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# Methodological issues in information technology assessment

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**Abstract:** Technology Assessment (TA) has been in existence for twenty years, mainly through specific governmental institutions, and during that time conceptual and methodological debates have led to a so-called 'new TA paradigm'. The aim of this paper is to discuss the implications of the new paradigm. More particularly, Information Technology (IT) is presented as revealing the necessity of renewed TA approaches.

The evolution of the conceptual and methodological debates throughout the TA history will be reviewed briefly; a review then follows of the typical features of IT, to enlighten the orientation of renewed methods in assessment. Finally, a five-task methodological proposal will be made that could be useful for IT Assessment.

Research at the TA Research-Unit, the University of Namur (Belgium) (CITA), will be used to illustrate the theoretical developments described, through specific case studies (Electronic Data Interchange and Health Cards).

**Keywords:** Technology assessment (TA);

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**Biographical notes:** The authors belong to the Technology Assessment Research Unit (CITA) of the University of Namur (Belgium). The researchers of CITA are specialized in the fields of computer science, law, economics, philosophy, organization analysis and management, but the TA studies are conducted in an interdisciplinary perspective. The main current research topics are related to Interorganizational Information Systems and Electronic Data Interchange, Smart Cards in Healthcare Institutions, Law Courts Automation, Information Highways and Society, Technology Assessment Methods, etc. CITA participates actively in European research programmes and has many contacts with the Belgian, US and European research world. Created in 1986, CITA publishes a series of 'Cahiers de la CITA', which provides the involved actors and decision makers with accurate technical information as well as analytical tools.





## 1 Introduction

Twenty years have shaped the landscape of TA. The 1980s were, for Europe, the decade of TA institutionalization – 10 years after the US example. In 1972, the Law n° 92-484 of 13 October, created, for the US Congress, the Office of Technology Assessment (OTA). In 1983, a French Law, n° 83-609 of 8 July 'portant création d'une délégation dénommée Office parlementaire d'évaluation des choix scientifiques et technologiques (OPECST)', was enacted. In 1984, in Belgium, the 'Conseil régional flamand erected the Stiching Technologie Vlaanderen' (STV) was formed. In the Netherlands, in 1986, the Netherlandse Organisatie voor Technologische Aspectenonderzoek (NOTA, called today Rathenau Instituut) was established and, in the same year, in Denmark, the Danish Board of Technology (TeknologiNaevnet) was formed.

In 1987, the European Parliament set up an organization called Scientific and Technological Options Assessment (STOA) and in the United Kingdom the Parliamentary Office of Science and Technology (POST) was formed. In 1988, the Commission of the European Communities (FAST, DG XII), created the European Network of Technology Assessment at Regional Level (EURETA) but, more formally, established in 1989, the European Parliamentary Technology Assessment (EPTA) network. After long controversies, Germany, in 1989, formed its Büro für Technikfolgen-Abschätzung des Deutschen Bundestages (TAB), depending on the Ausschuf für Forschung, Technologie und Technikfolgen-Abschätzung des Deutschen Bundestages. The TAB is now part of EPTA.

Most of these efforts have been supported by the tirelessness of the Forecasting and Assessment in Science and Technology Programme (FAST) of the Commission of the European Community (D.G.XII). The Commission of the European Communitites is now establishing a European Technology Assessment Network (ETAN), in its fourth framework programme. Other TA Research Centres or institutes include such as the Akademie für Technikfolgenabschätzung of Bade-Württemberg, the Observatoire des Sciences et des Technologies of Paris, the Programme of Policy Research in Engineering, Science and Technology (PREST) in Manchester, the Science Policy Research Unit (SPRU) of the University of Sussex, the MERIT of the University of Limburg, The Netherlands, etc.

Such 'proliferation' is significant of the major interest today in assessing the recent development of science and technology in their multiple dimensions. Things have changed in society: competition between USA, Japan and Europe has provoked a challenge to develop economies built upon the strength of Science and Technology. Choices had to be made. Forecasting was necessary in this matter and there is no forecast of what should be done without assessment of what has been done, how and why.

Over these twenty years, methodological developments have taken place that have been partially reported in papers or reports. Surprisingly, the 'Discourse on the Method' is still on the anvil. Rarely is it explicit. It has to be looked at through the different themes which are tackled. Annex 1 of the First Biennial Report to the European Parliament was one of the attempts to sum up the main trends of methodological issues [2]. It enumerated nine typical methodologies of TA studies:

- literature reviews
- trends analysis and comparative time series

- questionnaire and personal interview
- case studies
- pooling of experts opinions, such as DELPHI
- scenarios development
- future shops
- consensus conferences, and finally,
- social experiments in social settings.

Looking at things more carefully, one must recognize that many of the reported studies were handled from a mono-disciplinary point of view. Does it mean that the idea of TA was not clear for everybody? That is the least one could say. Some were speaking about 'impacts of science and technology on society'. Others were looking at science and technology trying to anticipate some of their potential negative effects; others stressed the risks of their development. Unfortunately, many of these approaches considered science and technology as 'black boxes', without acknowledging that science and technology are social constructs. Intrinsically, both are not societally neutral nor are they without effects and consequences on society. Eight different functions of TA have emerged from the first European Conference on Technology Assessment (ECTA 1), in Amsterdam (1987):

- reinforcing the position of TA in the decision process
- supporting the short-term and medium-term policy of the government
- contributing to the development of the long-term and future governmental policy
- early warning
- broadening knowledge and decision-making
- tracing, formulating and developing socially desirable and useful technological applications
- promoting the acceptance of technology by the general public, and finally,
- advancing scientists' awareness of their responsibility to society [3]

The relationship between these nine methods and eight functions has also been suggested to promote further theoretical progress [4].

To clarify the ideas, let us give a first approximate definition of what TA is. FAST's first synthesis report drew attention to the conditions of innovation as follows:

> "One may say that the societal impact of a technology, in its dynamic and in its final result, depends upon the interaction between four sets of factors: scientific and technological, logical, economic and industrial, social and institutional." [5].

According to Petrella, TA may be defined as:

> "...the set of procedures and means that a society gives to itself in order to understand the nature and the issues at stake of scientific changes, of development, and of present and potential uses of technology, and in order to assess its economic utility and feasibility, and its social and political value and relevance, in the short- and long-term" [6].



In the same 'FAST culture', we have tried to show that there is no innovation without consideration of, at least, a three-dimensional perspective: scientific and technological, economic and organizational, social and societal. We have called it the 'Technology Assessment Triangle' [7].

In those conditions how could TA methods be 'mono-disciplinary'? They must, at least, link in the representation, the different features that define its approach. Inter-discplinarity is a necessity, but this has still to be done!

Let us first examine in more detail the results of the TA methodological reflections, to measure their strengths and weaknesses. We shall then suggest a new approach that could enable us to meet better the specific features of Information Technology Assessment.

## 2 The evolution of methodological preoccupations throughout TA's history

When speaking of methodologies, we cannot ignore a more fundamental question of the *ultimate goals* of TA. Such discussion has inevitably a direct or indirect influence on the choice of adequate methodology.

By way of introduction, we briefly recall the principal steps of the debate in the International TA Congresses [8].

At the First TA International Congress at the Hague in 1973, there was a discussion between the 'reductionists' and the supporters of 'holistic' TA. The reductionists supported 'neutral' scientific work, independent of all political constraints, while the 'holistics' preferred a far more participative approach, in which the actors' interests, norms and values had to be taken into account. In 1976, during the Second ISTA Congress in Ann Arbor, a so-called 'new TA paradigm' progressively emerged: TA had escaped from the scientific ivory tower and reached the level of policy. According to Christakis *et al* [9], this new TA paradigm influences four levels of TA work: the philosophical, epistemological, methodological and procedural [10]. More precisely on the methodological level, let us point out a series of *shifts* that accompany the transition from the traditional TA paradigm to the new one:

- first, technology is no longer considered as an independent factor, but closely connected to the evolution of society
- likewise, it becomes clear that there is *not just one TA model* (in the same way as there is not just one for institutionalization or for organization)
- consequently, no specific methodological strategy seems to have prevailed over another.

Qualitative analyses are adopted in combination with classical quantitative analysis. Otherwise, it has been made clear that the various actors support the methodologies that fit in best with the goals that they are pursuing (for example, business enterprises often prefer cost-benefit analysis, in order to predict the negative effects of a technology, while 'participative methods' are supported more by unions or users' groups,...) [11].

The conceptual and methodological discussion was increasingly present in the later TA Congress (Bonn 1983, Amsterdam 1987, and Milan 1990). Thus, Smits and Leyten [12], in a systematic way, proposed a comparative table (See Table 1) showing the differences between the traditional idea of TA and the new one.

**Table 1** Comparative chart between traditional and new concepts of technology assessment

| *Traditional concept of TA* | *New concept of TA* |
|---|---|
| Dominant role of science | Equal role for researchers and users |
| High expectations as regards the potential of research | Modest expectations as regards the potential of research |
| TA outputs = study report | TA output = study report + discussions ensuing from study results |
| Little attention given to problem definition | Much attention given to the formulation of the problem definition |
| One TA research organization | Multiform TA research capacity |
| Instrumental use of information in a rational decision-making process | Conceptual use of information in decision-making process dominated by political consideration |
| TA results are automatically incorporated in the decision-making process | Much attention given to the attunement of the TA process to decision-making |
| Technology is an autonomous process | Technology is the work of man |

As can be seen in Table 1, the idea of a neutral and unique TA approach seems to have been definitely abandoned in favour of approaches that are more focused on partnership and *dialogue and consultation.* As a result, the *position* of TA researchers is changing perceptibly, from assessment to a *mediation role,* between the policy makers and the social groups involved in a technological debate.

To operate the new form of TA, we, and others, proposed the use of a tool called the 'social map', which aims at identifying the various categories of actors directly or indirectly involved in the technological innovation. In other words, on a procedural level, more attention was due to the development of *public participation* processes, considered as 'social learning processes'.

Since 1989, the University of Namur Research Unit in TA (CITA), had the opportunity to test these approaches through specific researches within the field of Information Technology Assessment. The realization of the tasks has led to many interesting results, but also to some conceptual and practical difficulties, which we discuss in detail later. At present, let us question Information Technology and its typical features.

## 3 Information technology as a revealing field for renewed TA approaches

In the new TA paradigm, the character of Information Technology (IT) is revealing from two points of view:

- the type of innovation that Information Technology is, and
- the nature of the technology itself.

Let us first recall briefly that economic studies on technological innovation suggest a *taxonomy* of technological changes for four types [13]:

- the *incremental* innovation, regarding the improvement of existing technological products or processes or production. This kind of innovation may be found in industrial activities such as steel industries or oil refineries, for instance.
- the *radical* innovation, consists of discontinuous events, in comparison with incremental innovation, that occur more or less continuously. This radical innovation may take place in different domains: new materials such as nylon, or new consumer products such as video recorders; it is, however, still located in a given economic sector.
- the *new technological systems* concern 'constellation' of innovations that are technically and economically inter-related (for example, the clusters of innovation in synthetic materials and petrochemical industries).
- the *techno-economic paradigmatic* innovation (also called by economists 'technological revolutions'), which, according to Schumpeter's long wave economic theory, appears like 'creative gales of destruction'. This innovation is diffused in the whole economic field, and is changing the conditions of production and distribution throughout the system. Some historical examples of the 'technological revolutions' are the introduction of electric power or steam power.

According to Freeman and Soete, Information Technology belongs to the fourth type of innovation; it concerns our everyday life, is managing our work organization and consumption habits, changing our perception of time and space, etc. This diffusing character of Information Technology calls for adaptation of concepts and methods in assessment.

The paradigmatic technological innovation also leads to widespread *structural adaptations* in institutions and organizations. As Perez remarks [14], one required condition for the economic boost is a 'good match' between the techno-economic innovation and the socio-institutional context. Reciprocally, periods of economic depression occur when there is a mismatch between the new techno-economic paradigm and the institutional climate. Consequently, a paradigmatic technological innovation must also be considered as a *social innovation,* calling for widespread social *consultation and dialogue.*

As far as the second point of view is concerned, the nature of Information Technology, we would follow the very interesting development of Weizenbaum [15] who describes computers as *abstract machines.* Weizenbaum says that we have to establish a distinction between 'physically embodied machines' and 'abstract machines', the latter existing only as ideas. The laws that govern physically embodied machines must strictly obey the laws that rule the real world, while the laws that rule abstract machines are less constrained.

As Weizenbaum observed,

> "One may, for example, design an abstract machine whose internal signals are propagated among its components at speed greater than the speed of light, in clear violation of physical law. The fact that such a machine cannot actually be built does not prohibit the exploration of its behaviour. It can be thought about and even simulated on a computer. (...) The computer is of course a physically embodied machine and, as such, cannot violate natural law. But it is not completely characterized by only its manifest interaction with the real world. (...) The game the computer plays out is regulated by systems of ideas whose range is bounded only by the limitations of the human imagination. The physically determined bounds on the electronical and mechanical events

internal to the computer do not matter for that game..." [16].

One can the realize that computers are able to create 'artificial worlds' in which they are the sole legislators [17] and, as said before, they are increasingly modelling our representation of time and space. In other words, they constitute an abstract tool of *reconstruction of social reality*. However, may we say that there is a unique representation of social reality that satisfies everybody? Assuredly not, and therefore we may say that the ITA work has to deal with the question of social *negotiation* and political *choice.*

It is because IT is a *representation tool* (Weizenbaum uses the words *autonomous* tool, i.e. a tool that runs 'by itself' according to the 'law' that it has been given), rather than a prosthetic tool, that ITA provides the opportunity of discussing its relevance. As said before, TA is questioning the relationship between technology and society. Neither technology nor society is a black box: they have to be examined in detail. Economic or organizational factors may influence some of the features of the anticipated technology as well as some technological features possibly affecting societal perception. ITA reveals itself as potentially determining the appropriate design processes, which include both users and technology. Everything, as mentioned in the present day literature, appears as a question of *interface.* Not as an interface where the technology would embody by itself the users' requirements and impose its intrinsic determinism upon us, but as an interface, which progressively emerges from the spectrum of the technological potentialities and from the users' needs.

ITA may thus represent an opportunity for the transition from a *reactive* TA – which principally aims at avoiding negative effects of a technology, to a *proactive or constructive* TA, i.e. a TA process considered as an integrated part of the technology policy.

A major challenge for TA practitioners, in the question of social negotiation, is their ability to inform correctly and on *time* all the parties involved in a technological innovation. In this way, one of the most difficult problems to be solved is the so-called 'time lag' phenomenon.

> "In the early stages of development of a technology, when most of the trajectories are still open, very little can be said about its impact on society. In the later stages, when technology is entrenched throughout machinery, products, routines, norms, ... the social implications are clearer, but, unfortunately, it is also often too late for influencing the development of technology itself." [18]

In these later stages, it is often too late for people to take part in the debate and to discuss the orientation of the technology policy. However, this rather pessimistic statement about the 'time lag' phenomenon may be nuanced in the field of ITA. As observed:

> "... studies have shown that IT has become programmable and negotiable. Undeniably, in the production processes or in the computer and work domain, technologies have become more flexible and participate in a process which allows them to be included in human-oriented or 'anthropocentric' (human-centred) devices. Moreover, some studies on ergonomics show that the features of most advanced IT are characterized by human and organizational representation so that technological determinism is considered as outdated, giving way to human choice." [19]

In fact, some European TA experimentation has already taken place within the new framework. Examples are research by NOTA, in Holland, in STV and FTU projects in



Belgium [20], the 'Mensch und Technik' programme in Germany, and the social experimentations carried out by the Danish TechnologiNaevnet. We have ourselves tested the TA paradigm through specific examples, such as the case of Health Cards, the Electronic Data Interchange, or more widely, the problem of public participation in science and technology decision making. In these studies, we focused on the role of *social controversies* that, in our opinion, constitute the core of the debate. The main statements issued from these works are now reported in the next section.

## 4 Methodological proposal

The main aim of our approach is to make explicit the social controversies of a technological innovation. This means that the research will not emphasize the consequences of a technological implementation, but rather the social, economic and political dynamics which institute and accompany the technological innovation. Therefore, a first deal for the researchers will consist of a 'good' *problem formulation* i.e. a good *representation* of the problem.

For example, the use of Computerised Health Cards creates social controversy, caused by the legal and ethical need for medical records to be confidential. Regarding this point, the research will have to make clear such questions as: who strongly insists (and who plays down) these requirements and for what reasons? Moreover, is the question of confidentiality relevant in the debate on Health Cards or is it just an 'alibi', and for what other purposes?

Electronic Data Interchange (EDI) may be another illustration. In this matter, the question of standardization is a central issue. Some examples of social controversies to be explored are:

- the opposition between the concept of a universal message standard developed by some international organizations and the development of proprietary standards by some firms or specific sectors, and
- opposition between a managerial and institutional project of a global open market, made possible by a same technology and a common language and the organization of some markets in very closed and specific nets.

In a more practical way, during our investigations into social controversies, it is suggested that *five principal tasks* have to be carried out.

1. A first task, using classical tools such as interviews, critical analysis of documents, reveals the conflicts between the *various social perceptions* and *representations* of the technology.

   Thus, in the case of Health Cards, we have noticed that this technology has *different meanings* according to the social groups involved. One group may consider it as a tool for the improvement of the doctor's practice, a portable medical record for the patient, an essential device in case of emergency. By contrast, another group may see it as an expensive and useless device, an imposed technological product, in other words, 'a solution looking for a problem', etc.

   Part of the management, on the one hand, sees EDI as a business necessity: a tool

that aims to diminish administrative costs and gives an economical advantage to the leading enterprises. On the other hand, EDI represents an important investment and an entry barrier to some markets. For national or international trade organizations, EDI is perceived as a means to reach an open electronic market, or an occasion to facilitate international trade.

2. The second task would be a *thorough description* of all the controversies, concerning the choice of technology.

   This approach calls for *interdisciplinary* work that involves two levels of reflection. First, an understanding of the technical discussion: for example, what are the advantages and the constraints in using a micro-processor card, in comparison with a more classical magnetic strip card? What is the technological reward of message standards in EDI? How to know the cost for a user to treat with various incompatible standards in its business transactions? Second, a larger debate on the social, economic and legal aspects generated by the technological option. The comparison of these two levels of reflection should allow us to broaden the scope of discussions, which are too often limited to the domain of experts' reports.

   In more concrete terms, a useful tool for the interdisciplinary research team would consist in the keeping of a *diary*, recording the evolution of the debates throughout the TA study. Another interesting device would be the establishment of an inter-disciplinary *'TA-Basics'* [21], summarizing the theoretical and empirical foundations of TA, the main results of European TA research and reflections on methodologies and tools. An outcome of this work might also be, for example, a text-book called *'TA, mode d'emploi'* ('TA, users' guide'), addressed to public authorities, enterprises, unions, researchers, or any social group interested in the realization of a specific TA process.

3. A third task within the analysis of controversies would consist in drawing up *'social maps'*.

   Such maps would give them as complete an *overview* as possible of the parties involved (and consequently the missing actors), the way in which they are or will become involved, their interests, norms and values [22], the decisions they have to make and the information they need about the technology. Moreover, a social map has to make clear from what point of view some particular TA research is developed, or in other words, to make explicit the scientific and social interest of the researchers themselves. Otherwise, the map must be regularly *updated* during the TA process, noting possible changes in actors' alliances, the evolution of the technology, the change of socio-economic context, etc.

   For example, in our research on the Computerised Health Cards, a social map has revealed the role of some European institutions and national authorities in the promotion of the card technology. These actors are, among others, the AIM Programme [23] of the Commission of the European Communities (to give an impulse to European informatics enterprises faced with the competition of American and Japanese companies), or the French government who wants to promote the micro-processor technology, a French innovation. On an economic level, the implementation of a computerised health card could also interest the *Social Security* authorities whose main objective is to reduce the health costs. Another, and not the least important actor, is the national *Medical Order,* which insists on medical secrecy and argues that medical information must remain under the strict control of physicians. In these debates, it has also to be noticed that the missing actors are often the *patients.* More generally, the consequences of using the health card, remain unknown to citizens who are concerned with their own health.



Concerning the definition of EDI message standards, and especially the question of their universality or specificity, we can design a social map of the actors involved in the controversy. Firms of the private sector are directly concerned, but only some of them are aware of the possibilities, and their expectations about standards vary according to the existing standards in their activity sector and the specificity of their interchanges with other firms. The sectorial organizations, at national and international levels, also play an important role in the diffusion and definition of standards, defending the specific commercial practices of their activity needs. Some public institutions are also engaged in the process, as *Customs,* for instance, which have played an important role in the development of international standards. The Trade Working Group, of the European Union, has developed a 'universal approach to standards', aiming at an open trade community, including countries outside Europe. The European Community supports this approach, through the TEDIS Programme, which aims at promoting the competitiveness of European firms.

4. The three first tasks focus on *active* social groups involved in a technological implementation. However, it seems to us that TA work has also to take into account a larger question, the *re-appropriation* of the technology by the *whole society;* to operate this objective, a fourth task should be carried out, consisting of:

   - building up *alternative scenarios*, and
   - promoting the concrete *public participation* processes (the latter, in our opinion, being an integrated part of a TA methodology).

   The *scenarios building work* is based on a set of hypotheses, drawn from the three previous tasks. The scenarios would describe alternatives concerning technological development, to clarify the social debate. These alternatives would be evaluated with *reliability* and *feasibility constraints* and *implications* for the involved social groups.

   The different users of TA, such as parliaments, executive authorities, professional groups, workers and unions, researchers and users' associations, will impose an extreme *variety of demands* on scenario building, which will have to be taken into account. Consequently, the scenarios must meet these different needs adequately, in *content* and *formulation.*

   For example, in the field of Computerised Health Cards, the scenarios would help people to understand various problems, including:

   - the financial impacts of a generalized use of the card, at a national and European scale, and the consequences on the organization of health systems
   - the evolution of the notion of medical secrecy
   - the redefinition of the doctors' roles and professional skills, and

- the explication of the epistemological basis underlying their diagnosis and therapeutics formulation.

Scenarios were constructed, describing the evolution of standardization, in the field of EDI, and their elaboration and study, for their feasibility, helped us to clarify the issues of entry barriers, needs for organizational adaptations and isolationist effects.

Looking now at *public participation,* let us first note that this idea has already been advocated in the early '70s, at the time of the nuclear controversy. It has led to some interesting experimentation and to many deceptions, but has never completely disappeared from the people's mind (perhaps simply because public participation is dealing with democracy, a never out-of-date preoccupation). During the last TA International Congresses (Bonn 1982, Amsterdam 1987, and Milan 1990), the concept again came up in the discussions, with stronger attention given this time to the practical aspects. The third European Conference on TA (ECTA 3), in Copenhagen, was entitled 'Technology and Democracy'. The TA method of Consensus Conference shares this preoccupation of involving the public [24]. At stake in this debate is the issue of public participation in the socialization of TA, i.e. "a situation where the function and the practice of TA has become an integral part of the decision making and choice processes related to technological development, be they public or private" [25].

Publication participation can be seen as a "social learning process" that stimulates a continuous dialogue between all the parties involved. The objective of this confrontation is not to produce a consensus, but rather to clarify all the *values* and interests supported by the different groups. Indeed, values and facts may hardly be separated, but TA should make values as explicit as possible. In this way, public participation can help to identify new issues, provide valuable inputs for the TA approach, and broaden the scope of discussion. However, as it has been recalled, setting up public participation remains, for many reasons, one of the most difficult parts of a TA programme.

The first reason is that the goals of a public participation process are not always clear. Should it serve as an input for the TA research (new information, expression of social needs, alternative views, ...)? Should the public discussion lead to a public choice between the various options presented in the report? Should the results of the public debate be presented to decision makers, and what can we expect from this action?

Another difficulty is the *definition* of the so-called 'public' and 'interest groups'. Is it possible for the general public to be involved in every question regarding science and technology? If not, who are the 'concerned' groups? Are they recognized as being legitimate by those they claim to represent? More particularly, this problem may become extremely acute in the case of a Constructive TA approach, where the definition of the partners plays a major role, and where the users' groups have to be legitimate and powerful.

A third, and no less important reason is the question of the TA researchers' *credibility* and *legitimacy* facing the decision-making pole. As was noted during the Milan TA Congress, there is still a gap between the research results and their use by the decision makers. Regarding this point, one difficulty lies probably, as it has been



mentioned before, in the inadequacies between the research output and the various demands from the TA potential users.

On a procedural level, there are also many difficulties in organizing a public participation process. Thus, in a research we carried out in 1990, related to 'the public participation in the field of science and technology decision making' [26], we pointed out a series of major *obstacles,* including:

- the complexity of our contemporary technological systems (involving sophisticated knowledge and intricate social organizations)
- the lack of time for informing the population correctly before the discussions
- the deficiency of institutional places for the public debates and, at a more profound level,
- the educational and social inequalities between the citizens faced with science and technology [27].

5. Our fifth task, following the four preceding ones, is tackled at a more empirical level, by carrying out thorough *case studies* or, in a more active way, by setting up *social experimentation* in partnership with actors directly involved in technological development.

For example, CITA is collaborating with the Haematology Department, of a large hospital in the Region, to implement a micro-processor card for patients suffering from blood diseases; this will enable us to test, in a concrete and active way, a Constructive TA approach that corresponds to the theoretical and methodological views we uphold and presented above. The work involves a series of conceptual and practical challenges, including:

- a clear definition of the aims pursued by each party (the physicians, the TA researchers, the patients, etc.)
- a balance between the technological objective and the TA work, and
- a 'good' understanding of the researchers' position in respect of the medical doctors' needs, etc.

All these difficulties may, in our opinion, arise in any other Constructive TA approach.

Let us summarize our five tasks:

- Establish the various social perceptions and representations of the technology;
- describe all controversies related to the choice of a specific technology;
- draw up the 'social maps' in determining the different actors and their objectives and interests;
- build up alternative scenarios and involve public participation;
- develop case studies or social experimentation.

In a way, these five tasks are also five steps where TA researchers are involved, but their

commitment is different from one step to another. In the first task, most of the time each researcher is bringing his or her own disciplinary view; together they trace a cliché of the state-of-the-art, but which already presupposes a first perception of the study they have decided to undertake together. The ideal is to specify the hypotheses around a problem, or to raise the most important questions as they can be seen at that moment. The description of the controversies is not only a 'social game', it reveals the components of what we called earlier the 'couple Society-Technology'. It specifies the issues at stake, the tensions, the interests, the organization (societal pole) as well as the genesis of the technology and its normalization (technological pole). It is time to open the 'black boxes', both societal and technological.

The third step is the time of full inter-disciplinarity. Researchers representing both poles of the duality are more and more interacting, trying to understand how a component of one pole, for instance, may affect a component of the other. It is the time to establish the possible interactions as well as the nodes or bottlenecks. On this basis, it becomes possible to build up different alternative scenarios, according to the choices that can be made. It becomes also possible to enumerate anticipated positive and negative impacts and consequences of such or such choice. The step of scenarios building allows to examine the 'technological as well as societal possibilities', to enlighten the potential dysfunctions related to specific objectives, etc. The public participation enlarges the scope and 'socialises' the process.

Finally, case studies and social experimentation give the opportunity of testing the scenarios, which are taken into account.

When we speak of 'researchers', we would not like to emphasize too much the scientific discourse. Those 'researchers' may include and, preferably, would have to include actors. They are also themselves to be considered as actors. The constructive TA tries to build up scenarios with the different participants, actors, technological systems designers, developers, industrialists, users, effected people (the so-called 'usees'), etc. If we have used the term 'discipline' it was to stress the necessity of a rationality that allows the consultation and the dialogue.

## 5 Conclusion

Throughout this brief historical, conceptual and methodological analysis, we have tried to make clear the specific implications of a 'new TA paradigm' development, in underlying the transition from TA 'scientific and neutral' work to a 'participative' research process. Within this renewed TA approach, we have shown the enlightening character of Information Technology, considered as 'paradigmatic innovation' and 'abstract machines'. More precisely, we have pointed out the 'holistic' and diffusing character of this technology, and the possibility for it becoming 'negotiable'. As a result, much of our research in the field has focused on the question of social controversies and political choices. Our researches have also given us the opportunity to test the relevance and the effectiveness of some methodological tools that, in our opinion, could be useful for a renewed TA approach. Also, our reflections have been built up progressively on empirical work: in this sense, they must be constantly improved.



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**20** An interesting TA method – called 'Social Prospective' – has been developed by the Foundation Travail – Université) (FTU), more centred at the level of the firm and on the workers' involvement. See Valenduc, G. and Vendramin, P., 'La prospective sociale: une méthode d'évaluation des choix tehnologiques, in: *Technologies de l'Information et Société* (TIS), Paris, Dunod, (1992) 4 (4), pp.457–472.

**21** cfr Smits, R., *State of the Art of Technology Assessment in Europe, op. cit.*

**22** It is interesting to note that the preoccupation for values and ethics is becoming more predominant amongst the computing community. The development is particularly significant in the International Federation for Information Processing (IFIP). See Berleur, J. and Brunnstein, K. (eds.) (1995), *Ethics of Computing: Codes, Spaces for Discussion and Law,* A Handbook prepared by the IFIP Ethics Task Group, London: Chapman & Hall.

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**25** See Petrella, R., 'Les enjeux du Technology Assessment', art. cit.

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**27** For these questions, cf. for example the work of Fourez, G. on Science-Technology-Society, University of Namur, Belgium.