an innovation.

When a TA process has made existing lack of knowledge or dissent among experts visible, or revealed new problems that had not been yet explored, this might lead to initiatives to further explore the problem at stake. Initiatives can be taken by expert communities or policy makers. This may be a new research project or a new (additional) TA-project on the issue or a new R&D funding programme or the set up of an expert committee.

Opportunities for TA to induce an initiative to continue or intensify "learning on the issue" are usually high when interests are not settled yet - in particular when technology development is at an early pre-market stage. Another window of opportunity might be given when decision making processes are blocked between competing major interests (lack of public acceptance against interests of industry to take the pole position in international competition). It might be a provisional solution

then to "wait" for further scientific clarification and get the chance to postpone decisions. On the other hand, when investments in innovation have already been taken, it is not likely that policy makers (or other actors) see the need or chance to further scrutinise central aspects of the issue and prolong the debate.

New orientation in policies (aims, objectives) (p)
Another situation in which TA can contribute to re-orientation of policy making in terms of initiatives to explore new objectives might appear when relevant actors are looking for new solutions or common definition of a problem. This is the case when a technology is quite new and its effects are not yet foreseeable. TA, by supplying comprehensive analysis, might contribute here to a shift in the framing of the policy process (e.g. from addressing a technology from the perspective of industrial development to a perspective of avoidance of risk and application of the precautionary principle - and vice versa)
Another case in point might be the ongoing discussions on general orientation in a policy branch; for instance how to apply the model of "sustainable development". "Re-orientation" towards new long-term objectives and adoption of new aims in strategies (for instance in a ministry) may be supported by TA via exploring instruments to implement the new objectives as well as compatibility with existing aims and strategies.

4.3.2 New Decision making processes

Apart from giving way to initiatives to continue debating on a new level of knowledge about scientific ("factual") aspects of an issue, it is often the case that the exploration of structures and problems in the debate lead to initiatives to restart (or continue) debates on a new level of inclusion of relevant actors or to apply new procedures of negotiation or bargaining among relevant actors.

New ways of governance introduced (q)
TA activities such as consensus conferences or other procedures of public participation can induce initiatives to involve actors in a more direct way in decision-making than through classical democratic representation. These initiatives can be embedded in specific programmes of new governance (top down) or are experiments that grew from the need of specific interest groups to bridge the gap left by the perceived deficiency of established democratic channels. Important in considering this role/impact is that the need for the introduction of new ways of governance is often not only driven by problems concerning new technologies but mainly by the perceived need for involving the general public or specific societal groups in a different and more effective way in processes of decision making - as it is dealt with in the debate on "Governance of Science" and the need for new ways to integrate science and society (Fuller 1999).

Initiatives to broaden, intensify, stimulate public debate or dialogue among actors (r)
The analysis of differing interests and perspectives with regard to the issue at stake (given by what has been called here "social mapping") and moreover attempts to mediate between conflicting actors may convince them that there is a need to include a broader range of afflicted interests into the debate or to expand it beyond circles of experts, raise more public awareness on the issue and get to know more about ethical perspectives of the general public. Especially when there is a high degree of

uncertainty about legitimate or socially acceptable decisions, this may motivate policy makers (as well as expert communities) to start an initiative or set up a program to intensify or broaden the debate. New initiatives to stimulate public debate may embrace conventional means like PR-campaigns or funding of consensus conference like types of activity. Another example could be the establishment of a new advisory committee including interest groups that so far were not involved in the process of policy making.

4.3.3 Decision taken

To initialise new policies in terms of taking a decision on the issue at stake of course can be regarded as the ultimate impact of any process of policy consulting. It is however well known that the road from knowledge to political action (which is the road from "policy analysis" to "new policies" in the typology) is by no means a straightforward one. Any scientific policy advice as well as any result from participatory procedures of policy consulting (DeLeon 1990) undergoes a lot of filters (made up by interests and perspectives of actors influenced by other resources). Consequently, the specific impacts or roles of TA mentioned below are highly mediated ones and not directly related to TA's mission. Most of the roles addressed in the typology can be - mutatis mutandis - understood as "goals" which a TA institute may follow when setting up a TA process. Those roles mentioned under the dimension of initialising action and particular the ones that are categorised under "new policies" can not be regarded as "goals" of a TA project, but as impact in the strict meaning of influence on the outside world that TA might have but are not in the reach of TA itself (its methods and activities, the design of a TA project, the quality of outcome, etc.)

Filter of policy alternatives (s)

Discussion and evaluation of policy alternatives is part of most TA processes to a certain extend. Policy alternatives are scrutinised with regard to their practical viability and their economic, social and environmental effects. Both expert and participatory TA are well placed to perform this role since it includes both technical details as well as value judgements. Evaluation of policy alternatives is intended to support and sometimes leads to conclusions about which policies should be implemented and which not. This must not necessarily result in legislative activities but e.g. in the shaping of governmental R&D programmes and allocation of funds with regard to different objectives.

When evaluating policy alternatives - which are often based on diverging interests and values being held by stakeholders - it is crucial to avoid politicisation of the TA process. TA needs to be particularly transparent throughout the process in terms of choice of experts and topics, as well as fully inclusive of major political representations.

New innovation-process implemented (t)

Technology Development is largely market-driven (supply push / demand pull). The market is however dominated by economic criteria: not demand as such, but well funded demand decides on the social diffusion of technology. Whether an innovation is socially (with regard to values and needs) and environmentally sound or not can in most cases only be stated in hindsight. R&D policy can be understood as an answer to "market failure". There is a need to steer technology developments according to societal needs that the market might not care for. This includes the attempt of "social

shaping" of upcoming new - supply push driven - technologies as well as to trigger development of technologies that are socially needed or useful (demand pull) but not supplied for by industry. In both cases R&D policy needs knowledge about the spectrum of possible technological solutions as well as social needs and demands.
TA can contribute to the shaping of technology according to social needs and thus facilitate the introduction of technologies by inducing related R&D development programmes. These may be technologies that are alternatives to existing technologies, but which live up to better standards (i.e. technologies that deliver better working conditions; sustainable solutions; low risk technology shifts etc.). This can be regarded as one of the fundamental ideas behind the consept of TA and has made up the focus of the Dutch concept of "Constructive TA" (Rip, Misa & Schot 1995). Typical examples are programmes - set up in most European countries - to promote the development of "environmental technology" in the meaning of technology that inherently lives up to objectives of environmental protection (i.e. reduces the consumption of natural resources as well as the environmental load in terms of waste and environmental pollution).
The opportunities to have an impact on innovation processes are highly dependent on the industrial structure: Are there important branches that support new technologies? Or on the other hand: Are there important branches that see the new technology under consideration as a menace (new technology might substitute their products)? It is important whether win-win-solutions are possible (double dividend). The public debate about risks as well as about the need for better technological solutions is important. Are there influential NGOs which support the new direction of technology development? Is the wider public (the media) attentive with regard to the problem?

New legislation (u)
To initialize or influence legislative action i.e. legal regulation with regard to a technology or an issue at stake probably represents the ultimate impact of any process of policy advice. When advice itself becomes policy, it has succeeded in providing the most comprehensive and pragmatic solution to the issue in question.
Nevertheless, TA's direct role is not, and could never be, to create policies. To develop and explore options for policy making includes input to the preparation of legislation. It might as well be that policy options developed by a TA-process give particular hints (advice) to aspects that have to be considered in preparation of legal rules. Most TA studies e.g. carried out during the 1990ies in the field of genetic engineering or biomedicine (such as genetic testing) were carried out in a context of discussions on legislative stop and go decisions for the application of technologies. Those studies often explicitly dealt with the pro and cons, the opportunities and restrictions and possible features of legal regulation, however did not intend to prescribe legislation by providing a (draft) bill.
The exploration of the need and opportunities for legal regulation carried out by TA only can take up, scrutinize and (re)structure arguments and demands expressed in public and policy debates. And policy making in general - but legislative activities in particular - is structured and influenced by a lot of players in the field and by difficult and sensitive processes of negotiation among actors and policy networks in the forefront of rule making. TA here is nothing more than one - albeit independent - voice and source of information amongst others. As with the impacts of TA on policy making in general it becomes quite clear that the best role for TA to play is to make a full picture of the pros and cons etc. available to decision makers and other actors. It

therefore will hardly be expectable to track down a clear line from a TA-process to the specific features of legal rules that have been decided on.

5. Influencing Factors

As it has been described in the introduction of this chapter, measuring the overall impact of TA is a rather complicated process as it involves separating the TA process from a big array of other parallel processes affecting the final decision making. Whether TA has been successful in its mission and has achieved its goals, depends both on internal institutional decisions to do with correct situational identification and choice of methodology (see method paper), and on external factors that TA might have little control about but should nevertheless be taken into consideration.

Influencing factors for the impact of TA, other than the chosen methodology, denote limits in the conception and execution of the TA process and at the same time present formidable challenges in the final reception of the TA study. The TAMI group has identified three main categories of influencing factors: Institutional Setting, Technology Policymaking Culture, and Structure and State of the Innovation Process. In terms of the typology of impacts as it is described in the previous sections these factors relate best to the "issue dimension", where, "Institutional Setting" refers mainly to the dimension of "technological/scientific aspects", "Technology Policymaking Culture" to "societal aspects", and "Structure and State of the Innovation Process" refers mainly to "policy aspects". Following is a brief description of the influencing factors.

5.1 Institutional Setting

The particular organisational structure of the TA institute naturally poses certain limitations on the type of work it can undertake and the manner in which this can be done. The overall mission of the organisation and the main target groups for its work constitute the first such limitation; further limitations can be identified as the official relationship between the institute and its "customers", and institutional image and overall state of competition.

Parliamentary vs. non-parliamentary setting

The TA institute could either be attached to the national legislature (e.g. TAB, POST) and thus be a "parliamentary office" or have a more "independent" status of a research- or academic institution (e.g EA, ITAS). This difference does not necessarily affect the independence and value of its work, but nevertheless denotes certain limitations in the work process due to the main target audience. Such limitations will doubtless have an effect in the perception and eventually the impact of the institute's work.

There is great variety in the setting, organisation and overall mission of parliamentary offices in Europe. Reflecting perhaps the general national decision making cultures, the mission of such institutes ranges from strictly adhering to the needs of the parliament (e.g. POST in the UK) to having a more general role in promoting public debates and act as bridge-builder in socially sensitive issues (e.g. DBT in Denmark). Despite this diversity which itself poses direct limitations in the work of the institute, there is a common denominator in the fact that the main audience of the institute is always the policymaking community and the main work should therefore focus exclusively on their needs. The limits this institutional arrangement poses include adherence to strict political neutrality, fast-track analysis (due to policymaking time

constraints and policymakers' low attention span), and sometimes low institutional visibility (since parliamentary offices are mere tools in the policymaking process)[8].
Non-parliamentary institutional settings are relatively rare in Europe (with the exception of Germany) due mainly to budgetary constraints. The few existing institutes enjoy a relatively more independent institutional arrangement since their mission and target audiences are usually described in general terms. This provides considerable flexibility in terms of working manner, study timing and results presentation since the work is independent from direct policymaking processes. In addition, there is usually self-determination in promoting the institute and raise public awareness of its work. As an antipode, the institutional setting does not guarantee access to the policymaking community (which the typology identifies as a main impact dimension under the title "initialising actions") and such institutes are also very vulnerable to general trends on budgetary cuts and public resources re-structuring[9].

Reactive vs proactive setting
This refers to organisational decision making structures relative to the topics chosen for studying. A reactive organisational structure depends on external factors in the choice of studies, the time allocation for the conclusions and even the preferred process. It refers to a situation where the TA institution is requested, or proposed as being the appropriate agency, to conduct an investigation (e.g. in the Parliamentary context, by a parliamentarian in a debate, or by a Parliamentary committee in the course of an inquiry). Whether or not the institute is obliged to follow or has some freedom of choice in the requests given does not alter the fact that its organizational structure is basically reactive. An example of purely reactive institutional settings is STOA at the European Parliament which consist of a secretariat that receives requests by members of the parliament and outsources the studies.
On the contrary, a proactive organisational structure refers to a situation where the TA institution decides, through its own internal programme-setting procedures, to conduct a study. This is a direct structure that maximizes self-determination and resource planning although this freedom is restricted by the fact that there is always a main target audience that requires relevance. An example of purely proactive type is the Europaeische Akademie GmbH in Germany that plans its own work programme that needs to be accepted by the funding organizations.
Usually there is no clear-cut distinction of TA institutes along the "reactive/proactive" category. Both parliamentary and non-parliamentary institutes might have either a proactive or a reactive structure, or indeed a combination of both. In either case there are limitations involved: in the reactive structure there is little flexibility in the choice of subjects and methods while in the proactive case the work can be of little policy relevance. One might argue that strict adherence to either type tends to influence the work outcome and eventual impact, and should therefore be undesirable.

Institutional Image
As with every other service, TA is influenced by competition forces (see also section on "organised interests" beneath). The number and diversity of TA services (e.g. risk assessment, technology foresight, bridge building, etc.) as well as the limited number

[8] For a detailed account of European Parliamentary TA settings, see "Shaping the impact: the Institutional Context of Parliamentary Technology Assessment" at the Supplement Papers section of this book

[9] The recent closure of the TA Academy at Baden-Wuerttenberg, probably the biggest European TA institute, for budgetary reasons is a sad reminder of the uncertain future for non-parliamentary TA institutes.

of topics at any given time with direct society or policy interest, raises competition amongst TA actors and institutions. The image and public standing of the institutes will inevitably play a major role in target audience preferences and subsequent effect of the TA study.
The image of TA institutes is a rather elusive topic as there is virtually no comparative research in Europe as to the level of European TA institutes' public standing or the elements of their public image. Similarly there is no "ready-made" recipe of success in this area. The institutional quality control processes differ immensely across Europe and offer no guarantee of raising public standing. As it is nevertheless a vital aspect for the future development (some might say survival) of TA to have a coherent and fair approach to improving its own image, some urgent research is requested in this area.

5.2 Technology Policymaking culture

Organised interests

The power of organised interests in influencing policymaking can hardly be underestimated. The number of different interest groups represented in Brussels alone more than tripled between the mid-80's and the mid-90's. The interests represented range from individual companies and European interest associations to NGOs and trade unions, while the number of individuals involved directly in lobbying activities is estimated at around 10,000. Various studies have corroborated the strong influencing power of organised interest groups. They show that the great majority of policymakers at the European level receive information mainly from interest groups and lobbyists. Moreover, interests groups provide more frequently direct voting instructions to members of the European Parliament than either the party leadership or the national governments.
Within this political reality TA is faced with tremendous competition as policy advisory service. It could furthermore be considered "unfair" competition considering the amount of resources that lobby groups usually can use in promoting their message. Despite the fact that TA can usually claim independence from interests and consequently greater validity in reporting, the limited time that policymakers can afford in information intake often means giving lower priority to bulky TA studies over more focused and politically aware information given by various interest groups[10].

Public awareness / level of social debate

The level of the current debate in society on technology issues is another uncontrollable influencing factor in the overall impact of TA. Media attention in particular scientific issues or technological discoveries can affect dramatically not only the need for immediate policy advice but also the themes and overall orientation that this advice should take. At the same time, high public awareness makes it more likely that policy makers accept the broad range of information and policy options delivered by TA as opposed to low levels of public awareness where policy making is more receptive to organised interests promoting the technology at stake.
Unfortunately, TA is poorly equipped to deal with sudden turns in public debates as it often enrols in a study process that can hardly change during implementation. At the

[10] The extend of the problematic of lobbying activities to the work of TA is analysed in detail in "Organised Interests in S&T Policy; The influence of lobby activities" at the Supplement Papers section of this book

same time TA rarely functions as a communication node and therefore does not have the means to follow or take part in delicate social debates. The implicit requirement for more flexibility during the TA process is very significant for the relevance, and therefore effect, of the TA advice. This will require re-evaluation of current TA methods and appropriate alternations to make the TA process sensitive and responsive to sudden changes in the subject matter[11].

5.3 Structure and State of the Innovation Process

State vs. market driven innovation

The way that the overall innovation system functions presents another factor affecting the impact of TA. No two national innovation systems are identical in Europe but there is certain similarity in indices such as R&D expenditure, share of private sector in national R&D, priority technology sectors, etc. These rough similarities nevertheless break down when considering specific technology subjects where a variety of innovation structures and trajectories appear in the picture. A general distinction of the innovation processes in Europe can use the categories state vs market driven.

In state driven innovation systems the prime driving force behind the adoption of new technologies are public fora. Whether due to a large part of the public interested in particular technologies or due to significant amounts of public funds spent in them, the government usually has a big say in the introduction of new technologies. In such case, TA can have more direct influence in policy making and the shaping of technology since it is an accredited public service, free of interests and agendas.

In market driven innovation systems, most technology development is market driven, the market decides whether a technology is acceptable or not, constitutionally there is no legitimisation for the state to intervene in technology development on the basis on a decision on whether there is a societal "need" for this technology or not. Legal regulation can only come in if a high potential of risk for health or the environment is probable. (freedom of research, private rights of enterprises).

State of Innovation

The "Colingridge dilemma" depicts accurately this influencing factor that many times TA is faced with. It relates to the notion of timing in the innovation process and how that affects any review of new technologies. It states that the earlier TA enters the innovation trajectory, the more possibilities there are to shape the future of the technology at stake but at the same time the more partial and vague the available information is. On the other hand, the later TA enters the trajectory, the more complete and comprehensive the knowledge over the technology is, but at the same time the less chance there is to influence the innovation strategy.

There is no rule of how to solve this problem. Timing is of outmost importance for the overall impact of the TA process, but this might also be a factor that there can be very little institutional influence about. Constant expert information flow is essential for the TA practitioner to decide whether the time is ripe for a study, provided that the institutional setting allows for internal decisions and the TA process is flexible enough to take into account new emerging themes and topics (see above).

[11] For a detailed account see chapter on "The Practice of TA; Science, Interaction, and Communication"

6. Conclusions

The typology and the set of roles developed by the TAMI project show that, regarding the impact of TA, there is more to be considered than the influence of TA on political decision-making (i.e. the lower right box of the typology). TA - whether "classical" or "participatory" - contributes to social debates and policy making in many ways: by supplying unbiased knowledge, supporting communication processes, offering new perspectives on the issue at stake, opening up new opportunities to restart debate in deadlock situations etc. The matrix of roles provided by the typology can support reflexivity in the design of a TA project (see also "The Practice of TA; Science, Interaction, and Communication" chapter) since it provides a structure for clarifying the goals of a project. In this respect the typology may also function as a means to clarify what kind of support for policy making in a particular case is desirable – e.g. relating to lack of knowledge on policy options, uncertainty about scientific data, lack of trust among stakeholders, deadlock of policy debate, etc. This is not to say that a TA institute is always free to choose which goal or role to go for. In most cases there are many restrictions set by the mission, the institutional setting or the organisational competencies of a TA institution, as described above. It is also obvious that the social and political environment restrict the choice of roles and the opportunities to influence the debate. In any case, however, reflection on roles TA can play will support the situation appreciation and lead to awareness of what realistically can be achieved and what scientific, procedural and communicative methods may be applied and arranged in the project.

Given the complexity of the issues TA has to deal with as well as the complexity of the political environment TA is embedded in, it cannot be expected that recommendations can be given for certain methods to be applied in order to achieve certain impacts. In most cases a mix of methods might be most appropriate and it might as well not be possible to strictly aim at one specific role.

Some more general insights on the relation on impact/role and method however have been triggered by making use of the TA typology:

Given the two TA paradigms - the classical scientific policy consulting model and the participatory TA model - it can be said that the methods these models typically draw upon are strongly (but not exclusively) related to one dimension of the impact typology. The methods applied by a policy consulting type of TA are mainly scientific; it is the core mission of those institutes working exclusively on behalf of the Parliament to support decision making by providing knowledge on scientific, social and policy aspects of the issue at stake and this is done mainly by drawing on state of the art in research. This also implies that the TA practitioner does not directly interfere in ongoing debates but rather observes these debates from a distanced, impartial point of view in order to give a comprehensive and unbiased analysis of the problem. Quality criteria such as argumentative quality and transparency of the analysis can be regarded as prerequisite for the acceptance of TA results by the client or other potential users. It is by the (scientific) quality of the product (albeit reflecting the quality of the process) that TA intends to make the user aware of problems and arguments not known so far.

Impact in the second dimension, i.e. in the sense of mediating conflicts, can be furthered by including stakeholders in the debate and providing new ground for mutual learning via application of participatory TA methods. That is however not to say that an unbiased and scientific analysis of the issue and of the stakes and

interests implied in debate can never induce self-reflection among actors and thus support conflict resolution. In participatory TA the scope of methods applied is however expanded in the direction of direct intervention in the debate - i.e. not only providing knowledge but also organising and stimulating the debate. Although references to scientific knowledge are integral part of the process, it is the interactive quality of the process (fairness, openness to relevant actors, etc.) that gains importance here. The TA organisation still is acting on the basis of the principle of impartiality, however the organisation and the TA process itself is more part of the debate than in the case of classical TA - or even more: the TA process is delegated to the social actors while the TA organisation only functions as a facilitator.

It can be said that classical TA is - with regard to its methods - related to the first impact dimension of the typology and participatory TA to the second dimension, and this should obviously be taken into consideration when evaluating the impact of TA. This however should not be taken too narrowly - in the sense of each of them being restricted to the respective type of impact.

Regarding the mission and the methods of TA it is evident that "raising awareness" and "forming attitudes and opinions" is in the reach of both classical as well as participatory TA. Since TA has been regarded from the beginning as an answer to the growing need for comprehensive scientific information for policy making as well as to the ongoing debates on the impact of science on society, TA has always been regarded as implying comprehensive scientific analysis as well as taking account of different social perspectives. The increasing demand for and application of participatory (process related) methods in recent years should be regarded as a reaction of TA to a change in its social and political environment, i.e the growing demands of civil society to be involved in policy making on scientific and technological issues and the increased need of policy makers to cope with dissent and conflicts on emerging technologies.

If TA thus, expands the scope of methods towards intervening directly in the process of opinion forming, this means intervention by providing new processes of communication and debate not by inducing a particular opinion, perspective or a particular political position into the process and thus directly intervene in the third dimension of the typology: the decision making process itself. In a way this is not surprising since it is part of the mission and self-conception of TA to obey a strict separation between policy making on the one side and policy consulting on the other side. However self evident this may be, it is important to stress, that whereas TA has methods at hand to raise knowledge about scientific and social perspectives on the issue at stake as well as to organise, stimulate and moderate debates and communication processes among actors, having a direct impact on decision making, often seen as being the ultimate goal of TA, is beyond the reach of TA's "method toolbox". It might even be regarded as being somewhat misleading to describe "roles" to play for TA in this context and instead we should be speaking of "contingent" outside effects of a TA process that are dependent solely on the state of the political process itself. Discussions among the TAMI project group on the importance of "communication" as a means to expand the opportunities for TA to produce impact (see "The Practice of TA; Science, Interaction, and Communication" chapter) raised the question whether there is an opportunity and a legitimate chance for TA to take a step further in intervening in debate by taking a more active role as a "player" in debates on science and technology. Whereas some pointed to the danger of a possible loss in the view of TA as an impartial observer and facilitator of debate and decision

making, it was regarded by others as necessary for TA to be visible in the media as an actor of its own rights (e.g. taking the role of a "agent provocateur"), challenging opinions and perspectives of actors in order to intensify the interaction between civil society, policy makers and scientists. In this case TA would in a way give up its traditional role of a "knowledge broker" and its affiliation to the branch of scientific policy consulting and move towards the role of an advocate or activist to provide civil society with a say in technology debates. The scope of actual concepts of TA in Europe seems to be marked by this position (e.g. currently discussed in the Netherlands) on the one end and the understanding of TA as being exclusively dedicated to proliferation of best scientific knowledge available to policy makers on the other hand. However, the practice of TA in most cases is likely to fall in between those categories and there is a constant discussion in the TA community about which way to expand or adjust the set of methods in order to improve the impact on policy making and social debate and what this will mean with regard to the mission and competencies of TA institutes. This ongoing discussion on self-understanding, function and impact of TA is ultimately solidified by the typology of roles and impacts developed in the TAMI project.

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4. Conclusions and Policy Implications

The following document presents the conclusions (lessons learnt) of TAMI, with an emphasis of the implication and scope of the project results. Besides this chapter, the specific conclusions on methods and impacts are represented.

4.1 The TAMI Project, Intentions and Frame

The TAMI project has had the aim of creating a structured dialogue within the Technology Assessment (TA) community as well as between TA experts and policy makers in order to improve our understanding of the effect of TA in science and technology policy-making.

In spite of its reputation as one of the most self-reflecting research communities, TA traditionally only spend few resources on evaluation of the impacts of its work. There may be many reasons for this, but it surely is of importance that the effects of such indirect advisory functions are very hard to document. TAMI therefore aimed at answering two main questions:

- Which kinds of impacts of TA can be identified and how can these be categorised?
- How can TA optimise their activities with regard to supporting science and technology decision-making processes in our societies? And how can the choice and use of methods contribute to such optimisation?

TAMI was established as a network, supported by the 5th European Framework Programme.

Two subgroups of TAMI partners were built with the aim of analysing the research themes from two perspectives: The method perspective and the impact perspective. The two groups exchanged views at plenary sessions at the six working seminars, and at a mid-term "cross-over" seminar. Two workshops were held, at which the TAMI groups could present and discuss their findings with invited experts, stakeholders and policy-makers. Finally, a dissemination conference was arranged, at which the results were presented, and the wider perspectives were discussed.

The partners of the TAMI project include researchers from Belgium, Czech Republic, Denmark, Germany, Netherlands, Poland, Spain, Switzerland, and United Kingdom. These participants include the known variety of institutional settings and methodology. Further, the participants have included members of the EPTA Network[12] and the EUROPTA Project[13], in order to gain advantage from the discussion of impacts and methods that have taken place in these professional communities.

The starting point of TAMI was an international development of TA, which has left TA practitioners with a broad experience, a growing theoretic and methodological understanding, and an increasing field of application. But also, TA is a relatively young discipline, still developing its aims, tools and self-understanding. TAMI may be seen as

[12] EPTA is the European network for Parliamentary Technology Assessment offices. See www.eptanetwork.org
[13] The EUROPTA project examined participatory technology assessment methods and scrutinized 15 case studies with regard to implementation and choice of method, project management, political roles and impact. The report and case studies can be found at www.tekno.dk/europta. Footnote 3 gives reference to the EUROPTA book.

a project that has focused on the most important fields for clarification on the functions of TA: Intervening into the right problems, picking the right tool, at the right moment, and with the right effect.

4.2 Three Central Terms

Analysing the relation between method and impact is in its essence an exercise looking at the functional relation between TA and its surroundings. This has made it necessary for TAMI to revisit the definitions of *technology assessment*, *method* and *impact* in order to ensure a common functional understanding of these three basic terms.

Technology assessment has been subject to many definitions, focusing on certain aspects of TA, such as for example the aims, the methods, or the addressees. Though - or maybe because - such definitions serve specific aims for different purposes, none of them seem to cover the functional relation between the full range of TA approaches, and the full range of outcomes. The following definition was therefore developed in order to be able to embrace the processes and aims involved in TA:

> *Technology Assessment is a scientific, interactive and communicative process with the aim to contribute to the public and political opinion forming on societal aspects of science and technology.*

A *TA method* is not a unit, which is easy to pinpoint. Methods can be described as the more or less well-documented procedures in the TA toolbox. But such an approach does not embrace the dynamic methodological process inside a TA project. Neither does it include the relation between these processes, the goals of the TA activity, and the societal situation surrounding the project. Consequently,

> *TAMI has interpreted methods as a plurality of scientific, interactive and communicational procedures, involved in a TA project design*.

Such procedures may formally be documented, or may be present in terms of the competence of the project organisation.

Impact of TA traditionally refers to the expectation, that TA should increase the quality of decision-making, which is often connected to a demand for influence on decision-making, and the idea, that real impact occurs, when political decisions have been taken. However, this understanding of impact suffers from the problem that it simplifies and to some extent ignores the nature and reality of decision-making. A useful definition has to take into consideration the complex nature of change. TAMI found it necessary to make an interpretation of impact, capable to catch the many different kinds of effects that TA can induce, and which can serve as contributions to a process of change.

> Impact is an induced change with regards to the state of knowledge, opinions held and actions taken by relevant actors in the societal processes on science and technology issues.

4.3 Method and Impact

A method has to be seen in the light of its surroundings. A method is a tool, used in a project or activity to serve a certain purpose, framed by the project organisation, the host institution, the actual situation of the issue under scrutiny, and, in broader terms, the political and institutional culture. The meaning of a certain method is in other words defined by the context.

But at the same time, a method used in a technology policy analysis intervention makes changes to the context. The state of the issue, the condition for the actors involved, as well as the institutional and political situation may be affected through the TA intervention, and these changes - the impact - are, among other things, a result of the specific method.

4.3.1 Perspective – Method Group

TAMI has developed a description of the relation between the method and its context, which is described in-depth in chapter 3. This method interpretation puts weight on the processual aspects of TA activities, with scientific analysis, interaction and communication as the processual pillars.

As the meaning of a method is dependent on the context and on the "goals of change" which has been setup for the TA activity, methods have to be chosen in accordance with an understanding of the problem situation – the context. Part of this analysis has to take into account the wider settings of the TA institution – the political culture, institutional background and history – which empirically can be seen to have had great influence upon the methodology of TA institutions, in particular upon the composition of the toolbox.

Involving scientific, interactive and communicative processes, TA has a broad set of quality criteria to live up to, in order to make assessments that are valid and can be trusted as a promoter of change. Scientific quality includes the proper management of interdisciplinarity, of reviewing processes and professional discourse. Quality of interaction involves social as well as processual fairness, transparency and the quality of arguments. Quality communication has to do with flexibility towards the ongoing debate, ensuring relevance with regard to the social, political and scientific reality, and with focusing on target groups, media and strategic alliances.

The choice of methods has a potential impact on the wider political perception of the TA institution and its role. This is a consequence of the fact, that methods have a political cultural meaning connected to them. Consequently, the composition of the toolbox and the choice of method is an important part of institutional strategy. A method that may contribute to building up trust in one TA institution may have the opposite effect in another institution. On the other hand, the establishment of a TA institution may in itself be a reflection of the need for a change in political culture, in which case not only new fields of method experimentation are opened up, but also the exploration of these fields may be a prerequisite for building up trust. Trust and recognition are important determinants of the general impact of an institution, which leaves the choice of method to be not only an instrumental choice, but also a strategic choice.

Though the method should be chosen to support the goals of the TA activity, the method is certainly not the only determinant of the impact. The success of TA projects is dependant upon other internal factors (project management competencies; budget constraints; organisation culture; etc), boundary conditions (institutional setting; links to policy-making; political culture; etc), as well as an infinity of more or less controllable external influencing factors (strategies of other actors; timing of policy-making process; sudden changes in the problem situation; the immediate issues on the media agenda; etc, etc). A method may be chosen and adapted to compensate for as many as possible of the relevant influencing factors, and some methods are stronger in setting the agenda than others, so, a conscious method implementation will certainly lead to greater chances for impact. However, the examples of unforeseen obstacles for impact are many, which to some degree has to do with the fact that no project design can control all influencing factors.

An important part of maximising the impact of TA activities is to acknowledge the importance of conscious communication strategies connected to the method. Communication is an embedded part of all knowledge sharing, social learning and policy definition, and as such, it is the backbone of all interaction. The more consciously and professionally the communication inside as well as out of the TA process is handled, the more readily will the actors learn from the process and its results. Communication strategies should not only focus on the outcome, in terms of reports, briefs, follow-up conferences etc, but much more important focus on the interaction included in the method, and the spin-off in terms of involvement of actors and networking along the project process. In a broader sense, communication techniques and skills should be regarded as an integrated part of the methodology competencies in a TA organisation.

The methods of TA are generally well described and studied with regard to the range of methods of stakeholder involvement and public consultation methods of participatory TA, of which manuals are often available and a worldwide exchange of experience is common. Different attempts have been made to build up typologies of TA and policy analysis methods, but none of the attempts has succeeded in the establishment of a generally accepted typology. TAMI has found that the lack of a common typology of TA methods, can to a large extend be explained by the fact that a refined picture of traits of different methods does not exist. Especially the different traits of scientific or expert based TA approaches needs to be examined and described with regards to their procedural differences. Further research is needed to make an in-depth overview of TA methodology, and to suggest a method typology that connects the method to a set of goals of the TA intervention..

4.3.2 Perspective – Impact Group

TAMI has developed a typology of impact, which is described in chapter 3. The typology is build on the assumptions that A) TA can *be about* the technology/issue under scrutiny, the societal aspects, or the policy aspects, B) TA can *lead to* new knowledge, new attitudes/values, or new actions taken, and C) there are a number of *specific roles* that can be played by the TA project inside the framework made up by A) and B).

The idea of roles[14] as an expression of the often delicate and complex changes evolving from a TA activity that involves for example experts, stakeholders, policy-makers, public authorities and NGO's in the same TA process, makes it possible to characterise those kinds of impact that are often referred to as "soft" or process-oriented. However, though delicate, soft and process-oriented, impact understood as a "role" is a concrete change in the societal situation on the issue at stake.

TAMI has identified an inventory of 21 roles, which have been seen performed in TA project examples. The list is non-exhaustive, and future case studies may reveal new roles.
The introduction of the concept of roles reveals that TA plays more roles and has more impact than usually appreciated in the discussion of the impact of TA and other forms of science and technology policy analysis.

An important conclusion of the TAMI project is that defining impact as a change in decision-making is much too narrow. This kind of impact makes up only one "corner" of the TAMI typology. It is often questioned, if TA should search this kind of direct impact on decision-making at all. There are examples of direct and targeted impact on decision-making that has been regarded as legitimate – for example in terms of campaign-like TA activities towards decision-making at local or enterprise level. However, it seems to be in contradiction with the role as advisor to be expected to exert direct influence upon political decision-making, and even if it is expected, TA is in the lack of methods, which legitimately can intervene directly into the processes of representative democracy.

A TA project goes through a series of phases, of which some of them are occupied by the execution of the included methods. When impact is regarded as an ongoing process of change during the TA project, which can be identified as specific roles, it becomes apparent that all project phases are potential platforms for impact. For example, just the fact that a TA institution takes up an issue (the first phase of a project) may in itself play the role of "setting the agenda". Or, an expert/stakeholder seminar at the end of a desktop research TA project in a phase of synthesizing policy options may play the role of "building bridges" between the actors.

Certain roles are method dependent in the sense that they are typically expressed by certain categories of methods. For example, the role "self-reflecting among actors" is hard to perform in a desktop research activity, and more easily will be facilitated by an interactive method of participation. Further, to play a certain role may be dependent of other roles to be played. For example, a change in legislation is often dependent of knowledge and debate.
Therefore, there are ties between the ex ante choice of "goals" for a TA activity, the expected dynamic relation between "roles", as it is expressed in the project design, and the ex post registration of the roles played by the project. Or in other words, the TA project goal has to be broken down into the needed roles, as part of the project design.

[14] TAMI has developed the concept further from the ideas presented by the EUROPTA Project by Danielle Bütschi and Michael Nentwich: "The role of Participatory Technology Assessment in the Policy-making Process", in: "Participatory Technology Assessment, European Perspectives", Ed. Simon Joss and Sergio Bellucci, Centre for the Study of Democracy, London, 2002. See also www.tekno.dk/europta

How to ensure the project to perform certain roles has to do with the competencies (process understanding, communication skills) of the project management, with realistic and strategic setting up of expected roles during the project timeline, and with a careful choice of methods.

There are, as stated above, many influential factors outside the control of TA, which may have immense impact on the type, amount and direction of impact that the TA activity can exert. However, in connection to each role, intended to be played by the TA activity, there are means that can be set in effect to counteract unwanted influence, and to amplify the specific role. The problem situation always leaves a certain degree of freedom for the actors to change strategies, which leaves it up to the TA intervention to prepare for flexibility.

It has not been a research aim of TAMI to make in-depth case studies to examine how the roles are played inside the variations of methods, institutional and political settings, issues, or any other potential factor, which may influence the impact of TA. However, such research is highly needed, as the key to playing the relevant roles on a sufficient scale lies in the ability to choose the right measures, taking the relevant factors into account. Therefore, empirically based research on the instruments connected to performing specific roles needs to be set up in order to build up further efficacy in policy analysis exercises. The institutional and political settings needs special research attention as factors that may determine the acceptability of or presuppose the use of certain measures (such as for example citizen participation or direct contact to politicians) and therefore may affect the ability of the project to pursue a certain goals effectively.

4.4 Evaluation of Impact

Historically, impact of TA has been difficult to measure. There are *examples* to be found of all kinds of impact, but it has been scarce with *evidence* of direct impact of TA on decision-making. This is not at all surprising from a political science theoretical point of view, since TA – as any other policy analysis – serves decision-making with knowledge, options, networks and arguments, which are highly valuable raw material for the political process, but which also are difficult to trace after the workings of the political foundry.

The TAMI project has made some major improvements in the understanding of the nature of TA impact, by a) establishing an impact typology that b) involves a set of "roles", which c) can be seen as a relative realisation of the "goals" of the TA activity. It has not been the intention of TAMI to develop an evaluation methodology for TA, but retrospectively, it appears that the systematic use of "roles" as the expression of impact makes evaluation easier by role-specific evaluation indicators. Identifying the effects of TA activities still is a difficult task, but the more precisely one knows what to look for, the easier the search gets.

The TAMI partners are convinced that a structured evaluation tool can be set up for any TA project, on the basis of the priorities that are given to the roles that are to be played by the project. Such a tool should differ between the ideal intentions in the project design, the realistic expectations with regard to the scale of impact (level at which certain roles is expected to be played, taking – among other things – the

involved method into consideration), and role-specific evaluation criteria, which may be documented with a variety of tools. A possible layout for such an evaluation structure can be sketched as an inventory of the TA goals, their possible level of expression, and their specific evaluation indicators:

Goals	**Realistic achievements**	**Evaluation Indicators**
Priority list of roles	Adjusted expectations to each role with regard to situation appreciation, project design and influencing factors.	List of indicators for each role: • Hard indicators – e.g. opinion surveys, media coverage, official proceedings • Soft Indicators – e.g. interviews, personal judgements

The general scheme for an adequate evaluation methodology that respects as well the scientific, interactive and communicational nature of TA seems to have come much closer with the introduction of the TAMI typology. Such an evaluation tool would be extremely valuable for cross-national comparison of the outcomes of TA, foresight and other science and technology policy-analysis functions. However, further research to develop this tool into a general benchmarking technique is needed, and would be highly relevant.

4.5 The institutional Setting

TAMI has seen the institutional setting as a specific "influencing factor" on the types and level of impact that can be expected from TA activities. Institutional boundary conditions may affect all phases and aspects of the TA process, such as:

- Problem selection and definition. For example through presumptions and values embedded in the organisation and its surroundings.
- Actor relations and involvement - close or loose connection to important actors; ability to connect to actors as needed.
- Toolbox composition and method choice – which may be affected by the institutional relation to certain communities (scientific institutions; trade or employer organisations; parliaments etc).
- Project management and interaction. May be affected by the expectations to the function of the TA staff – are they to act as researchers, process managers, policy-makers or civil servants?
- Communication. How freely can the institutional choices, the TA process, the involved knowledge, values and decision-making, or the conclusions and their consequences be communicated?

Looking at the worldwide institutional landscape of those TA institutions, dealing with parliamentary TA[15], three models of institutional settings are visible, all of them imposing different influence on the methodology and impact of the institutions. The three models may be called the scientific institute, the parliament office, and the public institution.

[15] We focus here on the parliamentary TA institutions, as they have a common aim of directly supporting the policy-making process. Other TA institutions may resemble these with regard to institutional setting and analytical process, but may not have the same kinds of incentives that are involved in PTA.

The scientific institute is characterised with a more or less formalised link to academia, whether this is in the form of connection to a university, to the research councils or to an academy of science – historically, such setups have been seen. This type of institution typically has its strength among those types of impact that have to do with the research, analysis and synthesis of knowledge – the cognitive dimension of TA. The limitations can be found among those roles that can be regarded as being in conflict with the role as scientist. For example, it can be difficult for these institutions to take an active role in setting the public agenda, to involve itself in interactive normative clarification, or to set up political processes. Historically, at least for parliamentary TA institutions, this model often seems to be an intermediate state towards an institutional setup, which has closer links to policy-making and a toolbox that goes beyond the scientific analysis.

The parliament office serves parliamentarians directly, and is set up as an internal office of the parliamentary institution. The strength of this type of setup seems to be connected to the clear focus on the need of MPs, which favours impacts on the knowledge and policy dimensions. The main limitation is the other side of that coin – a low ability to set up TA as learning processes directly involving or put in the hands of stakeholders and the general public, which makes impacts of opinion-forming and debate less probable. In terms of methods, this means that these institutions mostly focus on scientific consultation – often in connection with hearing-processes involving stakeholders -, and have lesser focus on methods that support the social and political processes outside the parliament.

The public institution may be set up in connection to the parliament or the government, or other constructions. It has a high degree of self-governing competencies, obligations towards the societal discourse as such. Parliamentary TA institutes set up as public institutions also have obligations towards the parliament, and most often a direct link to a parliamentary committee. The autonomy to take up issues and pick methodology as the institution finds it most relevant is an important feature of this organisational setup, which is reflected in the use of a broad toolbox, which potentially can result in any of the impacts/roles in the TAMI typology. The backside of this setup, however, is mostly to be found in the low involvement of politicians in the internal process of the institution, which may hinder the call for TA as part of the parliamentary decision-making process.

Though such models can be identified and can be seen to influence the methodology and the impact, the choice of roles has as much to do with institutional strategies as it has with formal boundaries. Inside the models, the aims of the institutions are always subject to negotiation, which means that the right strategies may open up for new methodological fields to explore, and, subsequently, for new and more roles to be played. For example, the *scientific institution* may open up for interactive methods involving stakeholders or citizens, in order to supplement the scientific analysis with debate; the *parliamentary office* may decide to take in citizen participation in order to serve the parliamentarians with in-depth knowledge about public opinion; and the *public institution* may compensate for the weak links to the parliament by going into cooperation with the parliamentary committees directly on an ad hoc basis. An important feature of TA seems to be that such strategies are real, and there is a

tendency for all types of TA institutions towards expanding the toolbox and playing a more diversified set of roles.

These points are supported by the fact that across the different models and the many different kinds of TA being performed in our societies, there is a common understanding of the rationales and the mission of TA activities.

From the assumption, that the establishment of TA offices is an expression of a general need for more conscious technology policy-making, it follows that such offices should be present, wherever knowledge, opinion forming and action is necessary. This may be among MPs, but it may be among stakeholder, experts or the general public as well. In its consequence, this means that the strongest TA is to be found when certain TA goals can be unrestrictedly pursued with regard to method, target groups, communication efforts, etc. Because of that, it is of high importance to study how and with which results, institutions can overcome traditional barriers of political/institutional setting in order to maximise its impact. Such research would give important knowledge about the "open but unexploited fields" of roles to be played by different settings of TA.

4.6 Communication and Process

In parallel with the general movement towards expansion of the institutional toolboxes, an increasing awareness of the importance of communication as an integrated part of the TA methodology can be seen. This awareness means that besides the traditional methods of publication, an active approach to communication becomes an integrated part of the TA institutional policies.

The communication between the project activities and the actor networks is crucial for the total impact of TA, understood as the set of roles that are played by a TA activity. Some roles may be possible to play with a very simple communication effort, but many roles are dependent on an active communication strategy in the project, supported by an institutional communication policy. If TA is to reach the relevant actors, it will have to be able to compete on the crowded information market, since TA is not the only one to serve the public and political debate.

A communication policy may for example imply staff competence, clear rules on competencies to initiate communication activities, a set of ongoing communication channels (web-site, e-mail newsletters, magazines, report series etc.), and project specific communication plans. Communication integrates with all levels of the institutional life, as a communication policy will be an institutional orientation, a professional skill, and an integrated part of the toolbox.

A communication strategy needs to be tailored to the specific situation of a TA activity. This may for example involve the definition of target groups, and the specification of communication channels to reach them.

A strategic approach to communication will, however, also imply a strategic composition of the TA methodology, since the process of TA in itself is a communicational tool (to participants, audience, organisations, steering committee etc.) with great potential impact. The choice of method depicts the nature and level of involvement of the actor networks, and therefore is an important decision with regards to strategic communication. Correspondingly, the framing of the issue to a large extend defines the relevance of different dialogue partners in the activity, and

therefore the possibility for communication through the process, which makes strategic communication an important part of the design of projects in a TA institution.

The learning processes connected to the roles of TA may be supported by targeted communication efforts in many ways:

- Communication channels for effective "one-way communication" may be built up to support the transfer of knowledge and options from the TA activity.
- The TA project can establish channels of communication with the actors in order to ensure input and learn from the actors, and in order to establish bedrock for the communication of project results.
- Processes may be set up to activate the dialogue between the actors, in order to support the mutual learning, the normative clarification and the preparation of action among politicians, experts, stakeholder or individual citizens.
- Shaping the long-term TA involvement on a science and technology policy topic as a process of iterative learning cycles can support social learning, as it gives room for actors to develop their standpoints through time, and for the TA institution to flexibly adjust to the changing social understanding among the participants.

4.7 The trans-national Perspective

Science and technology issues are by nature involving all levels of governance in our society – from the daily decisions made by the individual citizen, to enterprise strategies, or to regional, national, trans-national and global decision-making. Therefore, TA can be seen as a universal function for all governing levels, which can help any actor to create knowledge, form opinions or to make policies.

Though TAMI has explored methods and impacts, mainly on basis of national or sub-national experience, it was an intention of TAMI to synthesize conclusions on the trans-national, European level. This last section of our conclusion paper should therefore be devoted to the level that has brought TAMI together.

Regional science and technology policy-making has come into focus during the last decade. Globalisation of science, technology development, production, market places and labour markets has forced regions to develop their own awareness of the available resources and their potential, and to build up strategic visioning. Alliances across borderlines, in terms of foresight activities and regional development plans involving trans-national cooperation can be seen all over the world, and not the least in Europe. Technology policy analysis of course play an important role in this development, and activities in the recent years indicate that national, regional and transnational foresight and strategic analysis may become a major task for TA in the future, since TA has the necessary interactive methodological, analytical approaches and strategic aims in place.

The challenges of governance of science and technology issues at European level are fully documented and politically acknowledged. Also acknowledged is the fact, that much of the problems of governance may very well find their solution in effective knowledge sharing throughout the EU society, in a widely embracing strategy of involvement and debate, and in a more open process of decision-making. The TAMI impact typology has been made in order to break these general aims down into a set

of specific roles that can be performed by TA. Looking at this typology through the lenses of the state of EU S&T policy, it clearly appears that the TAMI impact typology encounters the governance challenges of EU science and technology policy.

This is not surprising, since historically, parliamentary TA was established in order to meet the same challenges at a national level. The nearby question then is: Is it possible and relevant to adapt, transfer and use the broad toolbox of TA to the trans-national level? From the TA practitioners' point of view of TAMI, the answer is positive:

a. Most methods of TA have been shown to be transferable between nations worldwide. Trans-national events would be big events, but basically they would need a European problem analysis, and could often be built as coordinated parallel national events with a European synthesis phase.
b. Methods of TA can be performed by the trained professional community of TA, at European level in accordance with the principles of open coordination.
c. Cross-national TA in the pursuit of "roles", as described by TAMI, would be extremely relevant for the proper governance of European science and technology issues, such as transportation, energy policy, bioethics, intellectual property rights, consumer regulations, the brain-drain dilemmas, etc.
d. TA activities at the trans-national level make it possible to transfer competence and capacity to regions and nations inside as well as outside Europe. It would be an important mission in itself for Europe to pave the way for permanent establishment of TA functions and institutions.

Trans-national TA activities, aimed at analysing and finding policies towards societal conflicts on science and technology issues are, however, confronted with some important questions that needs to be answered methodologically. Such "up-scaling" problems are often debated, but there is reason to believe that they can be solved by proper project designs:

- The lack of a "European public sphere" is often mentioned as a barrier for initiating debates on the trans-national level. However, the lack of a European public does not mean that European issues cannot be treated in the public room. Focusing on nations as the operative level for trans-national TA seems to be the answer.
- Cultural differences in communication and debate on political issues are other challenges for trans-national TA. The answer may be to explicitly make use of a bi-focal approach in which as well the method as the content could vary from nation to nation, inside certain controlled limits.
- Language barriers are obvious obstacles for European public dialogue. However, national TA has overcome this barrier in several cases.

It is the impression of TAMI that the specific challenges of performing TA at the trans-national level, are possible to solve.

There is an increasing call for the methodology of TA to be implemented in a European trans-national context in order to harvest the impacts and societal roles of TA. In technical terms, there seems to be nothing hindering trans-national coordinated TA activities. Further, the TA community represent a unique network of mainly national

competence that is ready to go into coordinated trans-national activities. The immediate need does not seem to be the development, research in or further case studies on the already known methods. At the time being, there seems to be a much more urgent need for actual projects at a European level.

5. Dissemination and/or Exploitation of Results

a) International Conferences

The project plan of TAMI has included some important dissemination milestones. Besides the regular working meetings, three international conferences have been organised during the project.

The first conference was the kick-off meeting held at the Flemish Parliament in Brussels, 20/21st June 2002. The kick-off meeting aimed at creating a first discussion with representatives of the national policy-making community (Paraskevas Caracostas, European Commission; Prof. Dr. Bugl, Advisory Board CTA) of TAMI members as well as industry (Andrew Freeman, GlaxoSmithKline; Dr. Hans Peter Bernhard, Novartis Services AG Switzerland) with intense R&D efforts. The presentations, given by leading European politicians and R&D experts, referred to the expectations of the policy-making community towards TA-institutions.

The mid-term meeting was the second time when policy-makers, TA-experts and representatives from industry discussed with the TAMI group members over the work done so far, the wider aims of TA as well as the communication aspects needed to achieve these aims. The mid-term meeting took place in Prague, 3/4th April 2003. Seven experts (three representatives of the policy making community: Eryl McNally (European Parliament), Otto Bode (Federal Ministry of Education and Research (BMBF), Josef Bugl (Advisory Board CTA) and three representatives of the TA community (Michael Nentwich, Paul Berckmans, Bernard Reber) and a communication expert (Cees Midden) have been invited to take part in the round table discussion at the first conference day. During the next meeting day the discussions continued between the two working groups (Method and Impact) and the invitees of the mid-term meeting. Upon the results achieved out of the discussion the TAMI group finalised their papers until the dissemination conference.

The final results and recommendations of TAMI have been presented at the dissemination conference in the Flemish Parliament in Brussels, 27th November 2003. TA-experts, policy-makers, NGO´s and industry representatives discussed the results of the TAMI-project and the issues of how awareness of technology issues can be furthered in society and how societal interaction can be improved to widen the influences of technology assessment to decision-making-processes in politics. In the first part of the conference the results of the two project groups have been presented and discussed; in the second part, three central issues (Furthering Awareness on Science and Technology Issues, Improving Societal Interaction and Supporting Science and Technology Policy-making) arising from the project results have been commented by invited experts and discussed with the audience. 67 participants attended the conference which was hosted by the Flemish Institute for Science and Technology Assessment.

Detailed participation lists of all conferences can be found in the Annex.

b) Communication of Results

Each TAMI partner has published a description of the project and the partners on their homepages. The European Academy (coordinator) has published the results of every meeting in the internal newsletter – important milestones have also been published in the newsletters of the partners. The dissemination conference has been announced in the STOA newsletter, on the cordis and kowi websites and on other national and international homepages. Press releases have been distributed after the dissemination conference to 400 press contacts in Europe.

c) Publication of Results

The results of the TAMI project will be published in the Springer series "Wissenschaftsethik und Technikfolgenbeurteilung" of the European Academy. The book will be announced (summer 2004) at the following website: www.europaeische-akademie-aw.de

d) Additional Dissemination Activities

In the following some additional activities arising from the TAMI project within the single countries are briefly illustrated:

- Consejo Superior de Investigaciones Cientificas (CSIC), Spain

The Consejo Superior de Investigaciones (CSIC, Spain) has asked for an internal workshop on TA to disseminate the TAMI results directly to the national politicians. The workshop took place on the 13th September 2003 in Madrid to provide an overview about the various institutional settings of TA-offices in Europe. Every TAMI member was asked to give a brief overview about the institutional setting and methods used. Since Spain does not have an institutionalised TA-office at the moment it has been of great interest to illustrate the differences between parliamentary and independent organisations. The results of the TAMI report will also be distributed to the President of the Spanish Senate.

- Danish Board of Technology (DBT), Denmark

The Danish Board of the Technology (DBT) has disseminated the TAMI results in an internal project manager seminar in autumn 2003. DBT decided to use the typology of impact as an internal reference for impact and to establish a task-force to find ways to develop an internal project evaluation tool, based upon the TAMI roles and suggested layout for evaluation. The results will also be presented as part of the methodological concept of DBT in future international presentations. Besides, it has been decided to distribute the TAMI results to the Board of Governors after the book publication.

- Centre of Science, Technology, Society Studies at the Institute of Philosophy, Academy of Sciences of the Czech Republic (STS Centre)

  Teaching Technology Assessment (TA) – for students of the BA degree of Pedagogical Studies on the Masaryk Institute of Advanced Studies (MIAS), Prague, Czech Republic (http://www.muvs.cvut.cz/).

  Elaborating a textbook for teaching **Technology Assessment** (TA) in 2003 within the TAMI project.

Machleidt, P.: TAMI –Technology Assessment in Europe, Between Method and Impact.(The information on the project implementation) Teorie vedy /Theory of Science, Prague, XII.

6. Acknowledgements and References

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For a detailed listing of references used in the compilation of the papers included in this report, please see the references section at the end of each paper above.

7. Annex

Annex 1: **Minutes of discussions and conference presentations**

Annex 2**: Supplementary Papers**

- Shaping the impact: the Institutional Context of Parliamentary Technology Assessment
- Organised Interests in the European Union's Science and Technology Policy; The influence of lobby activities
- Culturally-based Factors that Influence TA
- Industry Technology Assessment: Opportunities and Challenges for Partnership
- Examples of Roles