

ON STANDARDISATION AND TECHNOLOGY ASSESSMENT IN IT

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Abstract: The paper argues that a closer look at standardisation in the IT domain would be extremely beneficial for pro-active approaches towards Technology Assessment (TA). The paper first provides some necessary background information on the apparently separate disciplines of standards research, the social shaping of technology, and TA. This is followed by an initial proposal for how TA could use standards setting as a starting point for assessment, and indeed, active shaping of technology. It turns out that the standards setting process exhibits many characteristics required specifically for Constructive Technology Assessment.

Keywords: Information technology, standards, standardisation, social shaping of technology, technology assessment.

Introduction

"Standards are not only technical questions. They determine the technology that will implement the Information Society, and consequently the way in which industry, users, consumers and administrations will benefit from it."

You can hardly put it more to the point than this quote taken from a document published by the European Commission (1996). Information Technology (IT) will have a profound impact as the major enabler of the move from an industrial society to an information society, and a knowledge economy. Yet, this transition will only take place reasonably smoothly if adequate standards for IT systems are in place, which take into account not only the technical aspects, but also the characteristics of the specific environment within which they will have to function. That is, social, policy, and administrative aspects, among others, will have to be considered as well.

Yet, IT does not exactly seem to be in the focus of Technology Assessment (TA) activities; at least not in Europe. This comes as a bit of a surprise given the degree to which IT has been altering many aspects of our daily lives (for better or worse).

TA analyses typically take as their starting point technical artefacts and systems that have already been implemented. However, at least in case of networked systems – such as IT systems – it would certainly make sense to have a closer look at the actual origin of a technology, i.e. its design stage. Whilst this may be next to impossible for proprietary developments, the work done within standards bodies' committees and work groups is pretty much open to external analysis.

IT standardisation itself represents a form of technology assessment. At least implicitly IT standards include statements about e.g. economic and societal

implications of the technology they specify. And by their very nature they frequently establish trajectories which future developments are virtually forced to follow.

The paper will first provide some necessary background on standardisation in IT, on the Social Shaping of Technology, and on Technology Assessment. This will be followed by a discussion of how an integration of these distinct domains may contribute to an improved forecasting of future technological developments.

Setting the Scene

This chapter will provide some background information on the different domains this paper attempts to integrate. That is, it will provide some general background – and maybe even food for thought – about IT standards and standardisation. It will also look briefly at the concepts that form the basis for Social Shaping of Technology (SST), and how they may be applied to standardisation. Then, some of the main ideas of Technology Assessment (TA) will be presented, with a focus on Constructive Technology Assessment (CTA).

IT Standards – Some General Thoughts

Even if we disregard social, moral and religious rules for the moment, standards – in a very general sense – have been with us for quite some time: about 5,000 years ago the first alphabets emerged, enabling completely new forms of communication and information storage. Some 2,500 years later, the first national, coin-based currency, invented by the Lydians, established the basis for easier inter-regional and even international trading. The industrial revolution in the 18th century and, more so, the advent of the railroad in the 19th century resulted in a need for technical standards, which was once more reinforced when mass production generated a demand for interchangeable parts. In parallel, the invention of the electric telegraph in 1837 triggered the development of standards in the field of electrical communication technology. In 1865 the International Telegraph Union – to become the International Telecommunication Union (ITU) in 1932 – was founded by twenty states. The other major international standards setting body, the International Organization for Standardization (ISO), was established in 1947.

‘Standard’ and ‘standardisation’ are tricky terms. They are even trickier when it comes to information technology. Think about it for a minute – what exactly establishes a ‘standard’? Is a specification rubber-stamped by one of the ‘official’ standards setting bodies a standard? Or is the degree of usage of a system or a product the decisive factor – is, for instance, MS-Word a ‘standard’, or SAP/R3? Do industry consortia actually issue ‘standards’? And what about the Internet – are the RFCs published in the STD-series standards? Ask any three people and the odds are that they will come up with at least four different opinions.

One such opinion (in fact, mine) would be that a standard is

“A publicly available definitive specification of procedures, rules and requirements, issued by a legitimated and recognised authority through voluntary consensus building observing due process, that establishes the baseline of a common understanding of what a given system or service should offer.”

This definition restricts the scope of what is colloquially referred to as a standard in three ways: firstly, it includes only base standards (the 'baseline'); as opposed to functional standards or profiles, which rather more address implementation issues. Secondly, it limits the sources from which a standard may emerge to 'recognised authorities', i.e. those organisations typically and commonly referred to as 'Standards Development Organisations' (SDOs). In particular, this excludes specifications issued by industry consortia (most of which are also excluded through the required characteristics of 'voluntary consensus' and 'due process'). Finally, as standards are said to be established 'through voluntary consensus building', this definition also excludes legislation from being seen as standards.

These days, a web of SDOs, i.e. the likes of e.g. ISO and ITU issue what is commonly referred to as 'de-jure' standards – although none of their standards have any regulatory power at all. Likewise, a plethora of industry fora and consortia (a recent survey found more than 250), such as, e.g., the WWW consortium, the ATM forum, and the Open Group, to name but a few of the longer standing ones, produce so-called 'de-facto' standards.

As a result, there exists an almost impenetrable maze of what is generally called 'standards', ranging from company specific rules, over regional and national regulations, up to globally accepted standards. Moreover, one may distinguish between different types of standards: there are voluntary, regulatory, de jure, de facto, pro-active, reactive, public, industry, and proprietary standards; this list is by no means exhaustive.

Every IT system, from the most complex corporate infrastructure of some globally operating company down to the humble PC on the desk back home incorporate and observe scores of standards. There are standards for operating systems, programming languages, user interfaces, communication protocols, disk drives, cables and connectors, etc etc

In fact, these systems not just implement standards, they are actually shaped by them to a considerable degree. If you stop and think about it, you will realise the enormous importance of IT standards for businesses, and even for the individual. Yet, standardisation still appears to be the most under-estimated and under-valued activity in the realm of IT. Typically, it is considered a necessary evil at best, and unless a company has really strong business interests in a specific sector it can hardly be bothered to actively contribute to standards setting at all.

The desire to make sure that the 'right' standard emerges normally lies at the heart of stakeholders' involvement in the standards setting process, be it in the 'official' process or in consortium-led activities. Yet, what exactly characterises the 'right', or at least a 'good' standard is far from being clear. One author associates a good standard with the attributes 'speed' and 'meet technical requirements'. Whilst these characteristics are valuable for winning stakeholders' support, this is a surprisingly narrow focus. Clearly any technical specification should meet technical demands, the issue of speed, however, is popular, yet questionable. Moreover, meeting organisational and, particularly, societal requirements should clearly play a role in standards setting as well. Regrettably, though, trying to prevent standards from coming into being may also be a motivation for participation.

Standardisation may thus be seen as an interface between technical and non-technical (e.g. economic, organisational or social) considerations. Standards are not

only rooted in technical deliberations, but also result from a process of social interactions between the stakeholders.

Social Shaping of Technology

Technological artefacts in general, and especially such powerful representatives as IT systems, will exert a potentially strong impact on their environment. Complex interaction can be observed, where technology may assume both an active and a passive role; that is, technological artefacts and their environment are mutually interdependent. The environment within which technology is used and employed has, among others, social, cultural, societal, and organisational behaviours, rules and norms. It is clear that technology cannot emerge completely independent from such external influences. However, the impact IT may have on organisations, or indeed society as a whole, has thus far attracted considerably more attention than the powers that shape this technology in the first place. Especially the impact of IT within organisational settings (e.g. on a company's performance, or its role as an enabler of business process re-engineering) has been subject of a vast number of studies and analyses. Keywords such as 'management of change', 'technology management' and 'organisational transformation' can frequently be found in the literature, typically denoting studies on how the introduction and subsequent use of IT have changed a particular organisational environment – for better or worse. Only comparably recently has the reverse direction of impact been studied, i.e. the one exerted from organisational and societal conditions on technology.

Two mutually exclusive schools have dominated research on technology and organisations until the early eighties (and are still in evidence). Proponents of the 'organisational choice' model consider technology as a vehicle to both reflect and foster the interests of particular groups; the process of change can be, and indeed is, shaped entirely by policy makers or an organisation's managers; these actors have unlimited technological choices. *"Technology has no impact on people or performance in an organisation independent of the purposes of those who would use it, and the responses of those who have to work with it"* (Buchanan, 1985). In contrast, 'technological determinism' in essence postulates that IT determines the behaviour of organisations, that the consequences of manipulating a given technology will always be the same, independent of who manipulates and within which context. It follows that, according to this view, organisations have little choice but to adapt to the requirements of technology; particular paths of technological development are inevitable; like organisations, society at large also has no other choice but to adapt (Williams, 1997).

Research into the social shaping of technology (SST) largely emerged as a response to technological determinism. SST adopts a middle course between the two older approaches, acknowledging that technology indeed has an impact on its environment, but that at the same time it is well framed through technical, but rather more through e.g. organisational, societal, cultural and economic factors. In particular, SST attempts to unveil the interactions between these technical and social factors (Fleck, 1995). Abandoning the idea of inevitable technological developments implies that choices can be made regarding, for instance, the acquisition, the use and particularly the design of technological artefacts. There may be a broad variety of reasons upon which these choices are based. In an organisational context this may

include purely technical reasons, as e.g. the need to integrate legacy systems, but decisions may also take into account company particulars, as for instance organisational or reporting structures. These choices, in turn, may lead to different impacts on the respective social or organisational environments. Thus, studying what shaped the particular technology offers a chance to proactively manipulate that very impact expected to result from this particular choice. At the same time this capability should also contribute to the prediction – and thus prevention – of undesirable side effects potentially resulting from a new technology. After all, technology tends to have other effects besides those actually intended, and these effects need to be explored as well. On the other hand, the respective environment shapes technical artefacts and systems during design and in use, i.e. at the site of the actual implementation.

The different factors and entities that shape technology and innovations include (but are not limited to):

- The context from which the invention emerges, including
 - designers' views,
 - vendors' preferences and strategies.
- The environment where it is to be implemented, including
 - work and organisational actualities,
 - end-user attitudes,
 - managerial guidance,
 - successful co-operation between stakeholders,
 - adequate innovation potential.
- External forces, including
 - advances in science and technology,
 - prevailing societal norms,
 - legislation.

This list includes a diversity of influencing factors, represented by stakeholders with different backgrounds, perceptions and interests. I would argue that a similar environment may be found in a standards setting committee.

Shaping Standardisation

Technological artefacts embody, and thus transfer, their respective environment of origin. The same holds for standards, which result from work in a working group or committee. This alone implies that adaptations will subsequently be required if a system is to be exported to other markets, or user organisations, with different environments. *“The shaping process begins with the earliest stages of research and development”* (Williams, 1992). This observation points to a direct link between the shaping of a technology and standardisation activities. Especially since the advent of pro-active standardisation technological systems have increasingly been rooted in standards activities. In fact, the shaping of technology needs to start here.

Standards emerge through the co-operation and joint efforts of different individuals in technical committees and working groups. Whilst in theory these individuals act in their capacity as ‘independent experts’, their views, beliefs, and prejudices have to a considerable degree been shaped by the environment within which they live and, especially, work. That is, various factors that may shape

technology are also likely be channelled into the working groups of the international standards setting bodies. The corporate environment of the group members' respective employer, for instance, will have a major impact on the different visions of how a technology should be used, and the ideas of how this can be achieved. Therefore, they will also exert a significant impact on the work of the committees. This holds especially in the case of anticipatory, or pro-active, standards which specify new services from scratch, and thus offer the opportunity to incorporate to some (a considerable?) degree the particular presumptions, views, and ideas of the members of the originating committee (and their respective employers).

A reactive standard (i.e. one that basically just rubber-stamps an existing technology) will likewise transpose the environment from which it emerged; this will be the corporate environment (using this term very loosely) of its inventor (i.e. typically a manufacturer or a service provider) who originally specified the system upon which the standard will be based. Thus, this company's visions will implicitly be embodied in the standard specification, together with the ideas and views of its representative(s).

Technology Assessment

The deployment of a new technology implies the risk of unwanted, and possibly harmful, side effects. Likewise, with technology becoming increasingly important the ability to predict and assess future technical developments is becoming equally important for both companies (to be able to compete and indeed to survive) and governments (to interfere or enable, and to take appropriate legislative action). Technology Assessment (TA) for the legislature was institutionalised in the US in 1972 (through the foundation of OTA, the Office of Technology Assessment), and subsequently in most Western European states.

A definition used during the early years of OTA expresses the need for pro-active analysis and evaluation of technological choices:

“TA is the systematic identification, analysis and evaluation of the potential secondary consequences of technology in terms of its impacts on social, cultural, political and environmental systems and processes” (OTA, 1976).

The original objective of TA was to provide information – primarily to legislation, and as early as possible – on the likely consequences of new technologies which might have the potential to affect the welfare of their citizens. Thus, TA's major task was to act as some sort of 'early-warning system', with a view towards influencing or altering the trajectory of technological development if deemed beneficial.

Yet, over time it turned out that TA could not meet this expectation. This is primarily due to the complexity and unpredictability of the technological development process. Also, the ever-changing socio-economical and institutional context makes exact forecasting impossible.

It also became clear that it is impossible to do neutral TA. Whilst it is possible to apply objective, value-free processes of research and fact-finding, it is not possible to obtain the value-free information which would have to be the basis of the research. That is, depending on the respective source of information certain values are

conveyed along with the information (whether explicitly or implicitly). As a consequence, the evaluation process is necessarily flawed (UNEP, 1995).

These experiences led to a new approach of considering TA as a process closely linked with technology policy. That is, TA is now considered as a way of helping develop desirable and socially acceptable technologies. To this end, TA has also become a tool to stimulate discussions between the stakeholders of both technology development and technology policy. In addition, TA is seen as a conveyor of relevant information to these stakeholders and to the general public. A definition of TA that reflects this modern concept is:

“TA is a process of analyses of technological developments and their consequences and the discussions related to these analyses” (Smits & Leyten 1991).

An analysis of TA country studies yielded eight functions of TA (Smits and Leyten, 1991; quoted in van Eijndhoeven, 1997; see Table 1):

Strengthening actor positions in policy-making.	Through enlargement of their information basis about scientific and technological developments, political actors can have a greater, more positive influence on these developments.
Supporting short- and middle-term public decision-making.	To obtain executive or legislative power support for implementation problems, evaluation, and, not seldom, legitimisation.
Contributing to long-term policy.	Give information about possible developments and alternatives.
“Early warning”.	To assess, in the earliest possible stage of technological development, the possible problematic and unwanted consequences.
Enlarging the knowledge base.	Supporting societal actors in formulating their strategies for technological developments.
Looking for and developing socially desirable and useful technological developments.	This function has become the baseline of what has become its own "school" of TA practice, called Constructive Technology Assessment (CTA).
Promoting the acceptance of technologies by the public.	
Promoting societal responsibility of scientists.	

Table 1: The functions of TA

Constructive Technology Assessment

The approach of Constructive Technology Assessment (CTA) was one response to perceived shortcomings of ‘traditional’ TA. It emerged primarily in the Netherlands in the mid-80s. Its centrepiece is the idea of managing technology in society. That is, CTA does no longer strive to be an early warning system, but to identify and exploit the opportunities for constructive, active influence on technical development processes. That is, *“CTA is built around the attempt to anticipate effects or impacts of new technologies or new projects with a strong technological component”* (Schot & Rip, 1997).

Table 2 gives an overview of the main TA approaches that may be distinguished.

	Objective	Method	Philosophy
Explorative	Description of technological changes	Mostly quantitative methods	Future is known if technology is known
Reactive	Analysis of impacts of technologies	Analytical (expert opinion)	It is possible to know the consequences of technology
Proactive	Introduce societal elements in analysis	Dialogue & debate (workshops, consensus conferences)	Technology can be positively influenced, if organised as a learning process
Constructive	Analysis of social dynamics of technology	Intervention (deliberation, negotiation)	Stakeholders co-operate to shape technology

Table 2: The main TA approaches (taken from (UNEP, 1995)).

CTA has developed three generic strategies:

- **Technology forcing**
Whereas traditional TA assumes a technology as given and re-actively analyses its potential impacts, technology forcing takes a pro-active stance and attempts to stipulate desired impacts, e.g. through legislative action. Yet, CTA has also realised that other actors may have a significant impact on certain technical developments. These include, for example, large technology users like banks or insurances, and pressure groups.
- **Strategic niche management**
Here, CTA tries to influence the technology developer from the outset, in order to broaden the development process. A typical example would be governmental initiatives to help – e.g. through subsidising – develop alternative energy sources like solar or wind energy. However, care has to be taken to prevent developments that can only survive because of such subsidies.
Learning is crucial in strategic niche management. It will only work if technical experimentation actually takes into account user needs, cultural and societal requirements. This implies that all actors need to learn from each other. Yet, in many cases this just does not happen.
- **Alignment**
Mutual learning processes need a forum where this learning, and related discussions, may actually take place. Stakeholders from both supply and demand sides would meet at these forums and ‘modulate’ developments. It is, however, unclear how such a forum should look like.

Obviously, these strategies must not be considered as isolated from each other. Rather, they are interlinked enablers of the overall goal of CTA, the ‘management of technology in society’.

Bringing Together TA and Standards Setting

The idea of this paper is to look at the role standardisation processes may play for the purpose of technology assessment in IT. From the above descriptions we may

now identify several aspects which suggest that standards setting may indeed be a place for TA activities, particularly those which follow the CTA approach.

To reiterate: CTA aims to actively influence technological developments from its earliest stages. Especially in IT most new systems emerge from standardisation processes (using this term loosely). One of the more noteworthy recent developments here was the move from reactive standardisation, i.e. basically the rubberstamping an existing technology and the elevation of it to the status of an 'international standard', to pro-active standardisation. This is pretty much based on anticipated future needs and requirements, and maybe even on future technologies. That is, standards setting may in fact be considered as the earliest stage of a technical development process. Accordingly, this would be the best place for CTA activities.

CTA's 'technology forcing' strategy aims at applying external pressure on a technical development. It has been realised that this pressure can not only be applied through legislation, but also through other channels. A standards setting body could well be one such channel.

Also, CTA aims at ideally involving all stakeholders in the technical development process (in one way or other). Pretty much the same holds for standardisation, at least in theory. And even in real life we can easily find committees where vendors, service providers, and users jointly develop standards specifications. And we can also identify areas where standardisation is actually driven by large users (e.g. smart cards).

Deep and broad learning is another aspect crucial to CTA. This requires a wide variety of stakeholders to be involved in the design of a technology, and the recognition, and indeed incorporation, of their needs into the systems to be standardised. Pretty much the same holds for standards development. This again suggests that working groups could be an ideal platform for CTA-related activities.

Finally, CTA needs an institutionalised forum for its discussions and its learning activities. Again, a standards committee could well be considered a natural such forum. The committees are all established within a lasting organisational structure (at least those of the formal SDOs). Stakeholders meet there anyway, and the learning activities are an integral, and necessary, part of standards setting activities. In fact, 'consensus conferences', which are a typical tool for CTA, very much resemble a standards committee, with respect to both its task and its make up.

From this brief discussion we can see that standards setting committees or working groups should at the very least be considered as a platform by the (C)TA community. Yet, we must not ignore the potential problems that have to be associated with the deployment of standards groups for CTA purposes. For one, whilst in theory all stakeholders have an equal say in these groups, in practice they are typically dominated by vendors and service providers, respectively. In particular, users are hardly represented at all in many such groups. To make things worse, earlier research (Jakobs, 2001) suggests that the vast majority of the members of these groups are technical people, frequently with significant prejudices towards the participation of non-technical representatives.

There is an undeniable need for further research into the relations between TA and standards setting in the IT domain. Yet, I feel that this idea is most definitely a route that should be explored further.

References

- Buchanan, D.A.; A.A. Huczynski (1985). *Organizational Behaviour*. Prentice Hall, 1985.
- European Commission (eds) (1996). *Standardization and the Global Information Society*.
<http://europa.eu.int/ISPO/infosoc/legreg/docs/96359.html>, accessed March 19, 2003.
- Fleck, J. (1995). *Configurations and Standardization*. In: Esser, J. and Fleischmann, G. (eds): *Soziale und ökonomische Konflikte in Standardisierungsprozessen*, Campus, 1995.
- Jakobs, K.; R. Procter; R. Williams (2001). *The Making of Standards*. IEEE Communications Magazine, vol. 39, no. 4, 2001.
- Krechmer; K.; E. Baskin (2001). *Standards, Information and Communications: A Conceptual Basis For a Mathematical Understanding of Technical Standards*. Proc.of the Second IEEE Conference on Standardization and Innovation in Information Technology (SIIT 2001).
- OTA (eds.) (1976). *Technology Assessment Activities in the Industrial, Academic, and Governmental Communities*.
www.wws.princeton.edu/cgi-bin/byteserv.prl/~ota/disk3/1976/7622/762206.PDF, accessed March 14, 2003
- Schot, J.; A. Rip (1997). 'The Past and Future of Constructive Technology Assessment,' *Technological Forecasting and Social Change*, 54, pp. 251-268.
- Smits, R. and J. Leyten (1991). *Technology Assessment: Waakhond of Speurhond [Technology Assessment: Watchdog or tracker ?]* Kerckebosch Publishers, Zeist, Holland.
- UNEP (eds.) (1995). *Workbook for Trainig in Environmental Technology Assessment for Decision-Makers*.
<http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-5/part3-7.asp>, accessed March 13, 2003.
- van Eijndhoven, J. (1997). *Technology Assessment: product or process?* *Technological Forecasting and Social Change* Vol. 54, No. 2 & 3, pp. 269-286.
- Williams, R. (1992). *The Social Shaping of Technology: Research Concepts and Findings in Great Britain*. In: Dierkes, M.; Hoffmann, U. (eds): *New Technologies at the Outset - Social Forces in the Shaping of Technological Innovations*. Campus/Westview, 1992
- Williams, R. (1997). *The Social Shaping of Information and Communications Technologies*. In: Kubicek, H. et al. (eds.), *The Social Shaping of the Information Superhighways*, Proceedings of International Conference, COST A4, European Commission DGXIII, Luxembourg, 1997.