Technology Assessment in Techno-Anthropological Perspective

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Contents

CHAPTER 1:

Technology Assessment in a Techno-Anthropological Perspective: Some Introductory Remarks

Lars Botin and Tom Børsen

This anthology is a furthering of previous volumes on Techno-Anthropology as an emerging field of research and education. The program on Techno-Anthropology was developed during 2010 and 2011 as an inter- and transdisciplinary program between the humanities, engineering, planning, energy-, health- and biotechnology at Aalborg University in Denmark. The research and educational program has for the past ten years gained reputation as truly concerned with emerging and imminent problems within environmental, climate, health, and biotechnological frameworks. The anthology is building on *What is Techno-Anthropology?* (Børsen & Botin, 2013), *Techno-Anthroplogy in Health Informatics. Methodologies for Improving Human-Technology Relations* (Botin, Bertelsen & Nøhr, 2015), and a special issue of the *Journal For Philosophy of Technology: Techné* on Techno-Anthropology (Wellner, Botin & Otrel-Cass, 2015).

The array of contributions, which are presented in this anthology on Technology Assessment, show how different approaches are present, relevant, and often dependent on the specific problem to which the assessment revolves. This means that constructivist, comprehensive, participatory, and, in some cases, consequentialist technology assessments are presented, dependent on what is at stake.

We, the editors, believe that this convivial being of different technology assessment models is essential, and that the field of Technology Assessment is enriched and enforced by our ethical and value-oriented approach. The inclusion of normative positioning

should be read as the techno-anthropological contribution to technology assessment. We are fully aware of the fact that some of the constructive, comprehensive, and participatory technology assessment models are addressing norms and values, but in techno-anthropological technology assessment (T-ATA) norms and values are fully and clearly explicated as frame and rack for the assessment.

We are also fully aware that ethical and political frameworks for analysing and responding to technological problems and challenges can be risky business because who are we to advice and judge? Therefore, it should be stated from the very outset that our approach(es) is tainted by a certain ethical and political stance where we stress the importance of values like social justice, equity, democracy, protection of the marginalised, and sustainable and responsible action and reflection. This means that liberal-capitalist values like privacy, autonomy, security, and identity, in our opinion, must be complemented with values reflecting the common societal good.

Some historical notes on Technology Assessment

Technology Assessment has been around for the past 50 years, stemming from a decision made by the American Congress in 1972 where a board consisting of six members from the Senate and six members from the House of Representatives created the Technology Assessment Advisory Council which consisted of experts that should assess new and emergent technologies. The panel was under the direct leadership of Congress, and accordingly all became in order to control and manage the hitherto sovereign power of the president on these matters (Grunwald, 2009).

Declaration of purpose:

a) As technology continues to change and expand rapidly, it's applications are

1) *Large and growing in scale; and*
2) *increasingly extensive, pervasive and critical in their impact, beneficial and adverse, on the natural and social environment.*

b) Therefore, it is essential that, to the fullest extent possible, the consequences of technological applications be anticipated, understood, and considered in determination of public policy on existing and emerging national problems (American Congress, 1972).

Point c) and d) is not less important in this case but are too extensive for direct citation. They address the deficiency in contemporary dealings with technological innovation and development, which escape democratic and legislative assessments, and the Technology Assessment Act is meant to install a legislative and democratic unity that can qualify decisions (American Congress, 1972).

It is obvious that the public attention on the use of certain technologies in the Vietnam war – such as the use of Agent Orange in the Vietnamese jungle (Contakes & Jashinsky, 2016) – was a direct cause for this decision. Also the attention on long-term global side effects of insecticides and other chemical and polluting technologies in industry and agriculture (Carson, 2002; Fjelland, 2016) had an influence. From then on, Technology Assessment committees and councils were installed in almost all Western societies.

During the 1970s and the beginning of the 1980s, these committees were mainly made out of technical experts with a STEM (science, technology, engineering, mathematics) background and in many cases also implying sociologists, as was the case in the original American advisory board. They gave advice to political decision-makers based on measurements and consequences of existing technologies in use out in the 'real world'. In the table below, we have tried to sketch out the various phases of Technology Assessment and, as can be seen, the first phase is characterised by a focus on cause-effect and consequences when scientific (and positivist) approaches were standard.

In the 1980s there was a growing awareness of how to involve and embrace the possible social groups and stakeholders that had a share or/and stake in technological innovation and development processes. We, and others, have coined this phase the Constructivist phase of Technology Assessment because it is highly influenced by contemporary STS-studies wherein Social Constructivism was the

governing and dominating paradigm. In comparison to the former Consequentialist approach, Constructivism is characterised by a focus on how to create fora and time for discussion and debate between 'stakeholders', which is a Social Constructivist term. It tries to make way for these debates to take place as early as possible in the technology life cycle. Where prior committees were characterised by scientific and technical expertise, the new Technology Assessment entities were more open towards both the general public and the direct stakeholders themselves, i.e. the producers.

In the past two decades, there has been an increasing focus on how to engage and involve not just stakeholders but also citizens at large in debates on technological innovation, development, implementation, and use. Paradigms like Participatory Design, Citizen Science, Action Research, and Postnormal Science have invoked and claimed an even more embracing and *comprehensive* approach towards assessments on technology, where those that do not have a seemingly direct stake in relation to the technology are also heard and seen.

The movement from a small elitarian expert committee closely tied to political power institutions, like governments, departments, and parliaments, to a broad, encompassing, and often interdisciplinary approach that is only loosely tied to political power institutions has, of course, led to some collateral consequences, which require a different and more radical approach to assessing and evaluating.

Currently, we are witnessing a global orientation towards normative frameworks – e.g. United Nation' Sustainability Goals and Global Compact – that signals the coming of a new era of Technology Assessment that incorporates these normative positions into its very core, and not just attaching them as an add-on.

What we are proposing is a new approach which is conceived within the framework of Techno-Anthropology, and where the relations in between technology, humans, and world are considered intertwined and inseparable. This 'locked' intertwinement does have considerable consequences when it comes to the action of assessing because who or what is assessing what or who? Should we consider our actions and reflections on possible and potential consequences as assessments at all because there is a certain distance and 'objectivity' in the concept, although it cannot be embraced and/or accept-

ed if we take for granted that we are enmeshed with technology or at least it is this enmeshment that should be assessed. In the following, we will deal with this enmeshment in order to make some sort of sense of how we still have the possibility of guiding and steering our being together with technology in a world that is in need of direction and governance. T-ATA considers normative frameworks as intrinsic elements. It also includes and aims for the formulation of action points coherent with the normative framework reflectively embedded in specific T-ATAs.

In the following, we will list up the various TA models and approaches in order to create a chronological overview and furthermore to create some sort of taxonomy in between the models. By doing this, we do not suggest that one model is better than the other, but dependent on the type of problem, time at hand, and degree of interdisciplinarity models might show their appropriateness as the situation occurs. Of course, we are of the opinion that our model for T-ATA is better than any other when it comes to evaluating complex human-technology relations on both a systemic and individual level. This should become readily apparent through our description and analysis in the following paragraphs and figures.

	Consequentialism	Constructivism	Comprehensivism	Techno-Anthropology
Technology	Existing	Existing	Existing	Existing and imaginable
Context	Independent	Dependent	Dependent	Interdependent
Tools	Technical analysis	Stakeholder analysis	Stakeholder analysis/ participation analysis	Participation, imaginaries, visionaries, hopes, phronesis
Target	Policy	Stakeholders	Stakeholders and users	Intervention Policy Public Individuals
Paradigm	Post-positivist	Social Constructivism	Constructivism/ participatory	Hermeneutic/ participatory Pragmatism/ postphenomenology/ co-construction

Table 1: Various Technology Assessment models

As can be read from Table 1, Technology Assessment has undergone some paradigmatic movements within the past five decades, which roughly are aligned with how societal, environmental, medical, etc. problems become ever more complex and to some extent beyond the reach of technological fixes. The shifts in paradigms are hence dependent on the uncontrolled evolution and development of technology itself. We have experienced how technical analysis, stakeholder and user analysis, and 'blind' foresighting may give answers and solutions to conventional technological problems, but we have also seen that these are not transferable to more complex and potentially vicious technological problems of both the future and the present.

The Anthropocene and Technology Assessment

For the past two centuries, and since the Industrial Revolution, technology has had an increasing impact on the world as such. Enormous infrastructural endeavours on a world scale, like the exploitation of fossil resources, transportation, agriculture, etc., have caused the Earth to change. The current climate crisis bears witness of that. It is not as if the planet Earth has a problem because it will persist these human made changes and, in some way, find a balance. The problem is that we and many of our companion species will not survive the changes, and if we want to remain and thrive, we need to engage in new ways with our non-organic companion, i.e. technology.

Bruno Latour coined the concept of *Parliament of Things* (1991) and gave it an extra twist in *Making Things Public. Atmosphere of Democracy* (2007). The interesting thing about the concept is that it evolves around the enmeshment of things (organic and non-organic) and how politics are performed within and in between. Negotiations, debates, struggles, successes, compromises, defeats, etc. It all goes on in between *things*, which is, accordingly, not an exclusive human enterprise. We saw that the development within Technology Assessment has gradually embraced and encompassed more and more people but it has also remained within the realm of experts, social actors and stakeholders, and citizens – exactly people -- hence not considered *technology* as part of the judgmental and assessing processes. In the view of Latour, and in our perspective as well, this is

excluding both our companion organic species as well as our non-organic companions. We are in this together which means that the concept of the *Anthropocene* is all but a continuation of the modernist dualism of subjects and objects, and yet another example of human *hubris* claiming that we are to blame and we are the cause. We are certainly in it, and a central actor in the play, but the Earth is not an innocent and passive actor and technology is not just a tool in the hand of malevolent and scrupulous human usurpators.

It can be discussed whether it is a positive fact that we in current critical research and debate focus on the *Anthropocene* because, in this way, we raise awareness and attention in the public concerning our actions and behaviour, which is certainly needed; but at the same time, we miss the potential and opportunities of enacting processes where technology is put in a more propulsary mode.

Today, we are met by the imperative to 'disrupt our mind sets' from previous ways of dealing with technological innovation, development, and implementation because in the *disruption* we will get rid of burdening and useless conceptualisations and procedures when it comes to creating new and appropriate technologies. We are not of the opinion that disruption is the solution, even though some of the post-human elements in cutting the ties and connections to the past, and to what, how, and who we were, can be of some inspiration. By saying this, we suggest that in order to create the visionaries and imaginaries of the future that would have an impact on the present, we need to disrupt linear and causal thinking, although this is not new or even radical thinking because and due to what has been advocated from 'the other side' for the past 70 years by for instance Martin Heidegger, Maurice Merleau Ponty, Herbert Marcuse, Michael Polanyi, C. P. Snow etc. It is this lack of philosophical, historical, and ideological understanding which is the main problem in post-human (and transhuman) thinking, which also makes it hard to engage with the utopian worldviews and the focus on a new 'singularity' as a saving part in how we are together with technology. Disruption becomes a new religion where we are techno-human disciples within a faith of nihilism and disintegration. We are looking for the opposite when it comes to connecting and integrating on both a systemic and

individual level. Systems and individuals are interconnected through time and space, which means that if ruptures occur (and they do) then they are mended through temporal, historical, and spatial experiential processes and procedures. The de-contextual ontology of *disruption* is lethal to any kind of meaningful, critical, constructive, and constitutional togetherness with technology because it takes the human out of the equation of instrumental and mechanical singularity. Having said this, we shall return to how 'assessment' can be revisited in a post-consequential, post-constructive, and post-comprehensive stance, meaning that in the 'post' all is present of that which it is a sequence of. We are building on the post-'isms' within Technology Assessment or to put it to an extreme, we are walking in the 'ruin scape' of Technology Assessment and trying to create something new. This new construction should not be called an 'assessment tool', because actually it is not concerned with assessing in the classical definition, but rather a *framework* for addressing incumbent, emerging, and imminent problems of the technological real.

Techno-anthropological Technology Assessment

In this perspective it might be fruitful to engage with the Cynefin model of and on practices, which was developed at Harvard University a decade ago, and what characterises our reactions to simple, complicated, complex, and chaotic technological situations.

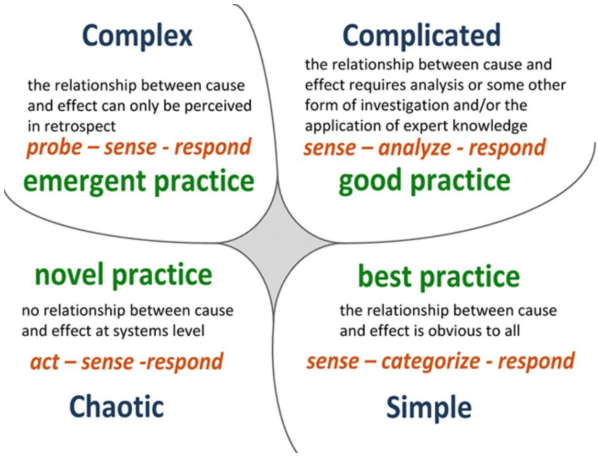

Figure 1: The Cynefin framework by Dave Snowden & Mary Boone (2007).

Consequentialist, constructivist, and comprehensive TAs are, in our opinion, dealing with simple and complicated problems, and the responses/advices are based on descriptions, categorisations, and analyses which refer to the best and good practice that can be documented. Elaborations of comprehensive TA reaches out towards complex situations where order is disturbed and can only be constructed in retrospect.

Our model has a focus on the complex where emergency and immanency are at stake, *hence quick and proper* solutions are necessary. This means that we touch upon action in the domain of chaos, where novel practices and models are constructed. This also means that we need to 'look' elsewhere when it comes to action because the known models for action are obsolete in possible chaotic and unforeseeable situations. In order to prevent to fall into chaos, we need to solve problems while they are still in the status of complexity. Here, we need to reach both backwards to consequentialism, constructivism, and comprehensivism and forwards to intuitive, irrational, and unplanned action, which is inspired by for instance art, and might it be music, literature, theatre, film, painting, sculpture, or hybrids of these.

We believe that Techno-Anthropological Technology Assessment (T-ATA) in embracing historical assessment models is groomed for almost any type of problem solving, and may the problems be simple, complicated, complex, or even chaotic. We also believe that T-ATA especially revolves towards complex and chaotic problems and situations because it emphasises new methodologies and approaches that transcend classical problem solving, based on descriptions, analyses, and scientific responses. T-ATA is concerned with sound, sustainable, and responsible intermediary action and intervention, where the concept and practice of assessment become paradoxically anachronistic because we are impeded to say anything final and/or absolute in relation to what we are part of. We are left, as the Cynefin model points to, with experiments, probing, imagining, and forecasting, which requires quite different skills and competences than classical assessments do. T-ATA points to the fact that we are enmeshed and intertwined with what we are trying to 'assess', which means that we are inevitably caught up in serendipity and causality. How

can we say anything meaningful, or for that matter produce advice for decision makers, in a situation of capture and seemingly chaos? T-ATA is concerned with sensemaking, i.e. does this make sense? In order to respond to this question, we need somebody/something to respond, which again means that these processes are characterised by co-construction, co-production, and co-constitution. In sense-making processes, we are required to actively see, hear, listen, and feel, which is a totally different measuring rod than calculation and scientific analysis. T-ATA is not in opposition to sound and reliable scientific calculation and analysis but rather seeking new ways for sensemaking that in the end would need to epitomise and materialise in a hybrid scientific methodology.

The actual anthology consists of an array of contributions that represent various technology assessment models, mainly situated in constructivist or constructivist inspired approaches.

Laubjerg and co-authors analyse the Welfare Technology Assessment (VTV) model from a Techno-Anthropological perspective entailing a variety of theoretical positions including postphenomenology, actor-network theory, feminist technoscience, social construction of technology, and critical theory of technology. In this way, they open the anthology by linking Techno-Anthropology to Technology Assessment.

Bertelsen and Stub Petersen are operating within the framework of construcivism and explain how Constructivist TA (CTA) has been embedded in all engineering educations at Aalborg University since the beginning of the 1980s this means that Aalborg University has been front runner in CTA, and that engineers graduating from Aalborg University have a strong culture and knowledge when it comes to analysing and assessing the relations in between humans, technology, and society. Bertelsen and Stub Petersen emphasise the need for involving the patient/user/citizen in techno-anthropological assessments of technology.

Christensen and Remmen are also producing a classic CTA on technological development and implementation in developing countries (Uganda, Tanzania, and Vietnam) and refer to a framework that developed in the 1990s here Remmen was central player together

with Johan Schot and Arie Rip (1996). Christensen and Remmen are mainly concerned with how technology transfer takes place; i.e. the problems occurring when technologies and methodologies for assessing technologies are transferred from a Western context to the developing world. Christensen was directly involved in the main parts of the projects that are analysed.

Birkbak, Koed Madsen, and Munk are addressing TA from an anthropological perspective and are mainly developing anthropological and ethnographical approaches within the digital field. They focus on how to involve citizens in decision-making processes through social media, specifically Twitter.

Balslev and Riis are close to Birkbak et al. in their attempt to show how digital technologies are shaping and forming their users and how this shaping and forming is crucial for the context, i.e. the school. They expand on hermeneutical TA as proposed by Armin Grunwald (2014) and build on Schot and Rip's constructivist TA. Balslev and Riis are of the opinion that CTA needs to address Boltanski and Thevenot's theory on justification because it is focussing upon how to solve conflicts in between technological constituencies.

Børsen addresses TA from an ethical perspective, and thereby provides a corrective to most TA models that are often criticised for lacking normative and ethical elements and reflections. He presents the socalled 'Quick and Proper ethical Technology Assessment' (QPeTA) model and applies it to two cases: preventive breast cancer surgery based on health information systems and digital replacement of professional judgent. The model is compared to other ethical TA approaches (eTA and eCTA).

In the final chapter of the anthology, Botin is calling for a postmodern deconstruction of the concept of assessment because it is inconsistent with how we actually are together with technology. We should focus on (this) being together and look at the interactions and intersections in between humans, technology, and world. Botin's chapter is highly inspired by postphenomenology and classical phenomenology in addressing this need for deconstruction.

The main part of the contributions are moving within the framework of constructivism with excursions into ethical, political, and participatory approaches and understandings. Almost all of the

contributions are in one way or the other referring to the work of Armin Grunwald, which indicates the enormous impact that Grunwald's hermeneutic approach has had during the past decade. It stands forth that values are at stake, and any techno-anthropological assessment has to address participatory, ethical, and political issues in relation to technological innovation, development, implementation, and use.

We think that a proper T-ATA has yet to be. In this short introduction, we have tried to call for new and radical 'assessment' models that transcend mere measurement and calculation, and embraces enmeshment and intertwinement. This means that T-ATA with an outset in clearly defined frameworks for action, might that be UN's Sustainable Development Goals, EU's Grand Challenges, or frameworks more relying and dependent on concrete and specific problems and challenges, strives towards goal and aim oriented interventions. T-ATA is in this sense characterised by intentional activism and interventionism. The contributions in this anthology are to some extent touching upon these intentions, but as we were saying, we are still in need of full-fledged T-ATAs which, hopefully, will be the result of future work within the research and educational program of Techno-Anthropology.

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CHAPTER 2:

A Contemporary Framework for Assessing Welfare Technologies: Unfolding an Assessment Model Developed by the Danish Technological Institute[1]

Amanda Lærke Laubjerg, Anne Leth Klærke-Olesen, Jeppe Nielsen-Hannerup, Kasper Koefoed Larsen, Ronja Ingeborg Lofstad, Tom Børsen

1. Introduction

Technology assessment has become increasingly relevant with the extended use of technologies to assist elderly and disabled people in their daily lives. These technologies are in a Danish context broadly termed welfare technologies. In the past 10 years, they have been an item high on the political agenda in Denmark and liaised to the future of the Danish welfare model. The political vision is that welfare technologies have the potential to increase the quality of life for citizens while both improving the working environment for staff and relieving pressure on public budgets (Botin, Bertelsen & Nøhr, 2016).

Technological efficiency is a prevailing political issue as the proportion of elderly people will rise over the next decade in most European countries, and health care expenses will rise accordingly (Danmarks Vækstråd, 2009). The increased awareness of the potentials of welfare technologies is also discussed in the media, where the term welfare technology has appeared 1,417 times in Danish written media in 2016, while, in comparison, the same term has appeared only five times in 2007.

In trying to optimise the use of resources, one should not look at welfare technologies as technical fixes to complex issues and thereby ignore the possible side effects generated by an extensive use of such technologies, nor the fact that welfare technologies create complex political and ethical challenges. Instead, focus should be on providing a way of comprehending the complexities of welfare technologies and their impacts.

One influential actor working with assessing the consequences of welfare technologies in Denmark is the self-owned Danish Technological Institute (DTI) which develops and contributes new knowledge relating to technological progress for the benefit of the Danish and European business sectors. In their own words, the most important task for DTI is to:

> *We translate the knowledge and solutions that we have and develop them into specific products and methods that add value to enterprises. By doing this, we are able to see the results of the work we carry out being put to practical use. 'Knowledge that works' dominates our mindset and our work.* (Danish Technological Institute, n.d.)

Thus, a big part of what DTI does is consultancy on a broad spectrum of technologies, i.a. assessment of welfare technologies. DTI has developed and uses a model for assessment of welfare technologies in their consultancy work. The model is called Welfare Technology Assessment (in Danish: VelfærdsTeknologiVurdering, VTV) and is the most explicit work on technology assessment done by the institute. DTI's website links to three exemplary technology assessments of telenoids (Gaedt, 2014), washing toilets (Gaedt & Pedersen, 2016), and sensor floors (Gaedt & Pedersen, 2017).

The VTV model is the focal point of this chapter, as it is an interesting case of technology assessment dealing – and at times struggling – with comprehending the complexities of how welfare technologies impact society.

This chapter introduces the VTV model by identifying some of the intentions of the model. From there, the model's theoretical framework is outlined as well as the types of technology assessment

the model produces. Subsequently, by examining the VTV model through the elaborated techno-anthropological lens below, the chapter investigates how the model takes techno-anthropological sensitivities of technologies into account, and elaborates on how Techno-Anthropology can further augment the VTV model.

The present chapter is a condensed version of a study published in 2016 (Nielsen-Hannerup et al., 2016) which examined the VTV model in a techno-anthropological view on the basis of fieldwork consisting of interviews with relevant actors from DTI and the Social Services Administration in Copenhagen Municipality. The former is included in order to examine the intentionalities behind the model, whereas the latter is involved as a case for understanding how the model is being used in practice. Furthermore, a systematic literature study of the theoretical framework of the VTV model was conducted, and subsequently VTV assessments published by different centres of the Social Services Administration in Copenhagen Municipality were examined.

2. The techno-anthropological lens

The contributions of Techno-Anthropology to the field of technology assessment are based on the socio-technical understanding of technologies. This understanding does not consider technology as fixed or static, nor does it derive from one specific theoretical standpoint. Rather, it breaks with a deterministic understanding of technology and rejects that technologies only have determinate and predictive effects on society. Instead, Techno-Anthropology examines how socio-technical ensembles are the results of complicated interactional processes, which are likely to produce new, and to some extent unpredictable, problems.

A central understanding in this conception of technology is that technologies are endlessly developed and have no final form. Social Construction of Technology (SCOT) demonstrated exactly this when it delivered an early critique of the idea that technology is situated outside society. Scholars like Pinch and Bijker (1987) argue that technology is shaped by society and vice versa. They state that the linear model for technology development is faulty, as it gives the impression that the process of technological development is teleo-

logical, i.e. gradually developing towards the fulfilment of its inherent purpose. Rather, historical analyses of technologies show that several potential versions of a specific technology could in fact have 'won', and that historical circumstances determine which versions are stabilised (Lauritsen, 2007).

This is central to the conception of welfare technologies, as it shows that innovation always involves a multitude of relevant social groups or actors and is not a result of inventive acts of uniquely creative individuals. This critique of the linear model is a central aspect in a techno-anthropological approach to technology assessment.

The socio-technical understanding of actors is developed further in actor-network theory (ANT). In ANT, the perception of actors derives from a semiotic understanding, meaning that actors are only meaningful in terms of their relation to other actors in networks. Networks are in this theoretical perspective composed of heterogeneous actors of any kind, e.g. humans, animals, machines, buildings, etc., who possess agency in the network (Law, 1992).

Although the field of Science and Technology Studies (STS) is versatile with regard to theoretical standpoints, the field as a whole supports the notion that actors are not only the entities directly influencing the design, production, and use of a technological artefact. This is central to the techno-anthropological approach and understanding of technologies as socio-technical ensembles and to the assessment hereof. Perceiving actors also as non-human entities brings forth an appearance of agency as technical and/or social matter. Hence, innovation is seen as complex outcomes of relations in networks. This is also something which is important to recognise in techno-anthropological technology assessment.

Another important issue to include in a techno-anthropological approach to technology assessment is the variety of impacts that technologies have on human practice. A thorough assessment may thus benefit from drawing on two prominent representatives of postphenomenology: Don Ihde and Peter-Paul Verbeek. Both argue that technologies shape and impact the relation between humans and the world in that technology mediates the world as a *hybrid entity* consisting of humans and non-humans (Ihde, 1990; Verbeek, 2009a; 2011). By looking at how technologies mediate human practices and

experiences in and of the world, Verbeek argues that technologies possess agency and intentionality embedded by designers.

Accepting that technology is embedded with intentionality makes it ever more relevant for techno-anthropological technology assessment to look at how mediations influence moral reasoning, and how morality can be actively designed into technologies and thereby become value-embedded (Verbeek, 2009b). Thus, designers play a seminal role in the ethical considerations when developing technologies, but "*(...) technologies need to be interpreted and appropriated by users in order to be used.*" (Verbeek, 2006, p. 5) Therefore, the effects of technologies are to some extent unpredictable, as the designers cannot control the contextual interpretations by users. Ihde describes this as multistability (Ihde, 1990; 2009), and further emphasises that it is not sufficient to review the intentions in technologies when doing technology assessment, but that one must also scrutinise how users shape technologies in specific contexts, as unintended and unforeseen impacts are likely to occur.

The postphenomenological approach to technology is not alone in its argument; the feminist approach to STS also argues that technology is value-embedded, although here the focus is on how power relations determine who impacts the development of technology. Drawing on this, it becomes important to pay attention to not only what is assessed but also who is included when carrying out technology assessments. Theorists within feminist STS, such as Sandra Harding, argue that marginalised groups possess a better position for judging knowledge than dominating groups because they are able to see the world through both the marginalised and the hegemonic position, as a result of their marginalised position in society. All knowledge is socially situated, but hegemonic knowledge is presented as value-neutral and objective. Hegemonic knowledge is accepted as it substantiates the hegemonic positions, whereas knowledge produced by marginalised groups of society is systematically disregarded.

All of these perspectives are part of what constitute the socio-technical understanding of technology and looking at welfare technologies in this perspective enables us to see the complexities of welfare technologies and the importance of a thorough assessment when

considering intensive uses of new and emerging technologies. They have potentially significant consequences for socially vulnerable people, the elderly as well as staff. It is these theoretical approaches which we will draw on in the following discussion of the VTV model.

3. Outlining the VTV model

The objective of the VTV model is to provide a 360-degree assessment of a welfare technology. This is done by assessing its impacts in four categories: *technology, citizen, organisation, and finance* – citizen referring to the user of a welfare technology. In order to carry out an assessment based on the VTV model, one should familiarise oneself with the categories, each of which is further divided into two parameters dealing with several related indicators, which altogether constitute the 360-degree assessment.

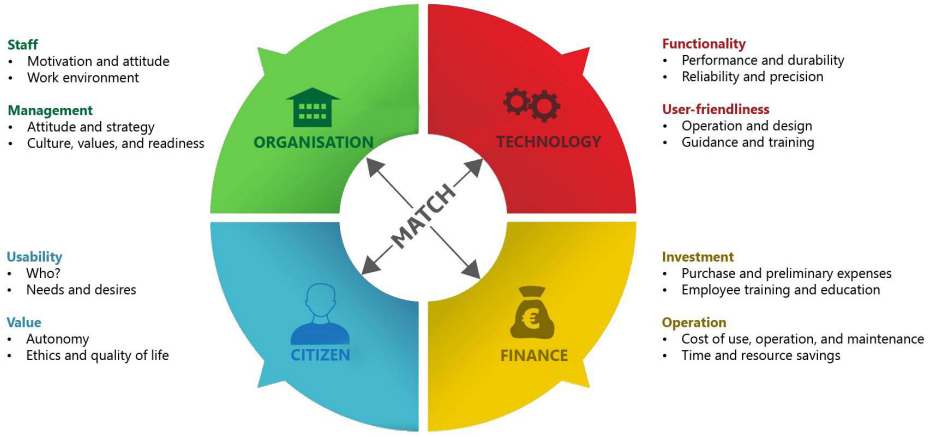

Figure 1: DTIs VTV-model, an assessment tool for welfare technology, is developed by M. Ed. Lone Gaedt while working for DTI (Teknologisk Institut, n.d.).

The *technology* category comprises an assessment of how well the technology performs as well as how user-friendly it is, hence focusing partly on technical questions related to the technology's efficiency, stability, and durability, and partly on parameters concerning usability. The model's questions relating to the technology include

whether the technology is intuitive in use and easy to operate, or if the implementation of the given technology requires extensive training of the employees; whether instruction manuals are necessary and if so, if they are adequate. Further, questions are asked regarding the basic functionality of the technology and whether the technology works as and when required. These questions are essential, not only because the technology needs to work in order to be used, but also because a malfunctioning technology often becomes fertile soil for loss of motivation among users of the technology.

The second category, *citizen*, assesses the impact of the technology on the citizens using the technology. It is crucial to clarify whether the technology has beneficial features, which might improve the life of the user, and whether the technology potentially has any negative influence on the quality of life for the user which are not mutually exclusive, as a technology might very well hold the potential for both. In this category, human values are the key element, and this is where the main part of the model's ethical assessment is often done. These are qualitative perspectives, and according to DTI it is important not to reduce these aspects to quantitative means. Ethics is woven into welfare technology because it carries the potential of having an extensive impact on the life of the users, and assessing these ethical aspects is essential to the model. This part of the assessment also revolves around the question whether the technology makes the citizen more self-sufficient in everyday life. In addition, the category raises less abstract questions regarding whether citizens want to use the technology and if the technology meets the needs of the users.

The category *organisation* constitutes relevant perspectives concerning the working environment of the employees as well as perspectives related to the culture of the organisation. The influences of the technology on the organisation comprise one of the parameters, while the other assesses the readiness of the organisation for implementing the technology, as these surrounding factors are of great importance in ensuring a successful implementation. Relevant questions in this category might be whether the employees are motivated to use the technology, or if management supports the use by adequate allocation of resources needed for implementing the technology.

Furthermore, the investigator must here examine how the technology underpins beneficial working procedures.

The final category of the VTV model assesses the *financial* perspectives of the technology and might thus be seen as a business case. Both the costs of implementing a technology and the operational expenses related to use and maintenance are taken into account, as well as the potential profitability of the technology. Questions asked in the finance category might concern the *return on investment* of the technology and whether the technology requires further implementation in the surroundings to work as intended. This includes investigating whether the technology might release employee resources or replace other facilities.

The intention is that assessing these four categories altogether produces a 360-degree assessment exploring all aspects of a welfare technology. These four categories were inspired by reviewing existing health technology assessment models, but the subject matters of the model also have deep theoretical roots which are unfolded in the following, as they are fundamental for understanding the assessment approach inherent in the model.

3.1 The theoretical backdrop: 'The Social Analytical Perspective'

The content of the four categories and their relations is inspired by the work of Lars-Henrik Schmidt and his notion of 'The Social Analytical Perspective' (1990; 1992). The Social Analytical Perspective is a diagnosis of contemporary time, which addresses the way we conceptualise and analyse the world we experience. To Schmidt, the interesting part of social life lies in the conflicts of social positions, which he illustrates through an arche-map. In this ontology, Schmidt's (1992) objective is to move away from the idea that mediation only occurs between two positions (A and B in Figure 1), and instead adopt the notion that external positions (in this instance C), which only mediate directly with one of the other positions (position B), are actually mediating both positions.

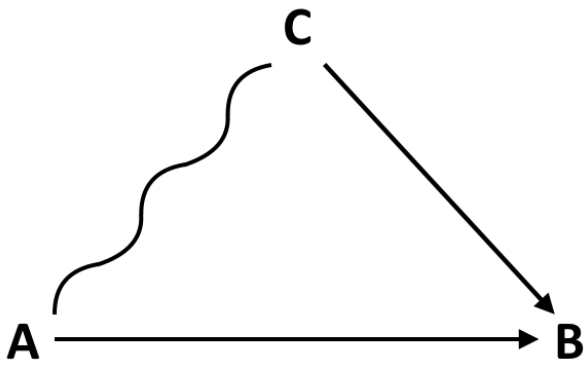

Figure 2: The Social ABC (Schmidt, 1992, pp. 82-84).

The central point is that when position A relates to position B, and position C relates to position B, they indirectly relate to each other in that they both are relating to position B. From here, it can be inferred that if you investigate a social relation, you must take into consideration relations that may influence what you are enquiring into. This view on mediations is what Schmidt calls The Social ABC (1992), and it is the basis for the complexity of relations between positions in Schmidt's arche-map (2005).

According to Schmidt, Figure 2 is fundamentally what sociality is, and it is important to note that A, B, and C are not persons. Rather, they are positions from where the world is viewed, and from where relations are experienced. Of course, social structures are more complex than just a triangle, and usually, as social beings, humans relate to more than one position at any given moment. The point is that positions indirectly influence each other, and this is one of the central concepts adapted by the VTV model.

Having presented the foundation for Schmidt's arche-map and how he views relations between positions, the map itself is explained. The arche-map is based on the notion that a position can be understood as a value (the horizontal axis in Figure 3) and a reasoning for it (the vertical axis in Figure 3). The argument for this division is that we do not simply have values, we must also defend them at all times. Hence, the reasons function as validation of our values.

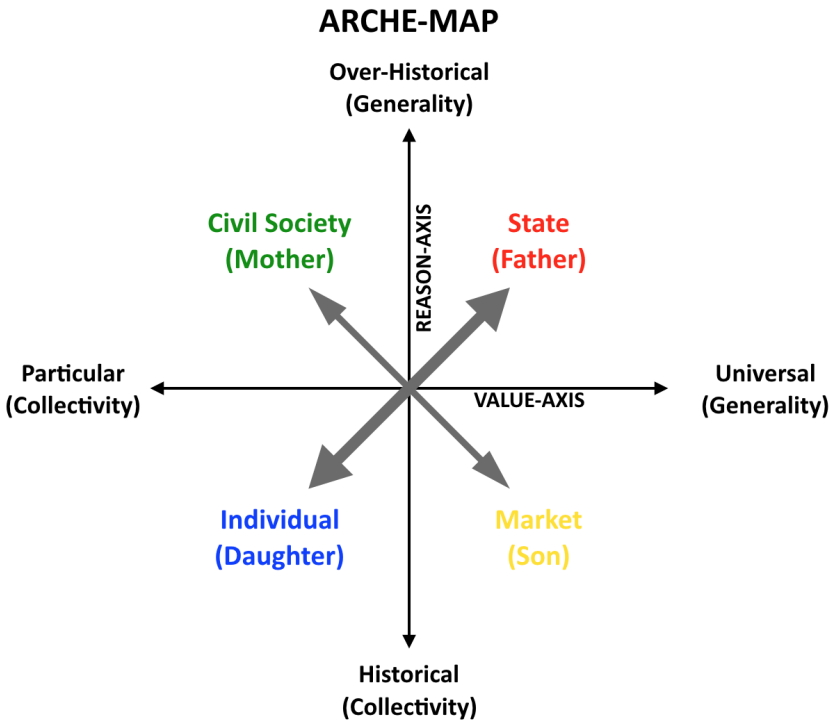

Figure 3: The Arche-Map (Schmidt, 2008).

The value and reason axes both span from collectivity to generality. Schmidt defines collectivity as something that applies to some, e.g. me, us, or them, and generality on the other hand as something that applies to everybody (Schmidt, 2008). Fundamentally, collectivity marks an internal agreement and an external difference or disagreement, whereas generality marks an absolute unity and an explicit agreement.

Collectivity and generality comprise the only social designators of sociality, as the terms otherwise ascribed to the arche-map are examples of social activities. When the axes are combined in a diagram, four domains are formed which Schmidt uses as markers of positions in a diagnosis of contemporary time's positions in sociality.

Schmidt unfolds this diagnosis using constituents of contemporary society such as core family relations or components of society

(market, state, civil society, and individuality), and sets forth to analyse their interrelational dynamics.

By striving for this model of the social landscape, tendencies in contemporary times become apparent, which might be able to tell us something about the future, but not in the form of predictions (Schmidt, P. F., 2011a). Instead, it is this effort of diagnosing which is adopted in the VTV model, as it aims to draw a detailed map of the consequences of implementing welfare technologies in relation to relevant positions.

Here the upper right-hand corner is symbolised with the *state* and is defined as a position of power and governance. The goal is freedom through the democratic state, i.e. people are free to choose the government, but the government rules on behalf of the people. This translates into the technology domain in the VTV, as the technology, chosen by a democratic assembly, becomes a governor of specific tasks. According to DTI, technology defines the assessment project and sets the agenda, relating it to an authoritative archetype.

The lower right-hand position is symbolised by the *market*, which, inspired by Marx, symbolises equality through providing equal opportunities and entitlements. This is translated into the financial domain in the VTV model, as the welfare state provides the financial ground for the technologies that are implemented.

The top left-hand position is symbolised by *civil society*, the collectiveness and unity of people, which translates into the organisational domain of the VTV model. The lower left hand-corner is the individual domain, which translates into the citizens affected by the given technology.

However, in these positions a significant difference between the arche-map and the VTV model is present, which has to do with Schmidt's archetypes, as these represent positions in the form of human entities. In the VTV model, the welfare technology is placed in the upper right-hand corner and is thus solely a material position. However, from a socio-technical point of view, the social and the material are difficult (and not desirable) to differentiate, as materiality is as much an actor as the social in the interaction taking place, and we therefore only applaud an unconditional involvement of material positions.

4. The VTV model through the techno-anthropological lens

Having described the theoretical framework of the VTV model, we now turn to an examination of how the socio-technical understanding of technologies is embedded in the model when viewed from a techno-anthropological perspective. The socio-technical attributes of the VTV model have trajectories leading back to the social analytical perspective. These attributes strongly define the capabilities of the model, but as the following will show, they are somewhat implicit and a view for that the complexity of socio-technical relations is not always captured by the model. In the following sections 4.1 to 4.3, we use the techno-anthropological lens to explicate implicit assumptions and to identify improvements of the VTV model.

4.1 360-degree assessment

The VTV assessment provides a broad designation of which elements are affected by the given welfare technology through its 360-degree approach, which ensures that the researcher thinks outside his or her own presumptions and expectations when assessing the impact of a technology. This is a valuable feature for the reasons stated above: the consequences of a technology are often incalculable and unpredictable, and therefore the model should force the researcher to do a full 360-degree study, which might reveal consequences of importance that might not be illuminated, should the researcher choose the relevant aspects to assess beforehand.

In a case from 2014, the Social Services Administration in Copenhagen Municipality set out to test if electronic keys could help the employees in a certain home care area, as they faced challenges managing all the keys for approximately 700 citizens under their care (Enheden for Velfærdsteknologi, 2015). In assessing a technology developed solely for the purpose of supporting the employees' internal working procedure, it is reasonable to assume that the assessment would not reveal how the technology would affect the quality of life of the citizens. Nevertheless, an assessment of the technology in all four categories of the VTV model concluded that some citizens felt unsafe because of the increased number of people now having access to their homes or because they did not understand how the technology worked, and therefore did not trust it to keep intruders

out. This was not the only perspective of the citizens, though, as some felt more safe and reassured knowing that more employees from the home care could access their homes in case of an urgent need for help. The Social Services Administration and the employees were thus able to take these perspectives into consideration when assessing the consequences of implementing the technology.

This example illustrates the importance of not making *a priori* conclusions concerning the effects of a welfare technology and emphasises the strong advantages of insisting on a 360-degree assessment, although it might at first seem redundant and overly time-consuming.

4.2 Interrelated influences

> *We know how to describe human relations, we know how to describe mechanisms, we often try to alternate between context and content to talk about the influence of technology on society or vice-versa, but we are not yet expert at weaving together the two resources into an integrated whole.* (Latour, 1991, p. 110)

When attempting to assess from all perspectives (360 degrees), one must not forget that the whole is more than the sum of the parts, i.e. looking at the four categories individually does not add up to being the whole spectrum, as the interrelated impacts of the categories are just as important. This is a point which is also highlighted by the Social ABC in how the different positions all relate to each other.

Latour is one scholar to dispute this notion of categories, even though he states that the aim of dividing the world into categories is a very human pursuit. The problem is that the world constantly intertwines the things we believe to be separated, and rearranges them as hybrids (Blok & Elgaard Jensen, 2011). Analysing the categories in the VTV model individually would undermine the point of the 360-degree assessment, since the world is not acting in neatly fragmented categories.

Although the model already illustrates some interrelatedness, as depicted by the arrows in the middle of the model, we argue that this might give the impression that the relations are between technology

and citizen only, and finance and organisation only. The arrows further give the impression that the interplay between the categories only happens directly and always occurs between two positions.

Drawing on the theoretical framework of the VTV model, it is illuminated how we must perceive relations as not only occurring directly between two positions. The understanding of the social in Schmidt's the Social ABC is thus a tool for us to explain how the different socio-technical positions of the VTV model interact with one another. For the view to be socio-technical, however, we must expand the definition of positions to not only encompass social positions but also material ones, as already described in the techno-anthropological understanding of actors.

In order to illustrate this, we will draw on the case of a VTV report done in Copenhagen Municipality on *play-and-learn* technology for children. The play-and-learn technology was implemented at two different care centres using different strategies for introducing the technology to the children. At the first centre, the children were introduced to the possibilities of the technology, and consequently they ended up using it as it was introduced to them. The other care centre did not give much instruction on how to use the technology, which forced the children to figure out how to use it themselves. The result was that the children from the second care centre found new ways of using the technology. From these conclusions in the VTV report, we can establish the different relations between the categories (or positions) in the VTV model.

Placing the technology in the centre of our relations enables us to draw an illustration combining the Social ABC and the VTV model. The reason for placing technology at the centre of the illustration, we argue, is that the other positions are forced to relate to technology as the newly introduced element that needs to be assessed, and it is these new relations the VTV model assesses.

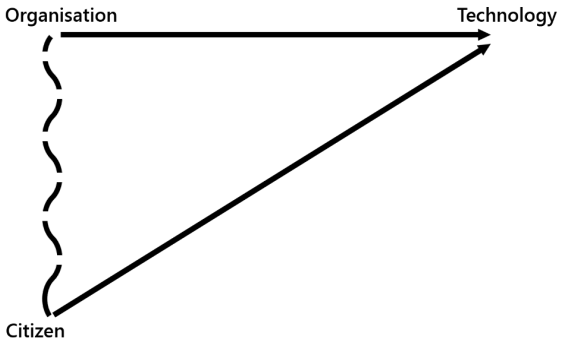

Figure 4: Different positions and perspectives interrelate directly and indirectly.

Looking at Figure 4, a depiction of the ABC using organisation, technology, and citizen as points of reference instead of A, B, and C, we may examine how the way that organisation relates to technology has an effect on how the other categories relate to technology. The case of play-and-learn technologies shows how the different ways the two care centres relate to the technology have an effect on how the children relate to the technology. Thus, when assessing how the different categories relate to the technology as the focal point of a given assessment, one must be aware of the (in)direct relations between the other categories and how these may affect the relations to the technology.

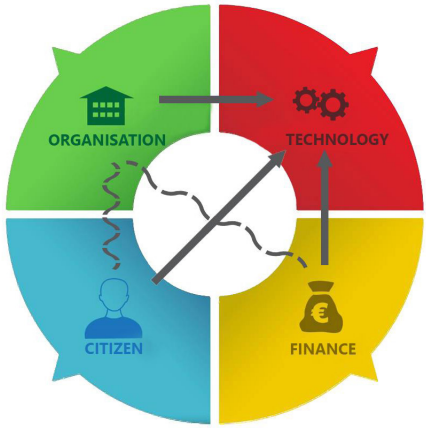

Figure 5: All four positions are intertwined.

In Figure 5, we have illustrated that the relations of the case are not confined to the three points of reference, and as Schmidt asserts, we are part of many relations at any given time (Schmidt, 2008). As such, the way the organisation, in this case the care centres, relates to a technology not only affects the way the children relate to the technology, but also how finance relates to the technology. When one care centre focussed on teaching the children how to use the technology, they were compelled to spend more resources on educating staff in how to use the technology, thereby increasing implementation costs. The other care centre did not have to spend resources on getting staff familiar with the technology, as their focus was to simply let the children come up with their own way of using it. This is not to say that one way of introducing a technology is better than the other, but rather an example of how relations between the categories have an effect on how the other categories relate to each other.

In summary, we argue that in trying to portray something complex in an easy-to-understand illustration, the VTV model and its 'match' arrows are in need of an expansion to offer a clearer socio-technical approach to technology assessment. Figure 6 sketches how this point could be included in the VTV model:

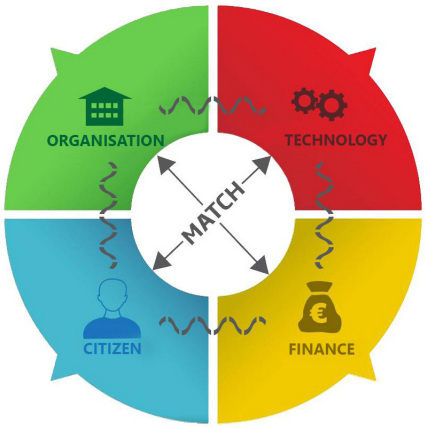

Figure 6: A suggestion to revise the VTV model so that it captures relations between all the four different categories.

4.2.1 Partial solutions

One of the things which defines a techno-anthropological approach to technology assessment is the understanding that solutions are partial and that technology cannot solve all problems on its own. This is partially due to the relationship between solutions and problems: the notion of a good solution seems to point to shared ideas about what the problem is - while in reality the conceptions of a problem are typically not shared by everyone. Besides, solutions will always be contextually situated and might even create new problems in other relations.

The VTV model is limited in its notions of solutions, as it looks almost exclusively at which problems the implemented technology is able to solve one-to-one, and not into how the technology might interact with other solutions and resources. The only references to other solutions in the model are the supplementary questions: '*Does the technology replace the use of other tools or services?*' and '*Can the technology be used without reconstruction or purchase of other products?*' (Enheden for Velfærdsteknologi, n.d.) These questions are not concerned with interaction; rather, they are questions of replacement and cost-free implementation, implying that the technology should be the whole solution in itself.

Looking at the published VTV assessments, it becomes clear that many of them examine technologies as self-standing solutions to selected problems. A VTV assessment which does capture the interaction of solutions is an assessment of sensory-stimulating chairs conducted by the Social Services Administration in Copenhagen Municipality at a group home called *Netværket* (Enheden for Velfærdsteknologi, 2015b). In this case, the technology has been implemented in order to assess whether it supports other solutions for stress relief among the citizens:

> *The purpose of the test is to examine whether the sensory-stimulating chairs from Protac support NADA treatment*[2] *and relaxation sessions at Netværket in a positive way.* (ibid., p. 7)

In the report, a citizen states that "*it almost has a double effect to sit in the chair while getting the NADA treatment*" (ibid.). This illustrates how

a technology often works as a solution through its interaction with other elements.

This understanding of solutions is in line with DTI's emphasis on how important it is to think of welfare technology not just as a replacement tool but instead as something which is able to support citizens and help them make use of their own resources in the best possible manner:

> *Who are they* [the citizens], *what loss of function do they have and what resources? Never forget the resources, either. Therefore, I say: 'This guy, he is able to stand, why is he being lifted? Shouldn't he keep his ability to stand in spite of the technology?"* (Gaedt, DTI, translated from Danish)

It is not that the VTV model does not support the view of technology as part of a bigger solution, however, it is not evident in the model either. Subsequently, our recommendation is that the model directly should make the researcher consider how a technology works together with other solutions, and how it might support the use of the resources which already exist among the citizens, the organisation, and the technology.

4.3 Ethical considerations

A matter which we found surprising during our interviews at the Unit for Welfare Technology in Copenhagen Municipality was that the subject of ethics was not initially brought up. When we addressed this in our queries, it was, however, evident that the subject of ethics is implicitly embedded in the work conducted by the Unit for Welfare Technology, hence not explicitly debated in the discussions concerning technology assessments. Further, these considerations are not facilitated by the VTV model. DTI is aware that there is room for improvement, however the task is not an easy one since ethics is an intangible matter.

The absence of a framework incorporating ethical considerations is further evident in the time scope of a VTV. As The VTV in this case is used to assess the implementation phase of a technology, it does not provide an assessment of the side effects of the technology. This

is problematic when the VTV model is used as the only tool for assessing whether a technology should be used prospectively as a supporting tool for the caring of the socially marginalised people.

We draw on Løgstrup to expand on this thought:

> (...) *why do we not notice a revolution when it is the technology that has caused it? Because the fundamental change in society is caused not by the objective of the technology but by its side effects.* (Løgstrup, 1982, p. 23, translated from Danish)

These side effects are presently not a part of the VTV. However, when we articulated the ethical aspects of welfare technologies, an employee at Copenhagen Municipality expressed how this is something which might be a need in the assessments:

> *Ethical considerations should be included in the VTV model, but it might be clarified some more. It is actually something that one could forget.* (Project manager, The Unit for Welfare Technology, translated from Danish)

We argue that ethical considerations should not only be facilitated by the VTV model but should be explicated thoroughly within the model. Subsequently, we propose the formulation of questions to be asked during a VTV assessment which do not only support ethical considerations in regard to the citizen but throughout all of the categories, hereby highlighting the relations between the categories. At present, ethics is a subsection of the citizen category along with quality of life.

However, in order to do a complete 360-degree assessment, ethics cannot be considered as regarding the citizen alone. Ethics should be considered not only in each category but also in how each category relates to other categories.

Another challenge with ethics in the VTV model is that the topic is too unspecified. Ethics is a challenging topic to assess, and merely mentioning the word 'ethics' in a subcategory does not do much in helping the researcher assess these crucial aspects. Questions regard-

ing specific relations might be beneficial in assessing this aspect of technology as well.

A tangible proposition is to use Value-Sensitive Design (VSD) as a tool to improve the ethical assessment (Cummings, 2006). VSD recognises that society and technology are mutually shaped by each other and is used to assess the integration of human values in a design process. As a formalised methodology, it outlines 12 central human values of ethical importance which are either supported or diminished by the design. They are assessed through an iterative process, looking at conceptual, empirical, and technical issues of the design, respectively. A strength of the approach is that it supplements and augments existing practices instead of replacing them, making it more straightforward to implement into the existing VTV framework.

5. The necessity of a methodical toolbox

Since the development of the VTV model, municipalities across Denmark have begun using the model as a systematic tool for assessing the implications of implementing welfare technologies. According to employees at Copenhagen Municipality, the greatest advantage of a partial standardisation of the technology assessment practice is that it makes it easier for municipalities to share and compare knowledge about possibilities and challenges related to implementing welfare technologies. However, having a model which only dictates *what* to assess, but not *how* to assess it, means that methods differ highly from case to case and consequently that the complexity of the impacts of welfare technologies is at risk of being captured only occasionally.

Exploring the use of the VTV in Copenhagen Municipality illuminates differences between how DTI envisions the model and how the different actors in the municipality work with the model. When the model is put into context at a municipality, different employees assess technology in different ways when using the same model. This is inevitable in a techno-anthropological view, as socio-technical configurations are endlessly shaped when used. The upshot is that the development of an assessment model alone, no matter how socio-technical in its understanding, is insufficient.

5.1 Methodical application

Employees at Copenhagen Municipality often succeed greatly in eliciting some of the complexity in the assessment of welfare technology, as they have a competent focus hereupon prior to working with the VTV model. But understanding the possible impacts of technology, when assessing whether or not to use it in the care of vulnerable citizens or elderly, is as crucial as it is challenging, and therefore this view must be secured through a thorough and qualified use of methods, and not just sometimes but at all times.

The merge of the terms 'technology' and 'anthropology' into 'techno-anthropology' emphasises the argument: the study of technology requires a strong methodical engagement. Knowing not only which categories to assess and what questions to ask but also how to do so, is at the essence of comprehending the complexities of technology. The challenges in this regard are especially vivid in relation to the use of qualitative methods.

In Copenhagen Municipality the backgrounds of the people collecting empirical data for the VTV assessments are quite diverse. As the head of centre points out:

> *There are different levels of competencies. Thus, it may be everything from an unskilled, educated staff to a pedagogue or a nurse. It might be someone with a medium-length education, with general knowledge about methods.* (Head of centre, translated from Danish)

Here, the role of the professional participant and that of the researcher are often being merged, as the professionals become responsible for conducting the research for the assessment. This emphasises the need for a clear methodical framework in which DTI and the municipalities can train their staff, in order to achieve a valuable, nuanced assessment.

The VTV model has a strong emphasis on assessing intangible concepts like 'quality of life' which require investigations into the lifeworlds of the citizens and therefore more in-depth understandings than those contributed by quantitative methods; understandings which are challenging to produce.

For instance, questions of how one can conclude anything of relevance for comparing knowledge on possibilities and challenges of implementing a welfare technology, when only having followed two citizens and their use of a technology for six months in a certain context, are not immediately obvious. These are questions of generalisability, which have occupied science studies forever and as the VTV model is set free by DTI without supplemental training or written guidelines in regard to methods, we argue that a prerequisite in order for staff to conduct a VTV assessment is to encompass the abovementioned knowledge and competences.

This creates another challenge also regarding representation. Working with welfare technology in a municipality often means working with groups of people who for various reasons have challenges reflecting on selected topics or who are difficult to engage in the reflection on certain issues due to a variety of conditions. However, when doing an assessment of welfare technology, the VTV model becomes a tool which speaks on behalf of these people, as the published assessments have great influence on which technologies municipalities across the country choose to implement as part of their work in caring for these people. For this reason, it is crucial to know how to involve the citizens in the assessments.

This idea of the VTV model aligns with the view of feminist standpoint theory in arguing that a strong view on a subject matter is obtained by involving vulnerable or marginalised groups in knowledge production. Sandra Harding (1991) uses gender as an example of power imbalances. She argues that for instance women's perspectives may be preferable in studies involving discrimination, as they have valuable experiences from their oppressed position in society, and that:

> *Using women's lives as grounds to criticize the dominant knowledge claims, which have been based primarily in the lives of men in the dominant races, classes, and cultures, can decrease the partialities and distortions in the picture of nature and social life provided by the natural and social sciences.* (Harding, 1991, p. 105)

This leads us to another epistemological challenge for the VTV model: the question of objectivity when doing assessments. Objectivity is not a notion to disregard according to Harding, as it facilitates reflections on the position one occupies in a knowledge claim. However, she advocates a redefinition of objectivity and what it means to be objective. A scientific description, which is explicit in its reflection on its own situated origin and how this affects the descriptions of reality, is therefore more objective than the description which in its own understanding has a neutral perspective.

5.2. An assessment from somewhere

The understanding of how one should act when closely related to the area where the data collection takes place is a central notion which we want to touch upon, as this is a concern not only to the employees working with the VTV model in practice but also to DTI. The latter argues that the optimal situation is for the researcher to be neutral or without stakes in the different categories of the model. This, as DTI points out, would give the assessment a balanced overview of the issues at stake in each category:

> *If you have a social and health care assistant doing a VTV assessment, then you make a person from the green category have an opinion on the red or the yellow category. It is a self-evaluation. It is very different from using us as an external resource, looking at something from another perspective.* (Gaedt, DTI, translated from Danish)

Gaedt thus argues that as an external actor is better positioned to conduct a more comprehensive assessment of a given technology. She further argues that the professionals should be used as support to gain knowledge regarding the context in which the technology is to be implemented, as well as having them participate in defining relevant indicators. As mentioned above, the role of staff and researcher often merge, which in Gaedt's view is problematic. However, this view of how the assessment ought to be conducted might portray an idea of a neutral science, where objectivity is synonymous with the researcher being a fly on the wall simply taking notes; an impar-

tial observer if you will, undetected and not contaminating anything in the situation observed.

Donna Haraway (1988) argues for a break with the illusion of a value neutral view, but argues beyond the master-slave dichotomy of standpoint theory by arguing that every drawn line between insider and outsider is a power move and not a move towards truth. Instead, what is central to Haraway is that every person's course of life is part of their view, and that trying to obtain a neutral view from above is a view from nowhere:

> *I am arguing for politics and epistemologies of location, positioning, and situating, where partiality and not universality is the condition of being heard to make rational knowledge claims. These are claims on people's lives. I am arguing for the view from a body, always a complex, contradictory, structuring, and structured body, versus the view from above, from nowhere, from simplicity. Only the god trick is forbidden. Here is a criterion for deciding the science question in militarism, that dream science/technology of perfect language, perfect communication, final order.* (Haraway, 1988, p. 589)

Haraway argues that in attempting to be objective - having a sight from above - scientists are failing that same objectivity, not being aware of their own positioning in the field and in their own observations. We do not argue that the professionals whose fields are being observed in the assessment process should necessarily take charge of the assessment, however, it is important that they are included in the process. Not allowing these professionals to take an active, reflecting part in the assessment might lead to a weaker assessment, since the professionals might be able to point to issues which the observers would not have noticed on their own. We therefore argue that the positions of the researchers, wherever they are situated, potentially pose a challenge for the quality of the VTV assessments if they neglect to reflect on their own position. However, actively reflecting on the consequences and implications of one's role as a researcher in the field is not a greater problem for the Social Services Administration than for DTI. Irrespectively, if it is a physiotherapist

from the Social Services Administration or a researcher from DTI doing the VTV assessment, one must actively reflect on his or her own position when conducting the assessment, and the acknowledgement hereof as well as the acknowledgement of the limitations of one's conclusions contribute to more qualified and transparent assessments.

6. Conclusion

The VTV model offers a tangible tool to deal with the complex matters of technology and society. It opens the field of research in municipalities and expands the opportunities to do elaborate research regardless of one's educational background. We argue that the VTV model provides the opportunity to utilise one's academic and professional experience actively in the assessment, creating a strong base for a qualified assessment granted that the researcher is reflective of own position in the field of research.

The use of the VTV model requires knowledge of a variety of methods that may be applied in the field. The researcher must be aware of the consequences of the methodical choices, the advantages and the shortcomings. Having a great tool is not in itself valuable if the researcher does not know how to use it. Therefore, we emphasise the importance of methodical training to make the researcher able to actively reflect on his/her methodical approach and the consequences hereof.

The VTV model is a useful tool to illuminate possible benefits and consequences of implementing welfare technologies. However, one must keep in mind that the assessment is a snapshot of the impacts, in the sense that it is mainly used to assess the implementation phase. We therefore suggest not only to use the VTV model in the implementation phase but rather implement it in a feedback loop with recurring assessments. Furthermore, there is a risk that the assessment model may cause the researcher to focus on one technology as one solution, which makes it important (as a researcher) to remain open to other factors co-existing with the technology so that the different factors can complement one another in an integrated solution.

Although the VTV model does possess the potential to facilitate a socio-technical approach, it needs a clearer illustration of the relations between categories, and further emphasis on the fact that we are not dealing with rigid categories or neat boxes in which to do accumulative research. Thus, the VTV model neither is nor is not socio-technical by default. We have suggested minor alterations to the model explicating the relational aspects in an attempt to steer the researcher towards a more socio-technical assessment. Furthermore, we have made the argument that the model lacks an explicit ethical component that forces the researcher to reflect upon the ethical implications of the given technology.

In a closing remark, it is necessary to state that DTI does not assert the VTV to be flawless. Hence, the format and intended use of the model are under continuous revision by DTI in order to improve future usage.

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Endnotes

1 The VTV model – with its four categories and 16 related questions, organized in a colored coordinate system (described and illustrated in section 3) – is developed and designed by M.Ed. Lone Gaedt, while working for DTI. According to Gaedt the VTV-model is conceived by and has reference to the Social Analytical Perspective (by dr. phil. L.H. Schmidt), which is described and unfolded in section 3.1.

2 NADA (National Acupuncture Detoxification Association) performs treatment of physical and psychical discomfort by acupuncture in the ear.

CHAPTER 3:

Techno-Anthropological Constructive Technology Assessment: What Participatory and Interactive Methods can Add to Constructive Technology Assessment

Pernille Scholdan Bertelsen and Lone Stub Petersen

Introduction and background

In the late 1970s and 1980s, a method for doing Constructive Technology Assessment (CTA) was developed by Jens Müller and other colleagues at Aalborg University, Denmark (Müller, 1980; 1990; Müller et al., 1984; Christensen (ed.), 1986; Lorentzen, 1988; 1994; Rostgård et al. (eds.), 1990). Since then, CTA has been introduced to most engineering students at the university as well as technical high school students in Denmark (HTX). The objective is to provide students with a method that enables them to understand how the technical matters they study and develop are embedded in society, and how society and its actors impact the development of technology. They are introduced to a socio-technical understanding of technology-society relations because they, as Danish engineers according to their curriculum, have to acquire knowledge on how technology and society are mutual dependent entities. In research settings, it has been used and further developed as a framework of assessment within healthcare (Høstgaard et al., 2011; Høstgaard et al., 2017) and environmental areas (Kørnøv et al, 2007). CTA has particularly been developed also in Dutch technology policy (Schot et al., 1997; Rip et al., 2013) and healthcare research setting (Douma et al., 2007) where the focus on assessing the societal impact of technology also has been in focus. In

this chapter, however, we will focus on the abovementioned Danish tradition.

Since 2011, Aalborg University has offered a study programme in Techno-Anthropology (T-A). One of the key purposes of T-A is to educate students in a way where they become competent in addressing complex or what is often named wicked problems that technology development of today poses – i.e., the complex environmental, societal, ethical, and political problems of technology also addressed in different CTA approaches. T-A is, however, not just concerned with technology analysis and assessment but also the co-construction of technology between multiple actors - both engineers, users, and other stakeholders. Here, ethnographic and participatory methods play a central role. A T-A approach to CTA thus contributes to the technology assessment by combining different socio-technical modes of analysis (e.g., STS, innovation, organisational approaches) with technical understanding, quick and proper ethnographic methods, ethical and societal evaluation, and participatory and action research methods. T-A is an interdisciplinary study and research approach to technology development, implementation, transfer, and assessment that builds strongly on and deepens the CTA tradition within the participatory design and research field. The aim is to bridge the gap between engineers, designers, policy makers, professionals, users, etc. Like CTA, it addresses the need for co-designing technology in its societal setting while addressing the societal considerations of sustainability and responsibility.

The research findings that we report from in this chapter contribute to expanding the methods and approaches available within CTA with participatory and techno-anthropological perspectives on technology assessment. Our focus is on how participatory methods can add new insights and enhance or qualify CTA through much more targeted and focussed interventions that facilitate a specific involvement of technology actors, e.g. users, designers, producers, etc. Furthermore, we do this by applying context sensitive participatory and ethnographic methods within a socio-technical framework of analysis.

In this chapter, we hence link together the concepts and understandings of CTA with participatory methods to involve actors in

technology assessment. With a point of departure in the early development of the Constructive Technology Assessment method at Aalborg University, we show how participation has played an integrated part in developing this framework and conclude that these participatory perspectives on technology assessment are if not as important, then more important in the assessment of complex technologies and infrastructures and the complex or wicked problem that they pose today.

First, we present the model of technology analysis and the framework for CTA. Then, we unfold three perspectives of how actors can participate and be involved, and what participatory and interactive methods can add to Constructive Technology Assessment and the understanding of the complex or wicked problems and responsible development of technologies by researchers and students. The chapter then offers two examples of how the use of a) participatory and ethnographic methods (technology users participate in the technology assessment), and b) the use of interactive methods (technology users are given visual and tangible artefacts to facilitate interviews) contribute to a much deeper understanding and assessment of technologies in local settings.

What is Constructive Technology Assessment (CTA)

The CTA developed in Aalborg has its outset in a socio-technical understanding of technology and in a social and environmentally responsible engineering practice. This perspective was developed and further elaborated by a range of researchers at Aalborg University in the 1970s and 1980s up until today (Müller, 1980; 1990; Müller et al., 1984; Christensen (ed.), 1986; Lorentzen, 1988; 1994; Rostgård et al. (ed.), 1990; Høstgård et al., 2013; 2017).

From a techno-anthropological perspective, there are five main reasons for the relevance and importance of CTA today.

1. A socio-technical perspective gives depth to the **understanding of technology**.
2. By assessing technologies, the **contextual elements** of technology becomes clear.

3. CTA facilitates engagement in technological change with local people and thereby highlights the importance of understanding the local settings and further **engaging in participatory processes with key actors** (users, designers, producers, etc.).
4. CTA provides a **framework for addressing technology-related complex or wicked problems.**
5. CTA can be used to **emphasise sustainability** (social and environmental) perspectives in technology development, implementation, and transfer.

In the following, we present and transform the theory of CTA in relation to a techno-anthropological analysis and participatory methods.

The socio-technical constituents of technology

For the purpose of the socio-technical understanding of technology, we present a slightly revised version of Jens Müllers (Müller, 2011) model of technology analysis. This framework is explanatory in relation to the elements of the models of constructive technology assessment presented below. The model of technology analysis is one approach among many socio-technical or STS approaches, like SCOT, ANT, post phenomenology, feminist approaches, etc. One of the strengths of this model of analysis is 1) that is has a focus on understanding technologies as products and 2) that it makes the potential social and technical constituents of technology visible in a structured analysis. This makes the model useful and understandable to students, and researchers. It also makes involvement of technology actors in the CTA process easier.

Müller et al. define technology as: "One of the means by which mankind reproduces and expands its living conditions." The socio-technical model proposes four constituents of technology: technique, knowledge, organisation, and product (see Figure 1).

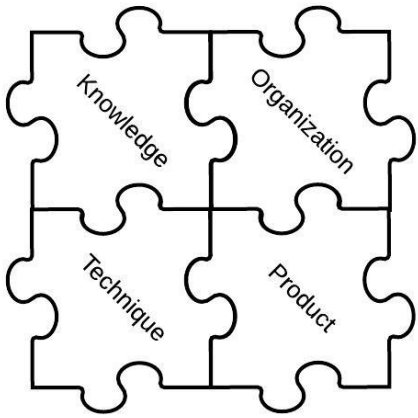

Figure 1: Elements in the conception of technology (Müller, 2011).

With this model, it is possible to describe and analyse technology as a socio-technical entity consisting of four constituting components – components that together constitute what the technology is. Additionally, technology is seen as consisting of several simultaneous and often contrasting processes, therefore technology is not a thing in itself. It is a result of constructive processes. In this processual perspective, technology is flexible in the sense that it could have been otherwise constructed given different knowledge, techniques, organisational and local application circumstances. Further, it is never 'finished' as it changes with the ongoing changes in the (four) constituents of technology.

The four constituting components in the socio-technical model of technology are:

* **Technique** involves the physical aspects of a technology and the transformation and consumption processes of these (**physical process**). In the digital era, this includes not only the hardware, raw materials, components, and energy inputs but also software as represented by code and functionalities. Technique therefore is an element of analysis where the transformation and consumption of material/digital resources are in focus. The processes are set in motion by actors through phys-

ical work processes, like manufacturing, developing, and coding.

* **Knowledge** relates to the human knowledge about the application of the technology. It is the know-how. The empirically acquired' skills, tacit knowledge, intuition, scientific knowledge, and creativity of the technology designers. It consists of the searching-learning of information processing and creative product development (**cognitive process**).

* **Organisation** relates to the **division of labour** and pattern of specialisation (**organisational process).** Structural organisational analysis can differentiate between horizontal and vertical division of labour. Horizontal refers to a structural organisation with many largely independent processes involved in technology design or production, whereas vertical refers to a sequentially structured process of design or production. Organisational elements can either be technically determined, i.e., inscribed in technology, or socially determined, i.e., more flexible for alternative arrangements. This process involves management, co-ordination, and communication processes.

* The **product** is related to the immediate result of the combination of the abovementioned elements and processes. The product can be many things from physical objects to immaterial services. The product constituent of technology in this model must be understood as a holistic conception covering the purpose-oriented application of technology in distribution and use **(application process).** Use value of the product can be either a local distribution and use-setting or it can be a part of another production process, wherein the product functions as a resource. Additionally, the product as a commodity has an exchange value or economic/market value. This is an essential part of the product in societal thinking, as technologies are often seen in the objective of enhancing economic growth.

The product often is what in layman terms is conceived of as technology – also termed the end product or service. This conception, however, is limited and not what is meant by product in this model. Technology is not something in and of itself. It must be understood as a combination of choices made in the production process relating to technique, knowledge, and organisation, and the purpose of the technology in local contexts of distribution and use. In this respect, the actors, which are users, designers, producers, etc., are a key element in the analysis in relation to all the constituents. As experts in relation to application of techniques in the physical process, as actors with different knowledge and worldviews in the cognitive process. As co-ordinating and participating in the negotiations of the organisational processes, and as users, designers, and producers of the products.

Until now, we have covered the constituents of the complexities of technology production. In relation to the last element of the product, we add technology for and in use. Technology is developed to satisfy needs or solve problems – i.e., reproducing and expanding our living conditions.

The constituents of technology should in an analysis not be seen as separate. They are analytical perspectives that enable us to understand the socio-technical make-up of technology and further understand how and why technologies should always be analysed, not as an abstract thing in itself but as situated and materialised in local social settings and practices.

Technology in context – the social condition of technology

Expanding on the model, technology cannot be understood outside the conditions of socio-political, economic, and cultural settings (see Figure 2). These can be termed the local conditions of the technology in use. Technology and the social settings coevolve. Some of these are exemplified in Figure 2.

The pieces should not be understood as separate entities but will always be interconnected. This is central when considering technology transfer and implementation in new settings and can be used in understanding why technology design, implementation, and transfer are complex processes. Further, the complex setting of politics, eco-

nomics, environment, infrastructure, etc. are important elements in considering technology development, implementation, and transfer. Müller states:

> *What actual technological changes do occur is as much dependent on the external socio-political, economic and cultural setting, i.e. the 'local conditions'* […] *as on the internal variables of the technology in question.* (Müller 2011)

Hereby, Müller emphasises the importance of considering both the changes and adjustment needed in relation to the technology and the social/societal setting when analysing technologies and that these always need to be understood in relation to complex local settings (Müller, 2011).

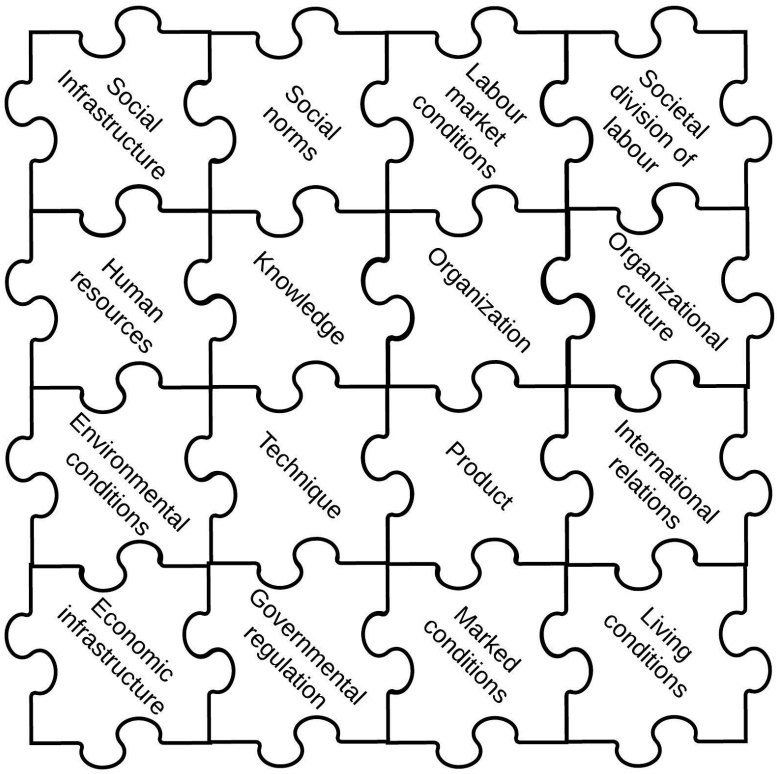

Figure 2: Technology in its complex context (Müller, 2011).

Because technologies are not neutral and omni-useful tools that can be placed and function in any setting, we need to consider what can be done in development, implementation, and the transfer of technology in new settings. Technology implementation and transfer are processes of redesigning the socio-technical make-up of technology. According to Müller, there are three main strategies of technology transfer which are also relevant in development and implementation (Müller, 2011).

1. The technology is adapted to the social setting of the receiver.
2. The social setting of the receiver is adapted to fit the technology.
3. Both the technology and the social setting of the receiver are changed or 'moved' to fit each other at some point.

Because the end result cannot be pre-determined, we need to be aware of and assess the multiple constituents in the processes of technology development, implementation, or transfer. This leads us to the model of constructive technology assessment.

Constructive Technology Assessment (CTA)

Central to CTA is that we need to develop new in-depth knowledge in order to design or redesign technologies for and with new settings. A key point of CTA is that we cannot look at the construction, reconstruction, or transfer of technology as a linear process, we need to account for and reflect on "the roads not taken" (Müller, 2011). Technology development is not a linear process as sometimes (re)presented in e.g. the classic engineering project model - the stage gate model (or waterfall in software engineering). This is not representative for the complexity in solving complex or wicked problems often related to technology development, implementation, and transfer. In order to serve as iterative decision support, there is a need for a flexible model.

Constructive technology assessment has been framed by Müller, Kjaer-Rasmussen, and Nøhr (1989) as consisting of eight steps relating to the constituents of technology presented above. CTA should be considered an iterative and interconnected process of understanding, going back and forth between understanding existing knowledge,

techniques, and use settings towards constructing new knowledge, techniques, and use settings that asses to what degree the problems of actors and society are solved in a sustainable way.

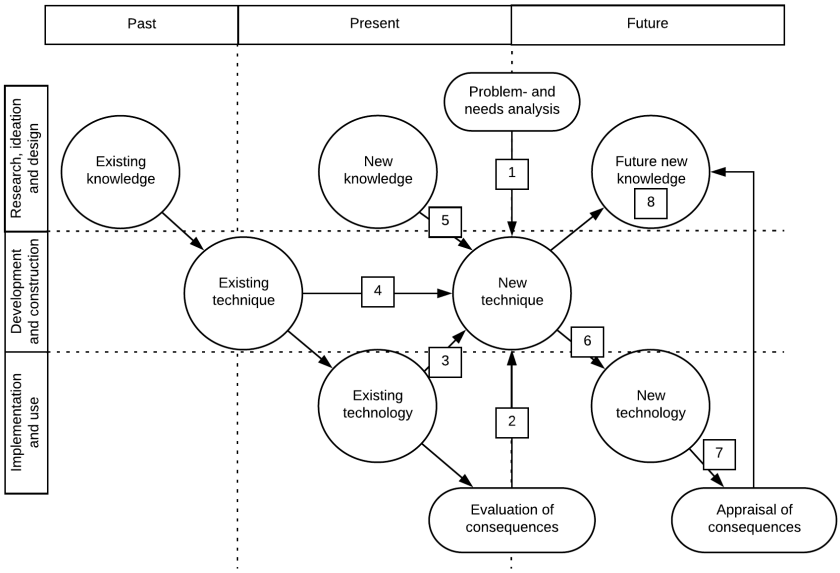

Figure 3: Representation of the CTA process (Müller et al., 1989).

The iterative process of constructive technology assessment (see Figure 2):

1. Analysing the problems and needs of actors and stakeholders in context and transforming these into specific demands. What needs and functions should the new technology fulfil?
2. Doing a summative technology assessment of problems and consequences of the current technology. To what extent has the existing technology process fulfilled and satisfied its functions? Where in the work organisation can problems be pinpointed? How do the different actors and stakeholders judge the consequences?
3. Explore the application and local settings of the existing technology. What is the current implementation of the technology?

What aspects of this implementation of the technology should be retained and which should be modified?

4. The previous design and construction principles are summarized. Which characteristics of the existing technique should be retained and which should be modified?
5. Generate new ideas through research, ideation, and design processes. What new design ideas are relevant in relation to developing new techniques? Are there new ways of solving problems and needs?
6. Outline and consider the new technical principles in their actual implementation setting.
7. A consequence appraisal is made in relation hereto, and at the same time as the considerations in step 6 are being made. Which construction and operation of the available options fulfil the specific needs and problems to the highest degree?
8. A final step is to inform new ideations and designs on the basis of the new techniques and assessments of the technology in use.

As mentioned, the process of CTA should be considered iterative. The elements of analysis inform each other through gaining knowledge of the constituents of technology and the local settings.

Examples of CTA

If we want to understand the technology, we need not to just look at the technique – the hardware – but its production methods, the knowledge of designers, producers, and users, the organisation of work, and the product within economic, political, distribution, and use settings. To understand the technology, we need to understand the physical, cognitive, organisational, and application processes related to the technology.

An example of the abovementioned is a glass of milk for consumption. There are all sorts of milk available. The use value – a glass of milk - is more or less the same whether organic (environment friendly production) or not. If we consider the difference in the production of the milk between conventional and organic milk production, the difference becomes more obvious. The way the grass

and food for the cows are grown differ, and therefore the effect on e.g. the environment is different. The factory treatment of the milk (homogenised or not homogenised) also differs and may have a long-term effect for those who drink the milk. Therefore, the technology (milk) as organisation, knowledge, technique, and product need to be considered or assessed in the local setting, not just as use value or an end product.

Related to the sustainability debate, it is also obvious that technologies are not equal. To understand how and why one product is sustainable and another one is not, we need to look at the entire product lifecycle (all the elements in the technology analysis) when considering environmental sustainability, both organisation, knowledge, technique, and product are central. Is production of milk considered sustainable because it is organic or because of the way it is produced from soil to table? Is the production of shoes considered sustainable because it consists of local materials or because it can be taken apart for re-use? If the parts are not reused, even though they are constructed in a way in which they can be – is it then environmentally sustainable? If the production of the environmentally friendly shoes is implemented with child labour – is it then sustainable?

Any in-depth technology analysis will inevitably become a dive into complex socio-technical settings, as can be seen in the examples above. The different element constituting technology and the CTA-model provide a framework for diving into this analysis of either an existing technology or involving design and redesign processes. However, one must be aware of the limitations. As mentioned, this model emphasises the structural and processual elements in relation to design, implementation, and transfer processes. The perspective therefore has a focus or starting point in a specific product or service. It is the understanding of technology complexities and problems in design, implementation, and transfer that the CTA adds to the assessment of technology.

Participatory Methods and Constructive Technology Assessment

In this section, we will present how participatory methods (PM) can help address key issues within Constructive Technology Assessment. CTA focus on actors. However, there is a strong potential for sup-

porting and developing CTA approaches in relation to why and how actors should play an active part in the assessment process. The aim of introducing PM is to facilitate that the actors as well as the end-users of the technology play a central role in defining and co-creating the assessment framework and the conclusions within.

As was stated in relation to the description of the constituents of technology, the processual nature of technology is central. In CTA, the actors are mainly analysed through the theory of the social carriers of technology (Edquist & Edquist, 1979). In Participatory Constructive Technology Assessment (P-CTA), the actors are seen as users, participants, and co-designers in understanding and assessing the technology (Facey et al., 2017). The users/actors are not just an integrated part of all the constituents, he/she/they should also be participating in creating the understanding of the technology in context – the assessment. The actors in P-CTA are, however, not a fifth element or a constituent of technology. The actors are focussed on how technology is reproduced and expanded – e.i. the processes of human activity through and with technology – what makes things happen. The actors are co-creators of technology in design, implementation, and use.

As an inspiration and consideration of how to do an assessment using participatory methods, the following three approaches of user/actor participation can be considered. The three approaches evolve from user involvement in IT design, but their application to technology assessment processes is relevant. All three approaches value involvement of users/actors, but the purpose, approach, and methods vary.

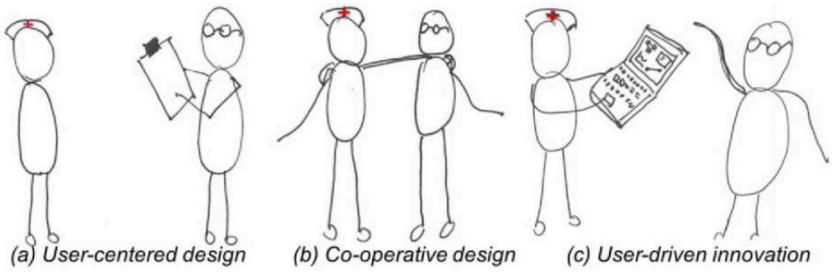

Figure 4: Three different schools of user involvement in IT design (Kushniruk & Nøhr, 2016).

A) User-centered CTA process

Users/actors are involved in the late stages of the assessment process, where they are invited to give their comments. User-centered design (assessment/evaluation) is a broad concept which seeks to embrace the needs and desires of the user and thus recognise that the user/actor has something important and valuable to contribute. The user-centered approach can be characterised by professional evaluators or assessors observing and noting what the user a) does or does not do, b) prefers, c) interacts with, and d) needs. Various methods can be used such as observation, e.g. participant observation, video observation, interviews (open and semi-structured), questionnaires, etc. However, these ethnographic methods are not necessarily participatory methods, as the informants may not necessarily be part of deciding what problems to investigate.

B) Co-operative CTA process

In the co-operative approach, researchers seek to involve actors in the assessment process to ensure that the result meets the actors' experience in the given context. The co-design approach emerges from the recognition that use contexts can be complex and involve human activities and include coordination and collaboration among many individuals with different areas of expertise. By facilitating open co-operation with the actors, the researcher recognises that gaining knowledge about a technology in context is a process where co-operation with the actors are needed, and interactive methods may be means to do so. When the number of actors involved in a use context for and of a technology exceeds a few, the complexity and need for coordination increases. The same ethnographic methods, as mentioned in a) user-centered CTA, can be used, although with some degree of facilitation, and interactive and participatory methods, such as workshops, can be used as well.

C) User-driven CTA process

User-driven participatory methods have direct involvement of the users/actors throughout the planning and the performance of the technology assessment process. This approach originates from different social and political movements in the 1960s and 1970s.

User/actor driven CTA is anchored in the technology users' input – those facing a certain problem - and they are actively involved in the decision making. User-driven innovation is an approach where the basic idea is to engage the users in assessing, innovating, and developing technologies. It is the technology users who are the key players and the key assessment perspectives are developed by them. The researchers' role is to plan and facilitate the processes in a creative and interactive way – using interactive and participatory methods to make it possible for the technology users/actors to assess the technology in question. The Participatory Design research community (PD) as well as the Participatory Learning and Action (PLA) research community will be an inspiration and may serve as a repository from where to learn about participatory methods (Robertson & Simonsen, 2013) or from the open access work at IDS at the University of Sussex, where Robert Chambers, among others, has developed participatory methods with people in the part of the world named the South for decades (see e.g. Chambers, 2008).

In the two cases presented below, the technology users are central in the P-CTA process. As co-creators of technology in design, implementation, and use, they show how it is possible to make known the existing knowledge, existing techniques, and existing technology (Figure 3) which have a key role in understanding and assessing technology. The cases are chosen as they show 1) an assessment of current work practices in preparing for organisational change and 2) the introduction of new technologies that radically change the healthcare services they provide. The P-CTA is therefore used to challenge the contemporary perception of work practices as sequential work task analysis when considering new routines or technologies. Instead, it advocates focussing on the internal dynamic at and of the workplace (Bertelsen & Madsen, 2004; Bertelsen et al., 2005) and the role technology play herein, i.e., the socio-technical aspects of technology.

T-A approaches to CTA takes responsible technology design, development, and implementation to the actors. It is an approach dealing with use contexts and experienced problems and it is appropriate for supporting the use of iterative methods in product devel-

opment, implementation, and transfer or appropriation of technology from one context to another.

P-CTA gives insights into:

a) key actors' own perspectives – exposing aspects of technology use that other more general/analytic ethnographic methods do not necessary get a grasp on, e.g., a difference between the researcher observing actors and actors observing actors as part of a co-creating or user-driven assessment.
b) how to assess and develop responsible technologies by creating different 'rooms' for involving actors and thereby creating the basis for sustainable radical change.
c) the organisational effects in relation to gaining shared understandings between professional groups – having actors in the organisation carry out the technology assessment.
d) how changes in the different constituents of technology can have an effect on other constituents of the technology or infrastructural or societal elements.

What P-CTA adds to the CTA, is a focus on facilitating the actors of technology to play an active role in doing the CTA analysis and the decision-making together with the researcher(s), and not the researchers using the input of users in decision-making. P-CTA is an assessment done with and by the users/actors involved in the technology use context.

As described above, there are different ways of involving actors in a P-CTA using participatory methods. The cases below show two examples of technology assessment done with technology users. The cases are far from exhaustive of the way participatory methods can inform CTA, however, they show ways of how empirical examples of P-CTA can be done, and are being done, and thus inspire future development of CTA methods.

Case 1: The use of participatory methods for technology assessment of how physicians use paper records when they do rounds in a Danish hospital

The target of the P-CTA was to understand the use of paper-based patient records by physicians when they did rounds at a hospital ward in a period prior to implementation of an electronic patient record. The organisation of work in a hospital is perceived here as a social construction by human actors. An explorative method is thus valuable when the objective is to break new ground and yield insights in relation to understanding how potential new technologies, like electronic patient records, will impact work practice.

We see the current change from paper-based patient records to electronic patient records as a change from one technology system to another. The digitisation brings along a new technique which would never be successful in use without a simultaneous adjustment in or of two of the other three elements of the technology, the organisation and the knowledge. Changes in these three elements will finally affect the end result, the product and application processes, which in the case of paper-based patient records, we defined as timely, documented, and accessible data ready for use by the clinicians.

An assessment of the current patient record practice provides knowledge that the electronic system implementation unit can learn from.

Method

This P-CTA was conducted in cooperation with the electronic patient record implementation unit at a Danish hospital as a co-creation of knowledge with clinicians.

The informants were identified by using what may be called a convenience or haphazard sampling method. The informants were few, two physicians in each ward, a medical and a surgery ward. Administrative leaders were given the task of identifying physicians who did rounds on a regular basis. In order to test the method, a pilot study with one physician was done before initiating. In the following, the steps of this P-CTA are described more in-depth.

1. Interviews with physicians

Each **physician** was interviewed using a semi-structured interview guide. An interview method which, in a participatory way, makes the informant explain and in doing so making an analysis of the technology in use, exemplified as the sequence of doing rounds and the use of the paper-based medical records.

Our definition of technology influenced the selection of themes for the interview guide. We were interested in socio-technical issues having to do with the organisational context, among others: the focus area was when the clinicians do rounds; the objective of doing rounds, how rounds are organised at the particular ward, what inputs they use (artefacts and information), and what type of rounds the individual clinician does, the planning, the start, and the end. We were also concerned with the following: who uses the paper-based medical records, what they use them for, who have the legal responsibility, the informal responsibility, the content of the records, and how the records at this hospital differ from records at other hospitals.

The interviews disclosed a distinct difference in the role the paper-based medical records played at the heart surgery ward and at the heart medical ward, respectively. At the surgery ward, the paper records were used to check up on well-known standard procedures, whereas at the medical ward, the paper records were a tool used during the process of identifying and monitoring the diagnosis and the plan for patient treatments.

2. Observations of work practice

After the interview's participant observation was used, we followed each informant on a workday when he/she did rounds, in order to observe how he/she used the paper records. The informants were observed from when they arrived in the morning to when they had finished doing their rounds. Field notes were made concerning all work tasks and how the records were used before, during, and after the rounds.

At both wards, mainly junior physicians did the rounds. Individual differences were observed. Either the clinician prepared him/herself for all the patients of today's round together with the nurse before they started, or they prepared for one patient at the time before

visiting the patient. How the patients were distributed between nurses also impacted the physicians' organisation of their rounds.

In combination with the information obtained from the paper-based patient records, the **physicians** used a number of other artefacts and sources of information when they did their rounds, e.g. morning conferences, whiteboards, other records, nurses, private notes, dictaphones, telephones, printouts of data sheets, order and prescription forms, and more technical devices like stethoscopes, percussion hammers, pupil lamps, etc.

In addition to the work tasks, knowledge, and technical equipment, the organisation of the work among the different professionals at the hospital were observed. The **physicians** were e.g. responsible for what was documented in the records. The medical secretaries were responsible for typing the documentation as well as bringing the records to and from the archives.

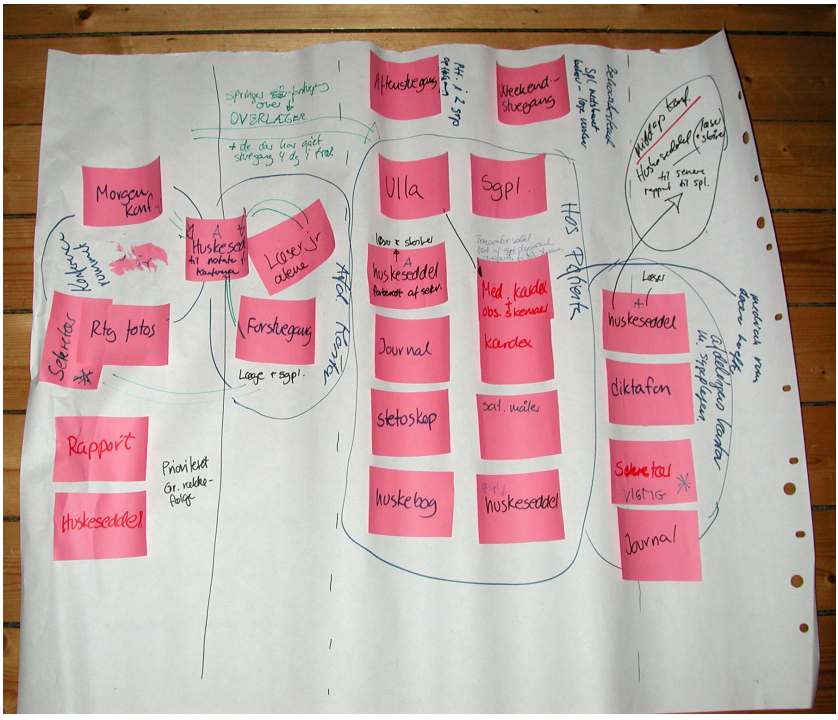

Photo 1: A physician's visual presentation of the different processes and artefacts involved in the technology of doing rounds at a ward.

Considerations concerning the method

By using the four elements in the technology model to design the interview questions, it became possible to gain knowledge from the different components in the technology of doing rounds and the role the paper records played. This understanding made researchers and non-physicians able to understand the difference between the two wards. It was made clear that an electronic patient record also would have to support and be part of different work practises at the two wards.

Visual mapping with the physicians after the interviews provided representations of the understanding of the technology. Either visually mapping the technology or describing or showing clips of video of key understandings of the technology in practice.

By structuring the interview guide and informing the observations based on the CTA framework, the analysis of technology identified the elements of the constituents of technology and therefore provided a broader socio-technical knowledge of the technology in question. This is central in considering the implications of developing and implementing sustainable new technologies.

Case 2: The use of participatory methods for technology assessment of work practise among medical secretaries in Danish hospitals

In this particular P-CTA, the participatory methods contribute to disclose the distinct work practices and in particular the numerous work tasks embodied in the jobs of the medical secretaries at Danish hospitals. Signe Vikkelsø and Sidsel Vinge (2004) argue that the exploration of everyday activities at work (work practices) may help to shed light on tasks that otherwise seem unambiguous and delimited; tasks that often require hidden work to be resolved or are closely intertwined with other tasks and therefore can be difficult to investigate. In practice, there are often unclear boundaries between who does what and who has what responsibility. It is not always that the actions and priorities being made are also those that survive in a subsequent verbal description of events. There is a tendency to 'unconsciously' reject information that questions the established perception. A deeper insight into day-to-day work practices result in the

veil being lifted on a far more complicated and sophisticated practice than initially assumed: an assessment by and with the technology users. This is important when considering the effects of assessing, designing, or implementing new technology or work practices.

Based on the socio-technical conception (hospital), work is here considered a technology understood in the way that the outcome from the work (the product) of the medical secretaries' can only be realised by using a certain knowledge and a particular technique that are organised together, thus making it possible to achieve a job result (Müller, 1973; 1984; 1988; 2003).

The purpose of this P-CTA is to gain an understanding of the technology by using different methods that make the informant think in new ways regarding the content and the outcome of his/her work.

Method

This technology assessment used interactive participatory methods and consisted of five activities.

1. The key actors are given a disposable camera and asked to take photos of his/her work and hereafter return the camera to the researchers who develop the photos prior to an interview.
2. An interview is conducted with the key actors centred around revealing the technical, knowledge, organisation, and product constituents of the technology in question (Photo 2).
3. The photos are used to ask the informants to elaborate on their description of the constituents of the technology. What work can be seen from the photos (the purple post-it notes on Photo 3).
4. The actors are asked to define and structure/describe/categorise their own understanding of the technology product – the purpose/structure of the technology (Photo 3).
5. Validation of technology understanding.

A P-CTA of this kind is best managed by more than one facilitator because questions must be asked, and at the same time there is a need to support the informant writing down keywords on post-it notes and placing them in relevant spaces on the flip chart.

In the following, the steps of the P-CTA are described more in-depth.

1. Handing out disposable cameras
Disposable cameras were handed out to the medical secretaries and they were told to document their work. Prior to the interview, the informants received a disposable camera that they used to take photos of their work. We developed and used the photos as a supplementary artefact introduced to the informant after the oral interview (step 2) was completed. The quality of images taken with a disposable camera by unprofessional photographers is very variable. Despite instructions, some informants struggled to take photos of their work, their colleagues, etc. However, the photographs turned out to be of great importance to the number of work tasks that were remembered. (Digital cameras can be used if more applicable, but a well-defined number of photos should be asked for.)

2. Visually based participatory interview
The interview method used is visually based and structured on the basis of a semi-structured interview guide. Questions were aimed at understanding e.g. used tools, materials, colleagues, work organisation, experience, and knowledge, to help to nuance and multiply the informant's own view of his/her work. The interview guide was designed to ensure that we asked in detail for the content of each of the four technology elements.

Assistive devices, such as flipchart paper, marker pens, and post-it notes in different colours, were used for the interview. The paper was initially divided into four parts or fields, corresponding with the four elements of the technology model. The informant also participated by writing down keywords and moving them around and changing what we registered with keywords, on post-it notes, and stick them to the paper. A kind of structured keyword survey of the interview took shape along the way. E.g., the knowledge that was mentioned (e.g. language proficiency) or occupational tasks for the nurses were noted on yellow post-it notes and placed in the knowledge and product field, respectively.

Photo 2: Participant responses to the four technology elements during an interview.

3. Photos for triggering memory of mundane or infrequent tasks
In phase three of the P-CTA, the medical secretaries answered questions based on photos of their work. The purpose was to register his/her own photos and cast light on possible new tasks not remembered during the verbal interview.

Their photos allowed us as outsiders to get closer to the daily tasks and physical surroundings. We could point at the photos and ask for artefacts and about people on the images and thereby trigger the informant's memory. The photos also expanded the informant's own ability to include work that may not happen every day or had been forgotten on the day he or she was interviewed. An informant had taken a photo of an aquarium standing in a conversation room because it was her responsibility to feed the fish. An apparently insignificant task, and perhaps even perceived as an indifferent one, but nevertheless a critical job because the clinical staff considered it important for people in crisis: to have a calm aquarium to look at when they were told difficult news concerning health.

On the flip charts, the tasks that were remembered after revisiting the photos were written on post-it notes in a different colour. The coloured post-it notes clearly showed on each flip over as an indication that new things emerged.

4. Actor lead understanding of technology

In the fourth phase, we moved all the post-it notes that indicated a task to a new piece of flip chart paper and asked the medical secretary to organise the work in main headings. Here, the actors deal with the structuring of the tasks (i.e., understanding the technology) based on the secretary's own criteria.

Photo 3: Participant's structuring of the work outcome (product element of the technology). The purple post-its are work outcomes that were remembered and added after reviewing the photos, taken by the participant herself.

Validation of understanding

After the first interview round, the partially processed interview data (i.e. the transcribed flip chart information) was submitted to the informant and discussed in conjunction with the full transcript of the interview, to quality assure our data. After the participatory interviews of the process, all interviews were recorded and subsequently transcribed and sent to the informants for them to correct any misunderstandings.

Considerations concerning the method

By asking in detail regarding the content of the abovementioned four elements of technology, knowledge, technology, organisation, and product, we got the informants to think about their work in a new way. The structure of the interview guide allowed for a more in-depth socio-technical understanding than if we had asked the informants to describe their working day. We gained access to many details and minor tasks that for those who work with them on a daily basis seemed insignificant. The use of flip chart paper and post-it notes enabled them to participate actively in the process and to see the information we wrote down and comment on it.

In the case of medical secretaries, a common understanding of them solely doing 'typing in' of physicians' notes most of their workday was questioned. The P-CTA revealed an exhaustive number of tasks that they were involved in (Bertelsen, 2005). The research gave knowledge and voice to an otherwise very silent profession. Now, they had a research-based report to refer to when managers and administration suggested their jobs to be redundant after the implementation of electronic patient records. The main research report has in 2020 been downloaded more than 3.000 times from the VBN at Aalborg University.

Discussion and conclusion

CTA supported by participatory methods should from a techno-anthropological perspective play a central role in informing decisions on developing, assessing, implementing, or transferring technologies. The reason is that many technologies, even though they seem simple, introduce complex problems. P-CTA can assist in providing appro-

priate, responsible, and sustainable technologies for the future. If we want to develop responsible technologies for the future, we need assessment methods that support a socio-technical understanding of technology and co-creation with key actors. The CTA, as developed in Aalborg, is an example of the former – gaining socio-technical understanding. Participatory methods add value to this method, by insisting on co-creation as an integrated part of understanding and assessing technology with actors.

The value of CTA supported by participatory methods is that not only it provides a greater understanding of the technology in situ but through involving the key actors and users, it also creates their learning processes within, preparing the ground for a development of responsible technologies.

We have provided two examples of how the methods have been used for a socio-technical analysis and assessment of technology that goes beyond classical observation and interview. The case examples serve as (limited) showcases on how to use participatory methods in constructive technology assessment. However, there are infinite possibilities of developing new methods and/or combining with known methods for better socio-technical understandings of technology in context (Kanstrup & Bertelsen, 2011).

It might be counter-intuitive that participatory methods are useful in analysis and assessment of technology because analysis often entails the researcher studying and describing the subjects of analysis. What is there to gain? Why invest time and resources in this endeavour? The reasons are plentiful. Basically, the basis for decision-making gets better and a deeper understanding is within reach with the use of participatory methods, where those doing the research include the users of the technology. The use of participatory methods can also entail anchoring and create shared understandings between different professions/actors. In turn, this sets the basis for solid informed decisions and negotiation processes within design and redesign of technologies or work practices. In the hands of a proficient techno-anthropologist, the P-CTA supported by participatory methods holds the potential for better navigation in, and when, solving socio-technical problems through the development and implementation of responsible and sustainable technologies.

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CHAPTER 4:

Constructive Technology Assessment and Partnership Innovation in Developing Countries

David Christensen and Arne Remmen

Introduction

The development and innovation of technologies in developing countries have been discussed for many years. 'Technology transfer' has been applied to describe processes of international technological change from one social and cultural environment to another. These processes have typically been seen as unidirectional, from a developed country to 'beneficiaries' in the South (Kimmage, 1994; Müller, 2011; Andersson, 2013). However, investments and aid programs with this logic have been hit-and-miss over the decades, and cases of 'white elephants' have been numerous.

Kebede and Mulder (2008) highlight local needs assessments and technology assessments as crucial steps towards improving technology transfer overall. Another emphasis has been on adaptation of technology, conceptions of 'appropriate' technology, and upgrading of key factors such as local technical or managerial capabilities (Chatterji, 1990; Reddy & Zhao, 1990; Cohen, 2004).

In lieu of the one-sidedness in technology transfer, innovation in developing countries can be framed as co-development among actors. This opens the field by recognising that people, organisations, etc. influence the process in various ways and directions. For navigating such complexity, we draw on Constructive Technology Assessment (CTA), an offshoot of TA. In this chapter, we consider how practitioners can use CTA to add robustness to promotion of sustainable solu-

tions in developing countries through socio-technical mapping and interaction.

Our explorations of CTA practice are based on partnership-based innovation experiences in East Africa through the initiative *access2innovation*. First, the principles and relevance of CTA in international technology (co)-construction and innovation are investigated. Further, we show through cases within solid waste management and smallholder coffee production how CTA informs practice. Finally, we reflect upon these experiences and their implications for CTA practitioners with respect to partnership innovation processes.

From TA to CTA

TA emerged in the post-1960s out of an imperative to *control* technology in society (Goonatilake, 1994; Rip, Misa, & Schot, 1995; Grunwald, 2015), and was institutionalised in the 1980s and 1990s (Russell et al., 2010). Eventually, some TA communities saw that TA gave rise to a dilemma, arguing that direct control of new technologies is illusory in light of the difficulty of reversing decisions once negative effects become apparent (Remmen, 1991) - also known as the Collingridge dilemma (Collingridge, 1980; van Merkerk & Smits, 2008). An anticipatory TA approach was called for instead, i.e. being able to manage technologies under conditions of incomplete knowledge about their effects. The objective of anticipatory TA remained the same: assessing the potential positive or negative impacts associated with a technology. However, added to this was a heuristic learning perspective which viewed technology development as a 'search process' guided by shared frames of meaning among coalitions of actors (Grin & van de Graaf, 1996). There was also the idea that by anticipating potential impacts and feeding them into actor strategies and decision-making processes as early as possible would reduce the cost of learning in society's handling of new technologies (Schot & Rip, 1996; Grin et al., 1997).

Different forms of TA emerged to reflect this difference from more reactive approaches. CTA was a distinct variant[1] that came out of an interpretative tradition, emphasising socially constructed processes of innovation and the shaping of technology in early stages of development (Moens et al., 2010). As defined by Remmen (1991), CTA is

characterised as an interactive process that embraces active negotiation and learning among involved parties in a technological development process in order to influence participatory change. Figure 1 elaborates on the principal differences between traditional TA and CTA.

Traditional Technology Assessment	Constructive Technology Assessment
• Dominance and authority given to science and scientist-practitioners • Provides the direct consequences and effects associated with a technology • Limited problem analysis • Focus on technical solutions • Results provided in a report • Tool for decision-making • Linked automatically (technocratically) with parliamentary decision-making processes	• Users and scientist-practitioners engage in dialogue • Specifies both aim and methods as well as consequences and problems • Emphasises problem analysis • Combines a number of possible solutions • The results are provided through design criteria and a report, as well as dissemination • Provides a 'catalytic effect' • Interlinks with different arenas of decision-making
Finding the right answers	***Asking the right questions***

Figure 1: Traditional and constructive modes of technology assessment (Remmen, 1991).

Lack of TA focus in developing countries

TA emerged out of a narrow 'Euro America' space (Goonatilake, 1994), and had a cultural bias that seldom took the needs of non-Western nations into consideration (Palm & Hansson, 2006). Though e.g. Coates (1998) saw its usefulness in guiding United Nations programs in developing countries, this was a rare foray into TA applications in these settings. Within the CTA strand of TA studies, there is a preoccupation with emerging technologies in Western settings, e.g. nanotechnology and biotechnology (van Merkerk & Smits, 2008; Kuhlmann, 2013; Rip & Robinson, 2013; Roelofsen et al., 2008).

To address the gap, the STEPS Centre[2] has published recommendations for flexible TAs in developing countries (Ely et al., 2011): here, decision-making ensures involvement of diverse actors including

citizens and continual learning among e.g. universities, NGOs, firms, and users/citizens, see Figure 2.

Figure 2: TA within the policy-making and technological development process (Ely et al., 2011).

According to Ely et al. (2011), the few TAs carried out in developing countries have mostly been technical and for national government or aid programs by centralised institutions or Western consultants. These TAs have been narrow-scoped covering e.g. cost-benefit analyses of infrastructure projects, like dam construction or technical assistance to national agricultural and development strategies. Whereas TA was originally developed to support democratically inspired parliamentary decision-making and policy, TAs in developing countries have been far removed from this ideal.

Some exceptions to the abovementioned rule can be found: Moens et al. (2010) report the robustness of a CTA process using a roundtable workshop methodology for information and communication technologies applied to education (Tanzania), agriculture (Mali), and health (Tanzania), using process and output criteria. However, Ely et al. (2011; 2014) note that the practicalities in developing countries make it unfeasible and unpromising to carry out TAs as in the West due to cost, infrastructure, capabilities required, and weak governance structures. Instead, they emphasise joining citizens and decision-makers together with technical expertise in ways that combine the best of both worlds through TAs that are *virtual* (referring to the use of IT) and *flexible*, i.e. which do not make use of dedicated TA institutions

but *networks* of different kinds of actors. This is seen as a way of filling out institutional capacity gaps of resource-constrained governments. As part of this, the authors call for a so-called 'broadening out' of inputs in TAs, referring to the involvement of diverse actors including citizens to support analytical robustness and continuous learning. In many ways, this mirrors the ambitions behind CTA.

CTA principles and practice

TA is an umbrella for a variety of methods that have developed and changed in characteristics over time. A number of qualitative and quantitative methods are covered by the term[3], from the inceptive use of financial evaluation tools and Delphi methods to so-called radical and broader scoped methods as with CTA in later years (Tran, 2007; Tran & Daim, 2008; Daim et al., 2011). The field is still under development, and researchers and practitioners often apply combinations of tools and methods as well as develop their own to cater to their specific needs. 'Traditional' TA can include e.g. economic analysis, decision analysis, systems engineering, technological forecasting, risk assessment, and impact analysis, while CTA utilizes e.g. intervention in innovation networks and demand articulation (Tran, 2007; Van Den Ende et al., 1998). Further elaborated, CTA is characterised by three analytical achievements (Guston & Sarewitz, 2002): socio-technical *mapping* involving analysis of actors and plotting of recent technological dynamics, controlled *experimentation*, and *dialogue* between the public and innovators.

Remmen (1991; 1995) elaborates on the use of *social experiments* as a mean to affect participatory technological change in CTA. Social experiments are trial-and-error search processes that involve practical sets of organised activities enabling technology developers and users to create the technology on an experimental basis, functioning as a learning platform. Social experiments bring forth concerns and negotiations among participating parties, and support pertinent external considerations being brought into innovation and implementation processes. Remmen (1991) states that this ought to be a focus in future CTA methodology development in which dialogue-based research and development activities ensure that users constitute the basis of planning and are involved.

Moens et al. (2010) describe CTA as an *infrastructure* for multiple actors to meet and exchange. In this respect, Avgerou (as cited in Moens et al., 2010) emphasises that construction of technological artifacts and organisational arrangements arise out of a mix of *technical/rational tasks, institutionalised enactments,* and *improvisational action.*

CTA practice is further described as an *insertion* methodology that is fairly informal and flexible in its initial approach to a research domain (Pearson et al., 2016; Rip & Robinson, 2013), and involves inserting oneself in a socio-technical context to gain an understanding of a phenomenon through interaction: CTA practitioners, in the early phases of a CTA, 'move about' in a socio-technical context in order to develop a better understanding and build relationships and trust among the actors in a domain. Gradually, opportunities are built for reflexivity among different technology actors, aiming to produce inquiry and generate insights. CTA practitioners need to understand layers and relationships between 1) broad public policy activities and public debate, 2) organisations and institutions within a particular domain, and 3) a bottom layer of ongoing practice and projects (Rip and Robinson, 2013).

For innovation processes in developing countries, CTA principles and practice can make use of e.g. social experiments, 'moving about', tasks, enactments, and action to incorporate users and broader inputs from relevant actors across sectors in line with Ely et al. (2011).

Critique of CTA

Criticism leveled at CTA is worth keeping in mind. Genus and Cole (2005) warn that co-construction of technology in CTA underplays differences in agenda or 'rules setting' among parties. This may lead to decision-making becoming influenced by those already powerful in society, which is a particularly sensitive issue in developing countries. Additionally, Reuzel (2001) questions whether CTA truly leads to 'assessments' since it cannot so easily be distinguished from technology dynamics and development in general. Since CTA has reflected a change from an analytical activity to a system of constant feedback, learning, moderation, and adaptation, Reuzel questions whether it can take a critical standpoint on technological change; because CTA

is applied to a social context but is also shaped by it, Reuzel argues that it cannot be objective or value-free. Genus (2006) notes similarly that subjective factors may constrain self-reflection and socio-technical criticism among individuals and organisations, and that there are fundamental tensions between being inclusive, reflective, and reflexive in TA, and finding practical solutions. Reuzel concludes however that CTA, while cumbersome, is a more 'justified road to take' compared with rational (or 'traditional') TA.

Reuzel and Genus' questioning of CTA makes it clear that subjectivity and contention of values are embedded within the method. This is a premise of CTA. We argue that not only can CTA *not* claim objectivity but it *should* not lay such claims either. The critique can instead be taken as a challenge. The onus is on CTA practitioners to be critical towards both self and technological dynamics in a CTA process.

Towards TA in innovation networks

Policy-making decision arenas have historically been prominent for TA across the developed world, and remain a focus (Klüver et al., 2016; Grunwald, 2017). An example is the Danish use of 'scenario workshops' and 'consensus conferences' with citizens in which the focus has been to facilitate an open dialogue between policymakers, experts, and ordinary citizens (Andersen & Jæger, 1999).

TA can however also be carried out within the decision space of a firm with an interest in developing a product and service for a market (Braun, 1998). Within corporate management and strategy as a decision space, managers pursue objectives, means, and ends and allocate resources towards e.g. technological developments in order to improve upon a firm's competitive position (Grin & van de Graaf, 1996). Tran and Daim (2008) note that businesses, universities, and individual researchers have picked up on TA and applied it to various technological applications such as alternative assessments, strategic selection, and acquisition and planning. They further note that this deviates from historical and so-called 'conventional' TA, but that value addition for TA applications for the business and non-governmental sector decision-making clearly merits further study.

We argue that network-oriented modes of TA that are aligned with CTA principles are particularly suited to developing country settings. In the following presentation of the *access2innovation* initiative, we seek to show how CTA principles have guided the initiative's partnership innovation processes in Uganda, which has been the focus for many of its activities.

Partnership innovation and the *access2innovation* initiative

Taking up the gauntlet from Ely et al. (2011) with respect to CTA principles in developing countries, *access2innovation* (www.access2innovation.com) is a Danish network-oriented organisation that has been fostering partnership innovation activities since 2007 (Ravn, 2012; Christensen, 2014; Christensen & Bach, 2015). *Access2innovation* involves the following sectors, both in Denmark and in East Africa, Uganda in particular:

* Civil society (international development and relief NGOs)
* Business (business membership organisations and individual firms)
* Academia (universities and individual researchers)
* Public sector (national bodies and local municipalities)

Figure 3 illustrates the sectors involved in *access2innovation* as well as their respective knowledge bases, with the organisation itself positioned in the center. *Access2innovation* originally formed in 2007 as an action research project to address calls for cross-sectorial collaboration between NGOs, businesses, and authorities at the EU policy-level, and innovation shortcomings within NGOs (Ravn, 2012). Originally, the focus was on humanitarian relief applications, i.e. partnership innovation directed at post-disaster settings. Based on the successful facilitation of four partnerships[4], regional development and national research grants were awarded in 2011 which allowed *access2innovation* to expand its scope to development issues with the poor as clients, customers, partners, and beneficiaries. Today, it is a stand-alone, membership-based organisation and a 'commercial foundation': a form of Danish legal entity with a number of requirements to its governance structure.

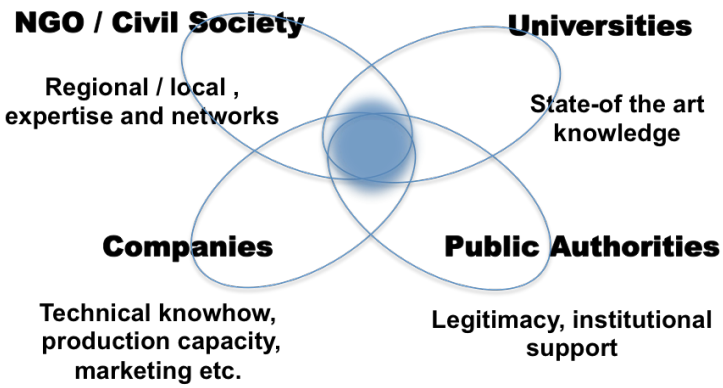

Figure 3: The access2innovation 'quad helix' configuration.

Access2innovation seeks to meet challenges and needs in developing countries through sustainable solutions, inspired by 'Base-of-the-Pyramid' (BoP) and business model development approaches. The BoP approach refers to the notion that that there is an overlooked business potential in the poorest and most underserved segment of the world's population, and that tapping into this segment allows businesses to pursue profits while also fundamentally improving living conditions (Prahalad & Hammond, 2002; Prahalad & Hart, 2002; Prahalad, 2004). Some BoP conceptions emphasise opportunities for environmentally sustainable solutions as well (Kandachar & Halme, 2008). The concept has undergone critique and evolution since the beginning of the 2000s and an overview is provided in Figure 4. The cardinal point in the latest strands of BoP literature is that successfully fostering BoP ventures are contingent upon involvement of many types of actors and setting up partnerships and networks.

Conceptions	Characteristics
Base-of-the-Pyramid 1.0	Explorative 'finding a fortune' efforts in the BoP, 'selling to the poor'
Base-of-the-Pyramid 2.0	Co-creating products and value propositions with communities, bottom-up innovation, sustainable 'green leap' technologies, 'business co-venturing'

Base-of-the-Pyramid 3.0	Open innovation and 'wisdom of the crowd', innovation ecosystems, cross-sector partnership networks, sustainable development frameworks, innovation for 'the last mile' with complementary partners

Figure 4: Evolution of the Base-of-the-Pyramid (BoP) concept, inspired by Simanis and Hart (2008) and Hart and Cañeque (2015).

The business model development approach involves a broader focus than product or service innovation in commercial ventures, emphasising 'how business is done' (Butler, 2017). In *access2innovation*, the business model canvas tool (Osterwalder & Pigneur, 2013) is part of the toolkit for informing practice. In it, different building blocks constitute a business model[5] which becomes a device used for viewing and shaping partnership innovation processes.

Triple- and quad-helix innovation frameworks also loosely inspire *access2innovation's* set-up (Leydesdorff & Etzkowitz 1998, Etzkowitz & Leydesdorff 2000, Etzkowitz 2008, Kimatu 2016). Helix innovation frameworks usually refer to university-industry-government interactions, which may expand to include civil society or other societal sectors. While helix frameworks are clearly applicable to the *access2innovation* conceptual set-up, they are most commonly used as macroeconomic analytical constructs for corresponding analytical scales.

The premise of the *access2innovation* initiative is that synergies may be found in combining inputs, interests, and capabilities of the different knowledge bases involved, with *access2innovation* functioning as an inter-organisational 'infrastructure' or 'partnership incubator' (Ravn, 2015).

The initiative's partnership innovation processes are cross-sectorial and involve co-development within three thematic areas: renewable energy, water and sanitation, and agriculture. Technology development is part of the processes, where *access2innovation* supports firms in matching up to local needs and cultural preferences. The initiative's activities are carried out by an interdisciplinary secretariat that includes staff with varied backgrounds in e.g. environmental engineering, business management, project management, and international development studies.

As per Stember (1991), an *interdisciplinary* way of operating means integrating knowledge and methods from different disciplines, and thereby using a synthesis of approaches. This is a mid-stage between being *multidisciplinary* (people from different disciplines simply working together) and transdisciplinary (a unity of intellectual frameworks transcending disciplinary boundaries). In *access2innovation*, the interdisciplinary mode of operation is shown in the roles and assignments placed on the people in charge of facilitating individual partnership innovation projects: regardless of disciplinary background 'specialisation', each is tasked with facilitating a project as a whole, using input and methods discussed in the secretariat team setting. Such a role requires the facilitator to cover all aspects of a partnership innovation process, often bringing a facilitator outside of familiar disciplinary territory. This requires them to integrate own training, background, and experiences with approaches and methods more familiar to other, fellow *access2innovation* members.

Access2innovation specialises in early-stage partnership innovation activities until a concept is tested. Once a concept has reached this stage, bringing an initiative to commercial scale is the main responsibility of the entrepreneur or firm taking the lead position in the partnership. Beginning as a set of activities funded by research project grants, *access2innovation* currently functions as a membership-based commercial foundation.

Access2innovation makes use of a palette of process management methods to drive partnership innovation processes. They include:

* At the operational or project management level: structured interactive workshops with representatives from participant organisations across and within sectors, as well as with target communities in Uganda and local authorities, as well as bilateral/multilateral negotiations (i.e. meetings) in more sensitive situations and as needed.

* At the strategic level: organised field visits to a developing country for a number of interested Danish businesses as well as strategic co-funding packages to carry out activities such as market and user studies, needs assessments, feasibility studies,

prototyping, business model testing, and meetings/dialogue with potential customers and partners. Organised field visits for local authorities and other partners to Denmark for mutual learning sessions.

* Continuously and in support of the above: networking activity in support of partnership and business model innovation processes. This includes such activities as partnership search, liaising with public authorities, finding further funding opportunities for up-scaling, and finding knowledge resources for technology validation, among others.

These are in line with CTA principles. *Access2innovation* itself functions as an *infrastructure* for actors to meet and exchange (Moens et al., 2010), and to support networked innovation processes (Van de Ven, 1986). Its operational, strategic, and continuous activities amount to *technical/rational tasks, institutional enactments,* and *improvisational action* (Moens et al., 2010).

In accordance with CTA insertion principles (Pearson et al., 2016; Rip & Davidson, 2013), its secretariat members 'move about' for gaining understanding of socio-technical contexts (socio-technical mapping). Socio-technical mappings focus on the thematic areas of renewable energy, water and sanitation, and agriculture in both Denmark and East Africa.

When a firm's innovation process develops to a point where prototyping and testing occurs in partnership with e.g. an NGO, researchers, local companies, or communities, this amounts to *social experimentation* with sustainable solutions (Remmen, 1991; 1995).

Finally, *access2innovation* insertion activities do rely on the secretariat's members being able to navigate different 'layers' (Pearson et al., 2016; Rip & Davidson, 2013), i.e. taking part in public debate and policy-making activities, engaging with organisations and institutions within a domain, and carrying out specific project activities. Figure 5 provides the full overview of *access2innovation*'s partnership innovation projects in the period 2011-2014[6].

	Stage reached	Details
Agribusiness		
Chicken incubators (Uganda)	Full scale demonstration project implemented	Community-based, solar-driven incubator units for chicken and egg production with use of microfinance
Small-scale coffee farming* (Uganda)	Exploration study carried out	Technology, marketing, and management upgrading of smallholder coffee farmers
Chili farming* (Uganda)	Exploration study carried out	Post-harvest technology and supply chain upgrading of smallholder chili farmers
Dairy cooperatives (Uganda)	Exploration study carried out	Technological upgrading of dairy production and supply chain with smallholders and farmer cooperative
Renewable Energy		
Energy hubs (Uganda)	Full scale demonstration project ongoing	Solar photovoltaic mini-grids in rural off-grid communities
Small scale biofuel* (Uganda)	Exploration study carried out	Low-cost and scalable production of second-generation biofuel from agricultural residuals
Renewable energy and energy efficiency (Uganda, Kenya)	Exploration study carried out	Business-to-business energy efficiency and renewable energy solutions
Waste-to-energy* (Uganda)	Exploration study carried out	Waste treatment technology for municipal waste with a view to biogas-based energy and soil fertilizer production
Waste-to-energy* (Vietnam)	Exploration study carried out	Waste treatment technology for municipal waste with a view to biogas-based energy and soil fertilizer production
Steam powered water pumps (Tanzania)	Exploration study carried out	Solar thermal driven water pump technology and business model development
Water and Sanitation		
Urban sanitation (Uganda)	Full scale demonstration project ongoing	Combined retail shop and toilet and shower facilities for urban areas
Payment system for sanitation services (Uganda)	Full scale demonstration project ongoing	Electronic micropayment system as alternative to cash handling
Water purification through renewable energy (Tanzania)	Exploration study carried out	Use of solar PV for water purification in Tanzania in e.g. rural communities and the service industry

Humanitarian Relief		
The 'green generator'	Prototype developed and ready for deployment	Multiple input energy supply for humanitarian base camps
Emergency sanitation	Exploration study carried out	Integrated sanitation solution for humanitarian base camps

CTA process further detailed in this chapter

Figure 5: Access2innovation partnership innovation projects 2011-2014. Asterix (*) denotes direct author involvement.

The following presents a few examples of how *access2innovation*'s facilitation processes have played out in two different geographies in Uganda and in two different thematic areas: renewable energy (waste management) and food security (coffee production). Action research and participant observation characterise the methods used in these processes, tying in closely with CTA principles.

Waste Management in Kasese, Western Uganda

In this case, *Access2innovation* worked with the World Wildlife Fund (WWF) towards mobilising municipalities[7] and businesses in Denmark to support the development of a showcase district in Kasese, Western Uganda, with renewable energy technologies meeting commercial and domestic energy needs. This 'champion district' initiative began in 2012 with WWF's Uganda Country Office as implementing party with support from WWF Denmark and WWF Norway. The district was to demonstrate replicable and scalable solutions through identifying, piloting, and demonstrating innovative ways for increasing access to clean energy. With a target of reaching 100% energy access by 2020, it had a broad partnership scope that included partners both locally and from abroad – including *access2innovation*.

Identifying waste management in Kasese as an intervention area came up during an *access2innovation* field visit in early 2012. The delegation observed waste practices and after discussions with WWF Uganda proposed it as a business case for Danish investors particularly, with regards to biogas or incineration technology with energy recovery for electricity generation.

The CTA process consisted of a socio-technical mapping study of the solid waste management system in Kasese, the district's main city of around 100,000 inhabitants. Christensen et al. (2014) provide a detailed elaboration of the mapping, providing a system characterisation seen through socio-technical theories of path dependencies and innovation and using the ISWM[8] analytical framework (Anschütz et al., 2004) for analysis of social and technical system elements. Methods in the mapping study included qualitative and quantitative data gathering methods including document reviews, semi-structured interviews, direct observations, and surveys covering 15 households and 5 services and industries. Additionally, a workshop with local stakeholders was carried out, facilitated by the WWF Uganda Country Office. A research team consisting of an *access2innovation* staff member and master students carried out the socio-technical mapping.

The mapping study included dialogue with key local decision-makers and waste generators in Kasese, and it was found that the introduction of the initially envisioned waste treatment technologies would be difficult opening a pathway for in the existing waste system, e.g. due to an existing composting plant in operation and lock-in of solid waste amounts to this treatment facility, and would not be commercially viable (Christensen et al., 2014). It was decided to abandon the idea of introducing the waste treatment technologies. Decentralised solutions based on the informal waste sector had more immediate potential instead (but would be less attractive for Danish investors), and opportunities for 'waste-to-energy' were identified in relation to urban sanitation in a separate but related *access2innovation* project in Kasese with the WWF Uganda Country Office.

Coffee production, small-scale biofuel, and chicken incubators in Mbale, Eastern Uganda

In this example, *access2innovation* partnered with a Danish coffee importer that had existing supplier relationships with a local Ugandan processing company that sourced from smallholder farmer groups dispersed throughout the slopes of Mt. Elgon to the east of the country. The coffee importer marketed high-quality coffee in Denmark, based in part on a CSR strategy: it had also been partnering with smaller NGOs to supplement their business with philanthropic development

programs, e.g. dissemination of improved cook stoves and solar PV units for schools. The beneficiaries of these programs were included in the coffee packaging for Danish supermarkets with personal pictures of individuals from the communities and supplementary text.

Access2innovation assessed that the well-established and long-standing relationships with businesses, NGOs, and communities in the area provided a solid foundation for additional partnership innovation activities. The secretariat sought out Danish firms that had an interest in working on innovative solutions to improve the livelihood basis for the smallholder farmers through e.g. agricultural post-harvest technologies.

The CTA process involved *access2innovation* first carrying out a series of research interviews with actors (international agencies, aid agencies, NGOs, and producers and exporters) within Ugandan agriculture and post-harvest technology in general as well and coffee production specifically. This initial mapping was carried out during the 1st quarter of 2012 in order to gain an initial understanding of the socio-technical context as well as the potential and challenges in the sector.

Later and during the 2nd quarter of 2013, a field study was organised in which the Danish firms that *access2innovation* had sought out were invited. In the field study, the firms, together with some university researchers who also showed interest in participating, interacted with the local communities at Mt. Elgon through informal interviews with farmers in their homes as well as workshops. The field visit also included visits to existing firms with post-harvest processing technology and with sellers/exporters. The composition of the participants in the field visit is shown in Figure 6.

Field study participant	Description
Firm A	Single-person agribusiness consultancy and agricultural economics specialist with longstanding work experience in Uganda
Firm B	Farm owner and manager with longstanding work experience in Uganda

Firm C	Private company developing and selling solar-boosted bioethanol production facilities based on agricultural residues
Researcher/Firm	Engineering researcher in vertical axis wind turbines for productive applications in developing countries, and also an entrepreneur within the field with Indian ties
Researcher A	Geography specialist in cultural economics with emphasis on international networks within quality coffee and specialty coffee
Researcher B	Geography and environmental social science specialist in sustainability, innovation, and networks

Figure 6: Participants in the 'Go and See' field study in Eastern Uganda, May 2013.

After the field visit, *access2innovation* invited the Danish businesses to carry out detailed feasibility studies based on their impressions and needs assessments, which the secretariat offered to co-finance. The feasibility studies were to encourage the individual firms (or partnerships, not necessarily with each other) to develop their business models. Afterwards, *access2innovation* was ready to offer co-financing for concept testing as the final step before commercial scaling.

Access2innovation granted feasibility study co-financing packages to two firms: Firm A which was interested in community based, solar-driven incubator units for egg hatching and poultry production in communities near Mt. Elgon, and Firm B which was interested in small-scale bioethanol production units for coffee residuals as well as larger scale units for cane sugar production elsewhere in Uganda. The researcher/firm also applied based on an idea of vertical-axis wind turbine technology for irrigation of coffee crops and energy production, but was found lacking by the *access2innovation* secretariat due to technical feasibility and due to questions that the secretariat raised about the firm's capacity to financially scale the venture. In assessing the applications, the *access2innovation* secretariat considered the proposed business models, the partnerships involved, and the individual capabilities and resources of the applicants.

For the final concept testing stage, Firm A received *access2innovation* co-funding for setting up a solar-driven incubator, while Firm B was refused but did receive funding from alternative sources (the

Nordic Climate Facility) instead. Firm A has managed to test its concept successfully in terms of proving the technical viability and significantly improving poultry production efficiency[9]. Currently, the concept is looking to be scaled. Firm B meanwhile received its funding to deliver a preliminary bioethanol production facility together with a sugar producer, disseminate cook stoves using the fuel, develop a background analysis for a business plan and national expansion plan, interact with stakeholders, and finally establish an office in Uganda (Nordic Development Fund, 2015).

The initial mapping and the following *access2innovation*-supported CTA activities, which included individual firms and researchers, have thus led to validation of business model ideas and opened up further technology development within poultry production and bioethanol in Uganda. The specific community needs with regard to coffee post-harvest technologies were not addressed directly. The single firm/researcher that did address the needs ended up not being supported by *access2innovation* for a feasibility study and concept testing. This is argued to have been a missed opportunity and shows that *access2innovation*'s CTA approach and allocation of resources can remain entangled in economic interests (resource-capable firms) and shies from niche technology development and entrepreneurial support.

CTA and the practitioner

Reflecting upon the CTA approach within *access2innovation*, there have been valuable lessons navigating the complexities in partnership innovation in developing countries with firms and other actors involved in 'making of technology' (Grunwald, 2015). One important challenge is directly addressing articulated user needs under conditions where there are different interests at play, e.g. Danish business communities, individual firms, and local communities. Articulated needs were not addressed in the case of e.g. coffee post-harvest technology. Therefore, the critical perspectives leveled at CTA by e.g. Genus and Cole (2005) remain relevant for the practitioner, i.e. the danger of favouring those already powerful in society, and the questions about being able to disentangle from a technological development process and keeping a critical standpoint (Reuzel, 2001; Genus, 2006). We argue that these are matters of expertise and training but also

matters of personal qualifications and competencies on behalf of the practitioner. It is also a matter of how a secretariat like *access2innovation* operates. What needs to be further developed are ways of articulation and balancing of views appropriately with respect to power relations, and more substantial critical reflection in technology co-construction.

Here, we recognise the conflicts involved in partnership innovation in places like Uganda, and that CTA practitioners have an important role to play in fostering inclusion and sustainable technology development. Feenberg (2017) offers support to this stance, having developed the 'critical theory of technology' approach since the early 1990s which calls for more democratic control of technology[10]. In the critical theory of technology approach, citizen action is vital and usually occurs downstream after technologies are released into public domain as controversies arise over e.g. pollution or medical treatment, but it can also occur 'a priori' with public participation via citizenship juries, or through "*… 'hybrid forums' to evaluate proposed innovations, and collaboration in the design process*" (Feenberg, 2017). This is consistent with CTA, and *access2innovation* can more systematically work with this aspect in the partnership innovation processes it facilitates, i.e. through 'hybrid forums' understood as systematic local community participation in collaboration and evaluation.

In *access2innovation*, the interdisciplinary way of working with partnership innovation processes could also be refined as a strategy for dealing with the need for fostering inclusion and sustainable technology development, i.e. synthesising knowledge and methods from different disciplines represented within the secretariat – but in a more elaborated manner than has hitherto been seen in Uganda. Competencies in the developing *Techno-Anthropology* tradition can help inspire the kind of further interdisciplinary fostering that the CTA experiences call for, i.e. what Børsen (2013) explains as 'interactional expertise', 'social responsibility', and 'anthropology-driven design', respectively[11].

Conclusion

CTA is a particular aspect of TA that remains relevant in developing countries due to challenges with e.g. required capabilities and weak

governance structures. *Access2innovation* experiences have involved partnerships across different sectors within renewable energy, water and sanitation, and agriculture in East Africa and Uganda in particular. CTA is not prescriptive but flexible and relies on an insertion methodology involving socio-technical mapping, experimentation, and dialogue between the public and innovators. CTA has been operationalised in *access2innovation* in a firm-centric, partnership, and network setting, as opposed to public policy and debate as with traditional TA.

Through practical experiences with CTA in agriculture (coffee production, small-scale biofuel, vertical-axis wind turbines, and chicken incubators), it is demonstrated that the *access2innovation* initiative has pushed ahead when local conditions have been favourable towards the introduction of innovative technology, and when there is specific interest in a venture from a firm. This has been the case with regard to chicken incubators and small-scale biofuel production. However, this has *not* been the case with regard to coffee production and post-harvest technologies involving vertical-axis wind turbines.

Through practical experiences with CTA in renewable energy (waste management), *access2innovation* discovered high risks and unfavourable conditions regarding centralised biogas or waste incineration technologies in a socio-technical mapping of the analysed waste system. Further partnership activities along this idea were halted hereafter.

For the practitioner, the *access2innovation* experience base provides a foundation for further development of CTA. In particular, the opportunity presents itself for further fostering of inclusion and sustainable technology development through 'hybrid forums' which have the goal of democratising technology development and ensuring public participation. Further, improved interdisciplinarity can be a strategy for building the needed competencies for inclusive and sustainable technology development. The competencies may build upon the techno-anthropological tradition, namely the emphasis on support to constructive cooperation among various interests and consideration of power relations, explicitly involving ethical analyses,

and keeping to a human-centred perspective in design and innovation processes.

These proposals address some key criticisms of CTA regarding power relations among participants and being able critically to stand apart from a technological development process despite being embedded in it.

Note

The authors wish to note that a previous iteration of this contribution has been published in the PhD dissertation *Bridging Actors in Sustainable Innovation for Developing Countries? Partnerships, Social Construction of Technology and Solid Waste Management in Vietnam and Uganda* by David Christensen, published by the Technical Faculty of IT and Design, Aalborg University.

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Endnotes

1 The terminology is sometimes muddled: aside from use of the TA term itself, similar approaches to CTA include e.g. awareness TA, strategic TA, interactive TA, participatory TA, tracker TA, and real-time TA (Genus & Coles, 2005; Kuhlmann, 2012; Guston & Sarewitz, 2002).

2 The STEPS (Social, Technological and Environmental Pathways to Sustainability) Centre is based at the Institute of Development Studies and SPRU Science and Technology Policy Research at the University of Sussex in the UK.

3 The methods have a truly broad range (Ely et al., 2011): "*… from brainstorming, literature research, document analysis, expert consultation, case studies, cross impact analysis, cost/benefit analysis, trend extrapolation, decision trees, Delphi methods, computer simulations and scenario development.*"

4 Successfully launched commercial ventures included SkyWatch, which produces unmanned aerial drones for various terrain surveying applications, and ViewWorld, a mobile phone application for assisting aid and development workers with data collection and reporting.

5 Value Proposition, Key Partners, Key Activities, Key Resources, Customer Relationships, Channels, Customer Segments, Cost Structure and Revenue Streams (Osterwalder & Pigneur, 2013).

6 2011-2014 covers the scope of this chapter and the main author's involvement in the access2innovation initiative.

7 The municipalities of Frederikshavn and Aalborg in northern Denmark, near where *access2innovation* is based, were in particular invited to take part in the 'champion district' initiative.

8 Integrated Sustainable Waste Management.

9 A hatching efficiency has been claimed to have improved from 10% to 96%, see video 'Chicken incubators in Budaka – access2innovation': https://www.youtube.com/watch?v=pzCpX0RpI_c

10 A full elaboration on critical theory of technology is not provided here but its essential position is to critique technocratic systems in modern society and open the way towards social critique in Science and Technology Studies (STS), from which TA and CTA have sprung from (Feenberg, 2017).

11 Techno-Anthropology is explicitly oriented towards translations of technology across cultural settings (Børsen, 2013): 'Interactional expertise' is a quality that supports constructive cooperation among various interests, 'social responsibility' informs ethical scientific and technological production, and 'anthropology-driven design' positions practitioners as bridges between opposing views in design and innovation projects.

CHAPTER 5:

Digital Methods Contributions to Citizen Hearings: A Techno-Anthropological Approach to Twitter and Technology Assessment

Andreas Birkbak, Anders Koed Madsen, Anders Kristian Munk

Introduction: Supplementing TA with digital methods

Over the past 40 years, technology assessment (TA) has developed into an institutionalised practice for decision-makers faced with the complexity of implementing new technologies in society (Grunwald, 2010). In a European context, the Office for Science and Technology Options Assessment (STOA) represents a network of institutions, such as the Danish Board of Technology Foundation (DBT), that have been pioneering a particular brand of participatory TA, where emphasis is on citizen consultations with a representative sample of the population, following established principles of rational dialogue (Jensen, 2005; Horst & Irwin, 2010).

Within the fields of digital methods and Science & Technology Studies (STS), from which we draw our techno-anthropological inspiration, another set of practices have emerged under headings such as issue mapping and controversy mapping. These efforts involve the use of digital methods to understand and represent public concerns (Marres, 2015). These methods are characterised by being both post-demographic (Rogers, 2013), i.e. not representative, and by following the actors of a debate in the wild, i.e. not in a controlled environment. As such, there is a potential conflict between the practices found in institutions such as the DBT and the practices we refer to as digital methods.

Nevertheless, this chapter explores how digital methods, although seemingly incongruent with established practices for TA, became pertinent in a concrete TA project in collaboration with the DBT. We analyse a specific event where we, as members of the Techno-Anthropological Laboratory (TANTlab) at Aalborg University, collaborated with the DBT to investigate whether and how analyses of Twitter data could provide viable inputs to a citizen hearing the board was facilitating on the topic of epidemics and pandemics. The collaboration revolved around a so-called data sprint (Munk et al., 2017) at the TANTlab in the early spring of 2016, where several data sets from Twitter were explored in order to understand public responses to the threats of epidemics and pandemics.

The chapter proceeds in the following steps. First, we account for the existing practices at the DBT in line with the techno-anthropological idea of building rapport with the domain-specific expertise (Børsen & Botin, 2013). We thus identify three central steps that underpin most TA practices as they are institutionalised within the EU, and we explicate the values of and assumptions about the public underpinning these. We suggest that the practices of DBT should be understood as a specific set of techniques for eliciting public assessment of emerging technologies. This view is informed by the basic techno-anthropological (and STS) idea that in practice, social and technological elements combine in the construction of knowledge, including knowledge about publics (Lezaun & Soneryd, 2007; Laurent, 2011).

Second, we introduce digital methods (Rogers, 2013; Munk, 2013; Birkbak & Munk, 2017; Madsen 2015; 2017), arguing that Twitter is best understood not as a source of 'big data' but as a field of activity that should be studied with a reflexive techno-anthropological attitude in order to take its media-related cultural and technical specificities into account. Also, we explicate the specific socio-technical infrastructures that influence the kind of publics that can be represented with digital methods. For instance, digital traces are weak when it comes to demographic metadata (information on e.g. gender or age are generally not available through digital platforms in any reliable fashion), thus digital methods feed on patterns in decentralised and unmoderated discussions 'in the wild'.

Third, we discuss how to make a techno-anthropological contribution that spans the different practices of DBT and of STS-inspired digital methods. Through fieldwork among TA practitioners, we identify potentially productive interfaces between existing TA practices and our own digital methods practices. Also, we note that some of our own preferred practices are too incoherent with core values in the established practice. The result being that we organise a data sprint around a quite specific challenge: how can a large set of Twitter data be repurposed to source relevant dilemmas about epidemics and vaccines? More specifically, dilemmas that can be used to frame discussions at a pan-European citizen summit?

Finally, the data sprint is described and analysed, including the specific steps taken during data collection and data analysis to develop a meaningful 'interface' between Twitter as a data source and the DBT as an interested party with specific ideas about what counts as public deliberation. This involved an iterative process, drawing on both what is characteristic about the DBT approach to technology assessment, how Twitter could be repurposed to contribute to this approach, and how the DBT approach itself could potentially be developed in view of the affordances of Twitter as a platform and arena of digital public inquiry.

Citizen engagement as Technology Assessment - the Danish tradition[1]

During the 1990s, The Danish Board of Technology was a key contributor to methods that combined practices of citizen engagement with inputs to what is commonly known as Parliamentary Technology Assessment (see for instance http://www.eptanetwork.org/). Born out of an interest in deliberative democracy and public engagement with science in the mid-1980s, the board made itself a consistent partner for Danish politicians in need of assessments of the promises and perils of emerging technologies such as drones or genetically modified foods. From 1995 to 2012, the board was funded as part of the Danish state budget and it was during this period the DBT established itself as an internationally renowned developer of procedures and methods for public engagement in the context of TA (see e.g. Jensen, 2005; Horst & Irwin, 2010).

Examples of methods that characterise DBT's approach to TA is the consensus conference, the citizen jury, and the citizen summit. Each of these methods contains detailed instructions of how to prepare public deliberation on complicated technological issues, how to moderate and facilitate such deliberation processes, and how to communicate the results of such deliberations to politicians and decision-makers. A central trait of the DBT is accordingly to combine a theoretical and methodological interest in the public and its concerns about technologies with an insistence on translating these concerns in ways that make them have an impact on politics. Even though the methods of DBT are many and have their differences, most of them follow a workflow that revolves around the following three steps (see e.g. Danish Board of Technology, 2017; Engage2020, 2015).

The *first step* is to identify dilemmas that can stimulate a productive discussion when the public meets to deliberate. Not all dilemmas are good dilemmas, and a central aspect of this preparatory work is to consult what the DBT would refer to as relevant experts and stakeholders in relation to the technology in question. An engagement exercise about robot technology could, for instance, be grounded in dilemmas sourced from interviews with researchers and engineers, who have reliable knowledge about the state and progress of technological development, as well as experts on the sociology of work, who have reliable knowledge about the impact of technology and automatization on working conditions in different sectors. This ensures that the dialogue takes place on an informed basis.

This way of preparing an engagement exercise suggests that two important assumptions guide the DBT approach to TA. One is that the role of citizens is to debate *pre-defined* dilemmas - not to formulate them. Another is that dilemmas must be selected and formulated in dialogue with people who are *officially credited* with having knowledge about the technology in question. The views of these experts will ultimately be presented in a *fair and balanced* information material that will be circulated among citizens as preparatory reading in advance of the engagement exercise. Since this material will often be written by a journalist, it is the typical journalistic criteria of impartiality that will guide the presentation of dilemmas. Accordingly, the

material presents two - often antagonistic - takes on the right political priorities in relation to a given dilemma.

The *second step* is when the citizens enter the equation. The aim in this phase is to facilitate a rational dialogue about the chosen dilemmas among a selected group of citizens. Again, not all selections are good selections. Most of the DBT methods get their legitimacy by presenting the concerns of a *representative* sample of the population. This reflects another central assumption underpinning the approach to citizen engagement and TA that has been developed by the board. The public that is deemed competent to engage in debates about technologies must be comprised of citizens with no vested interests in the given technology. The best selection of citizens is a group of people spanning a diversity of demographic categories and who are more or less blank slates when it comes to the specific technology being debated. This will ensure that the deliberation takes place with reference to the balanced portrayal of dilemmas in the information material rather than being polluted by dedicated interest groups with no interest in putting their preconceived framing of the issue at risk.

Besides these guidelines for selecting participants, this second phase is also characterised by clear guidelines as to how the actual deliberation takes place. Five to eight citizens are placed around a table with a moderator who ensures that everyone gets their say and that the discussion stays on track in relation to the information material and the questions the citizens are supposed to form an opinion about. For instance, if the prepared material about robot technology includes a dilemma between prioritising efficiency or human interaction in the workplace, it is the job of the moderator to ensure that the citizens at his or her table take a stance on this specific dilemma. In other words - the different tables are supposed to deliberate under the same headline.

The *third step* is to condense the results of the involvement process into actionable recommendation for decision-makers. Success in this phase depends on the moderation taking place during the second step. In order to have an impact, the report must be clear and concise in its communication of the visions and priorities of the citizens. Sticking to predefined dilemmas in the process increases the chance of achieving this in at least two ways. First, it ensures that the report-

ed concerns are 'realistic'. They are rooted in expert evaluations about potential consequences and possibilities of a given technology - not in the free-running imagination of a lay person. Second, organising deliberation across tables around cross-cutting dilemmas eases the communication of 'public opinion'. Because the citizens are discussing comparable issues, they appear as a uniform public that - despite disagreeing on solutions - share each other's framings of the problems.

In sum, the DBT approach to TA stages citizen involvement as a moderated endeavour that sits between expert-driven problem formulations and the output of findings to pass on to decision-makers. With this attempt to outline an archetypical workflow of a DBT engagement process, it becomes possible to understand the specific practice of TA that we aimed to contribute to with our digital methods. Even though our data-sprint was conducted as part of a specific project - *Action plan on Science in Society-related issues in Epidemics and Total pandemics* (ASSET) - it was a prerequisite for the relevance of our contribution that we succeeded in creating a workable interface between our digital methods and the values and assumptions that pertained to the field. For instance: the value of reliable foundations for dilemmas, representations of the public, and actionable recommendations. Before turning to our analysis of the actual construction of such an interface in the ASSET data-sprint, the next section will introduce digital methods as a specific method of making public debates visible.

Digital methods and public engagement

With the rise of new digital media, most notably social media and the web, an increasing amount of digital traces are retrievable and can be repurposed for social analysis (Rogers, 2013). The field of digital methods is guided by pragmatist principles (Marres, 2017; Birkbak & Munk, 2017), including the idea that publics form in response to specific issues and through specific means of conducting and circulating inquiry into these issues (Dewey, 1927; Birkbak, 2013; Marres, 2015). As a result, digital methods pay close empirical attention to how digital media shape social phenomena such as publics and carefully investigate methodological questions related to new digital opportunities for data collection within the social sciences and

the humanities (Rogers, 2013). A social media platform such as Twitter comes with specific formats and affordances such as hashtags and retweeting (Borra & Rieder, 2013; Madsen, 2015). There are also highly sophisticated and diverse cultures of media use connected with digital media. The Twitter platform and its trending algorithm, for instance, are less concerned with the representations of existing social networks (compared to e.g. Facebook) and more focussed on new connections between disparate groupings (see e.g. Birkbak & Carlsen, 2016).

Such media specificities are not necessarily 'biases' to be neutralised or filtered out when using digital methods (Birkbak et al., 2015; Madsen, 2015; Birkbak & Munk, 2017). Taking a techno-anthropological approach, they can be included in the analysis based on the insight that any kind of mediation involves a transformation (Latour, 1987). That does not mean, however, that there cannot be better or worse transformations. Research within digital methods has focused on finding the best ways to 'reappropriate' (Rogers, 2013) or 'interface' with (Marres & Gerlitz, 2016) the existing formats and technologies on the web for social research purposes.

Reappropriations have not least been guided by an attention to public engagement in digital methods. Public controversies, especially, have been argued to lend themselves to exploration through digital techniques that try to make the most of how an increasing number of actors voice their hopes and concerns on the web (Venturini, 2012). Projects such as MACOSPOL and EMAPS rely on data visualisation techniques to produce controversy 'maps' aiming to represent the various positions in a given controversy, including how the positions relate to each other (or not) and how popular they are at different points in time (see e.g. Venturini et al., 2014; Munk & Ellern, 2015).

Digital controversy mapping comes out of a long-standing interest in scientific and technological controversies within science and technology studies and related fields. Controversies are prized for their ability to render the uncertainties of scientific knowledge and technological solutions visible for analysis by social researchers. This interest in controversies thus comes with a problematisation of any simple reference to expert knowledge, especially in the case of public issues and controversies, something which is potentially at odds with

division between the framing of good dilemmas (by experts) and the deliberation of these dilemmas (by lay people) in the DBT citizen hearing method described above.

In short, digital methods come with specific sensitivities (e.g. to media specificity) and a specific conceptualisation of publics (as not falling clearly on any one side of a lay vs. expert divide). This also means that a particular take on participation has been cultivated in relation to digital methods (Marres, 2017). These developments owe not least to how the wider relevance of controversy mappings has been shown to depend on participatory processes involving those engaged in the controversies being mapped. We will briefly mention two such approaches, to which we have contributed.

The first concerns the question of how to design 'with' rather than 'for' publics when designing interactive digital visualisations of data related to specific issues (Birkbak et al., 2018). The thrust of such projects often follows the idea that public engagement can be generated by 'making things public' in relevant and well-designed ways (DiSalvo, 2009, drawing on Latour & Weibel, 2005). Such ambitions, however, also risk reintroducing an instrumental approach to publics, which comes close to the instrumental approach to 'users' that the participatory design tradition has long sought to overthrow (Simonsen & Robertson, 2012). The remedy proposed by Birkbak et al. (2018) is to explore the concerns of target publics as concerns that do not necessarily align with the agenda of the designers. Designing 'with' publics means working at this interface.

A second approach referred to as participatory data design specifies how such work with publics and users may take place by arguing that the qualification of specific digital traces as relevant data is a process that can benefit from being understood as an opportunity for participation (e.g. Jensen et al., 2017; Jensen et al., 2021). Participatory data design involves an understanding of participation as something that can unfold at (at least) three different points in a process of using digital methods. The first opportunity presents itself at the point of 'datafication' (Flyverbom & Madsen, 2015), which is the process of assembling and curating (i.e. filtering, organising, selecting, tagging, cleaning, as exemplified in the case description below) a relevant data set from the throngs of digital data available online and in or-

ganisational databases. The second opportunity comes with the harnessing of these data sets for the production of maps and visualizations that can guide actors in the given field or controversy being investigated. Data sprints are an example of how the production of data visualisations can be opened for participation of a broader range of actors (Munk et al., 2019). The third opportunity belongs to the situations in which the data visualisations are used. At this point, interactive maps and data exploration tools can allow for a more participatory and open-ended interpretation of the results.

The data sprint method has been developed as part of efforts to facilitate the involvement of area-specific experts in the digital mapping of a given issue (Munk et al., 2019). In short, a data sprint starts with input from invited issue experts as to what questions are most relevant to explore with digital methods. The sprint format means short-term, high-intensity work, which again makes it feasible for these issue experts to stay close and contribute to the framing of the data collection and the data analysis. The results of data sprints are (ideally) based on several iterations between expert questions and digital methods techniques, which increase the chance of the final maps and visualisations being relevant to practitioners and publics beyond the data sprint participants.

Creating a viable interface for digital methods contributions to TA

From what has been written above, it is evident that our preferred ways of representing public controversies with digital methods differ in important ways from the preferred ways of showing public concerns in more institutionalised practices of TA, as exemplified by the DBT approach discussed above. Whereas we have been accustomed to working with a theoretical conception of issue-publics in the plural, it is a consistent element in DBT's method that their legitimacy is ensured by presenting a singular and representative 'public opinion' on the given topic. Similarly, digital methods are characterised by a trust in the relevance of patterns in more or less unmoderated discussions on the web, whereas part of the craft of DBT is their expertise in facilitating and moderating rational dialogues.

Accordingly, and in order to contribute to the institutionalised version of TA, we must create a viable interface between two quite

different approaches to a similar task - namely, to make public concerns about emerging technologies visible to decision-makers. As argued in Børsen et al. (2013), this challenge is not surprising from a techno-anthropological perspective. In fact, all successful contributions to technology development have as a prerequisite to understand the culture and practices they are embedded in. In our case, this meant that we could not organise a data sprint without engaging with existing practices in the field of participatory TA on their own terms. In order to meet this demand, we relied on ethnographic encounters with current TA.

Specifically, we participated in two method development seminars - one internal in the DBT and the other organised by ASSET as part of their commitment to do methodological innovation in the field of TA. Furthermore, we participated as speakers at the European Engage2020 conference in Brussels, where the leading organisations in European TA shared methodological experiences. During these events, we were able to engage with central persons in the field to which we were trying to make a contribution. Finally, we conducted participant observation at one of the citizen hearings organised in relation to the ASSET project.

The main question guiding these efforts was to identify ways in which digital methods could make a contribution to the existing DBT TA processes. Would the point of digital intervention be at step one, focussing on selecting and formulating information material and dilemmas, at step two concerning moderated citizen involvement, or at step three, focussing on clear dissemination of results? Addressing such questions via anthropological methods is part of what Techno-Anthropology has to offer to technology assessment. Without acquainting ourselves with existing practices and norms, it becomes difficult to pinpoint the value of an emerging and non-stabilised toolkit such as digital methods.

In this build up to the sprint, it became clear that especially the values and assumptions underpinning step two were too central to the established institution of TA to be challenged. The idea that a proper TA process is built around a representative group of citizens that have engaged in a rational and moderated dialogue with each other was something that was mentioned every time we brought up

digital methods. Some of the fundamental characteristics of digital data stood in stark opposition to the guiding assumptions about proper data. Most importantly, digital traces leave no possibility to check the demographic characteristics of the public and thereby leaves no possibility for ensuring statistical representativity. Also, discussions on Twitter are not properly moderated, and for many it comes across as a space full of rumours and unsubstantiated fears and claims. The socio-technical configuration of Twitter thus made it difficult to produce an account of 'the public' in the sense found at DBT, which cares for the representativity of those traced vis-a-vis the general population. It became clear that DBT strongly preferred a 'citizen hearing public' to a 'Twitter public'.

It became clear that if step two of DBT's take on TA was to move to the web, it would be in a dedicated space designed and moderated by TA experts. In fact, the DBT is currently developing such a space under the heading Global Say. This does not have to be understood as an opposition between a 'real public' and a 'fake (digital) public', but it nevertheless means that DBT prefers the transformations involved in representing the public through the means of a citizen hearing over the means of social media activity on i.e. Twitter. Accordingly, the challenge for us was to develop a methodological protocol for using digital methods to represent publics that was explicated well enough for DBT to trust it, or at least be able to interpret the results through it (Madsen & Munk, 2019).

What emerged during these discussions was a realisation that the best fit for digital methods in the already established space for TA would be to make a contribution to step one. This conclusion was, for instance, the outcome of a talk with the co-director of DBT on the plane back from Brussels. The possibility to use Twitter as a kind of 'hive-brain' to source the relevant dilemmas to be presented in the information material could be a way to improve the usual procedure which would be to call on pre-defined experts. Twitter might provide an indication of other themes and concerns that could serve as relevant background to the physical meeting. Or perhaps Twitter could give new inspiration in relation to the list of experts to call upon when writing up the information material. These were the challenges posed

to the participants in the data sprint, which took place in the early spring of 2016.

Case: Data sprint on epidemics

A central element in the ASSET project was the organisation of citizen summits across eight European countries. This specific method reflects the more generic values and assumptions outlined as foundational for TA processes in DBT above. It aims at identifying citizens' attitudes towards political priorities on an informed basis and its purposed outcome is to provide "[...] a clear indication about citizens' attitudes, which implies some degree of commitment by the policy-makers" (Engage 2020, 2015). To meet this goal, ASSET involved carrying out simultaneous citizen meetings in different European countries where participants would be asked to discuss and respond to the same set of questions and read the same information material in advance.

The information material for these meetings contained a combination of fact boxes and case stories that presented dilemmas and raised questions for the participants to consider. Conventionally, the case stories are selected by the same experts who provide the factual information for the material. This carries an obvious risk given that the experts will frame the problem in accordance with the questions they are able to address within their field expertise. As mentioned in the previous section, it was therefore decided to attempt to draw on digital methods to source case stories from social media talk about epidemics. This would introduce a more bottom-up approach to the information material in which factual information from experts would be presented alongside topical case stories told and seen by a concerned public on Twitter.

The objective for the data sprint at TANTlab thus became to source stories from Twitter that would both address the issue of epidemics and qualify as interesting and legitimate in the context of a citizen meeting and its information material, where they would serve a specific purpose. The challenges involved in achieving this objective fall broadly in two specific categories, namely those related to Twitter as a platform and those related to the citizen meeting as a means for consulting the public. Eventually, the challenges turned out to be overlapping.

The first challenge is to build a good data set with Twitter. The Twitter Application Programming Interface (API) allows continuous and tailored harvest of tweets, but not retrospective harvest (although retrospective data sets can be purchased). It is therefore necessary, for most practical purposes, to build data sets in advance of a sprint or at least start collecting data in advance. The data collection can be delimited in several ways, including specific hashtags or keywords or by specific user profiles. In our case, we worked with data sets defined by the presence of the hashtag #*zika*, since we decided to work with a month of Twitter talk on the Zika epidemic. The data set was harvested using the Twitter Capture and Analysis Toolset (TCAT, see Borra & Rieder, 2014), between February 8th and March 8th, 2016. It contained 400,000 tweets from which we extracted 2,600 co-occurring hashtags to help us identify thematic clusters that could eventually be used to delimit and select stories about Zika through visual network analysis. The extraction process required several subsequent filtering operations that we will go through below. Our digital methods-inspired ambition of moving back and forth between data collection and data analysis in an interactive manner was toned down due to the time frame of data collection on Twitter, which meant that the filtering of the data became the crucial element instead.

The basic question we had to address was how to recognise a potentially useful story, or epidemic-related dilemma, on Twitter. It is a question that cannot be understood in isolation from the context of the citizen meeting and the information material of which these stories would eventually become part. Seen from the perspective of the project partners in ASSET, a story could not be told by a single user but would have to be circulated in a group of users in order to qualify, and it would have to underpin a good dilemma for the citizens to engage with.

There were several ways of operationalising these quality criteria for a story in the data set from Twitter. The most obvious one was to count the number of individual users sharing it. Another would be to measure the diversity of hashtags in use around a story. A single hashtag is, in a sense, already a thematic delimiter that could be used to find and select a story in a set of tweets. It would thus be reasonable to assume that tweets hashtagged #*Rio2016* (the official tag for

the 2016 Olympic Games) in a set of Zika-related tweets from within the same period of time would contain a specific storyline. If *#Rio2016* had high user diversity, this could then be taken as an indicator of a relevant story.

The problem with only counting unique users around single hashtags is that it risks uncritically following media-specific phenomena like bot activity, and that it gives priority to stories that are shared without modification by the users, which suggests a low level of social activity around a story. There is also a third risk that some hashtags are implicated in several stories (about the Rio Olympics, for instance). By focussing the analysis on hashtag diversity as well, these problems can be somewhat circumscribed.

In order to engage with not only user diversity but also hashtag diversity, we first filtered the data set to tweets containing at least two hashtags, a necessary consequence of the decision to look at co-occurring hashtags. This reduced the number of tweets from 400,000 to 19,100. We then applied a criterion of minimum three distinct users per hashtag in order to support the idea that stories should be shared, removing 12,600 hashtags from the set. Realising that some hashtag clusters were driven primarily by many users retweeting the same combination of hashtags once, we decided to filter out hashtags where all users had been active exactly once. This removed a further 3,200 hashtags. We then removed co-occurrence connections between two hashtags if they had been generated by one tweet only. We also removed the top 10 most connected hashtags, interpreting them as the most generic, thus proliferate across the dataset, and as a result not useful for detecting stories. Finally, we deleted hashtags that had been left with no connection to other hashtags (no co-occurrences in the same tweets) by the above filtering operations. The result was a network of 2,600 hashtags connected to each other if they co-occurred in the same tweet at least twice.

The network was imported to the visual network analysis software Gephi and subjected to a force vector layout based on the ForceAtlas2 algorithm (Jacomy et al., 2014). Community detection was carried out by calculating the modularity of the network and assigning a modularity class to each cluster of co-occurring tags.

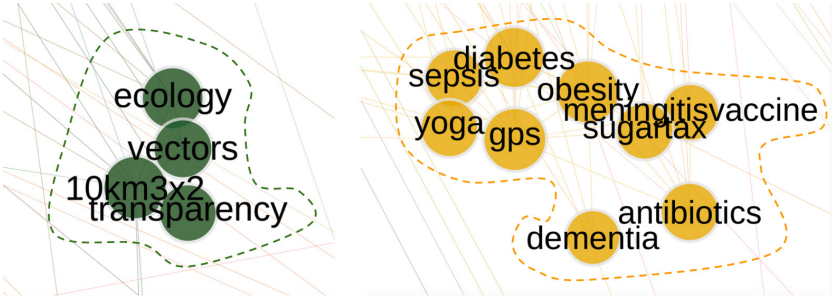

Figure 1: Two examples of thematically specific hashtag clusters from the filtered and spatialized network.

A combination of force vector spatialization and community detection made it possible to delimit clusters of co-occurring hashtags. Some of these were relatively non-specific, containing hashtags like *#WHO*, *#emergency*, *#global* and *#medicine* that one could expect to find in almost any storyline about Zika, while others, such as the ones shown in Figure 1, seemed to be thematically more specific. The first task for the visual network analysis was therefore to identify the most promising hashtag clusters (i.e. those most likely to contain thematically specific stories) for further analysis.

From this preliminary selection of clusters, we exported 12 tweet compilations for each of the clusters we had identified as interesting for further analysis. To be included in the compilation, a tweet would have to contain at least two of the hashtags in the cluster, thus contributing to producing at least one of the edges in the cluster. The tweet compilations were then scored by the issue experts from the ASSET project in order to determine which of the stories would be most interesting for inclusion in the information material.

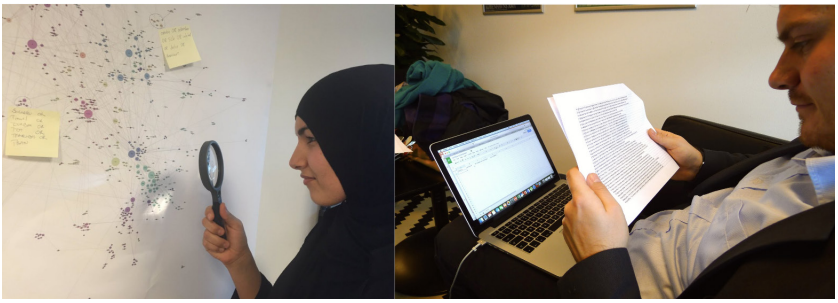

Figure 2: Key moments in the data sprint. Left: Researchers conduct visual network analysis to select Zika-stories for further evaluation by issue experts. Right: TA experts score stories on their controversiality, source diversity, and relevance to the topic of pandemics by qualitatively evaluating tweet compilations.

In the printed information material handed out to the ASSET citizen summits across Europe, a total of four 'Twitter stories' about Zika appeared, as illustrated below.

Historie fra Twitter

De Olympiske Lege i Rio i 2016 er et godt eksempel på denne type debat på internettet. Efter udbruddet af zikavirus i 2015-2016 er det lykkedes forskellige forskergrupper, almindelige borgere og medier at gøre verden opmærksom på virussen. I maj 2016 gik en gruppe forskere således sammen for at opfordre WHO (FN's verdenssundhedsorganisation, der varetager international sundhed) og den Internationale Olympiske Komité til at flytte eller udskyde legene. Eksperter hævdede, at nye konstateringer af zikavirus betød, at det ville være uetisk at gennemføre legene. Debatten bredte sig hurtigt på Twitter, og folk kommenterede på historien ved at bruge hashtags som #MoveOlympics og #Zika.

Lige siden de mere end 100 sundhedseksperter fra hele verden opfordrede WHO til at presse Den

Historie fra Twitter 1: Et tweet fra en gruppe sundhedseksperter, som opfordrede til, at De Olympiske Lege i Rio i 2016 enten blev flyttet eller udskudt, opnåede stor opmærksomhed på Twitter.

Figure 3: An excerpt from the Danish info material handed out to participants at the ASSET citizen summit the 24th September 2016 in Copenhagen. The story is about whether the Zika virus threat should result in the 2016 Olympic Games in Brazil being postponed or moved, and how this discussion appeared on Twitter.

Conclusion

The aim of the chapter has been to describe how digital methods may supplement participatory technology assessment in the tradition that the Danish Board of Technology belongs to. We have argued that this tradition is characterised by a three-step model, where a set of pertinent dilemmas in relation to a given technology are initially framed by domain experts. Then citizens are involved in systematic efforts to deliberate these dilemmas in an environment where opinions are

informed, and the population as a whole is as well-represented as possible. Finally, the deliberation is summed up as results that are short and focussed enough to feed into the various policy-making institutions that legislate about the new technologies in question. Digital methods to some extent break with this three-step model by problematising the lay/expert divide and by being less interested in conventional representativeness. In digital methods research inspired by Techno-Anthropology, publics are rather understood as plural, highly contingent, and emerging in relation to specific issues. This leaves us with the question of how digital methods may still find a place within the DBT process. In this chapter, we have provided one answer to that question by presenting the collaboration between the TANTlab and DBT on using digital methods to feed into the information material in advance of citizen hearings for the ASSET project. As discussed, several steps were taken both in the data collection and data analysis to ensure compatibility with the principles of DBT, including diversity of participants and sources, and the fit with pre-established topics. In the end, a set of *data-driven* Twitter stories about the Zika emergency were included in the information material by the DBT. The case described in this chapter thus points to a concrete way in which digital methods and citizen hearings can be combined despite their different assumptions about publics. When setting up such combinations, techno-anthropological approaches can be usefully drawn upon in order to situate digital methods in relation to existing norms and ongoing practices at the sites of intervention, in this case participatory TA across Europe.

To sum up, two techno-anthropological contributions to TA have been proposed. First, digital methods offer new ways of tracing and representing publics and their engagement in topical affairs for participatory TA. Second, and as just indicated, an ethnographic exploration of the empirical ground in which TA methods are situated can facilitate a more robust integration of digital methods approaches within existing practices.

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Endnotes

1 This section is written on the basis of information on the website of the Danish Board of Technology (tekno.dk) and the website of Engage2020 (http://engage2020.eu), which DBT was in charge of, as well as several conversations and meetings with project leaders at the board.

CHAPTER 6:

The Digital Potential: a monstrous composite?

> *Governments of nearly every country in the world now have well-established policy drives and programs seeking to encourage and support the use of digital technologies in schools, colleges, and universities. Digital technology is a topic of significance to a global educated educational audience.*
>
> (Selwyn & Facer, 2013, p. 1)

> *...advocates rarely announce how they are reasoning.*
>
> (Jasinski, 2001, p. 30)

Jesper Balslev and Søren Riis

Introduction

For 30 years or more, national governments worldwide have invested substantial funds in digital, educational technology[1]. The result? Apart from meeting tautological digitisation goals, it is debatable whether evidential proof exists of substantial improvements, at least on explicit intentions of improving learning outcomes, increasing social mobility, or differentiating education - at the national level. In some cases, the investments have had a direct detrimental effect, by introducing distracting elements into the classroom that perform substantially worse as learning aids than well-known technologies like blackboards, books, pen, and paper (Butler, 2015). In some cases, the political response to this stark reality has been to raise the stakes by accelerating investments in digital technology for education.

Something has gone wrong. Technology assessment (TA) is needed.

In the following chapter, it is our ambition to engage theoretically and critically with contemporary educational technology, by methodically applying theories of technology assessment (TA) but extended with french sociologists Luc Boltanski and Laurent Thévenot's theory of justification (Boltanski & Thévenot, 2006). We will analyse a specific policy paper committed to TA, to demonstrate the value of the model we propose. We will do this by argumenting for why educational ICT should be the focus of TA, and relate this to the problematic nature of digital innovation in the educational sector (and its history). We will then go more in-depth with TA and Boltanski/Thévenot to make the argument that TA fused with their theory of justification strengthens analyses of applied TA. We will demonstrate this by examining a report from the Danish Board of Technology. This analysis suggests new ways of evaluating the merits of ICT, based on justificatory orders that underpin mainstream arguments for introducing ICT in education. The ambition is both to enrich a specific analytic approach to TA, as it is to analyse how TA is performed in an institutional setting.

Semantic clarifications

A majority of our readers will intuitively associate educational, digital technology with digital artefacts used in the classroom since the 1980s, e.g. personal computers, tablet computers (like the iPad), smartboards, laptops, and in more recent years smartphones loaded with educational apps, and/or resources on the internet. However, educational technology can also be interpreted more broadly: as the material expression of ambitions for educational reform, or more broadly as part of a zeitgeist often described as 'the digital age', in other words as something changing the nature of reality itself, often wrapped in enthralling future imaginaries, and consequently put at the center of popular and political concerns.

In the political literature, the object of our study goes under different names. 'Information and Communication Technologies' (ICT). 'Technology Enhanced Learning' (TEL). 'E-learning'. 'Blended Learning'. 'Massive open online courses' (Moocs). 'Computer assisted learning' (CAL). 'Computer Assisted Instruction'. The corpus of institutional advocacy for educational technologies spawns a rich,

dynamic, and diverse naming culture. Whether this is indicative of truly differential innovations, with each their unique characteristics, or whether a strategy of commercial copywriting has seeped into institutional thinking is unclear. We choose to call the object of our investigation 'ICT for education', following a convention from established research traditions[2]. By ICT for education, we mean networked technologies that require electricity and that depend on microprocessors to retrieve, calculate, render, simulate, and manipulate information semiotically, designed for the improvement of learning and teaching.

It is a challenging phenomenon to study, as educational technology has been adopted as an important component in practically all subject areas in education (both as a generic *omnibus* tool, and as specific educational ressources), populated with a vast number of actors and stakeholders, and which has become physically ubiquitous in many countries. In theory, there is educational potential, wherever there is a smartphone or a connection to the internet, i.e. practically everywhere. How do we grasp the phenomenon at its deeper categorical levels - as opposed to theoretical inquiries on the values or effects of singular devices, apps, or software suites? Which framework might help us shed light on educational ICT, and the new challenges that follow in its footsteps? Even though it seems like the matter has been settled, that digitisation of education is a 'fait accompli', it will become clear that there are problems which clearly need methodological and systematic assessment, that in turn might inspire to revise current practices.

Is educational ICT worthy of TA?

In "Technology assessment for responsible innovation" (2014), Armin Grunwald outlines the roots and concepts of TA and introduces the different goals of theoretical TA, since its inception: adding "reflexivity to technology governance" (p. 20), preventing disasters or undertaking "compensatory measures" (p. 18), "to maximize technology's positive contributions and minimize its negative consequences" (quoting National Research Council, 2006), or more fundamentally: getting "things right from the beginning" (p. 16, quoting Roco & Bainbridge 2001). There are, of course, differing,

competing (or complementary) proposals for approaches, concepts, or methods be it from TA, "responsible innovation" or "constructive TA" (Schot & Rip, 1997).

Grunwald describes how TA in the 1970s emerged as a "science-based and policy advicing activity" (Bimber, 1996, in Grunwald, 2014). At its early stages, TA was developed as an early-warning function supposed to equip political actors with the means to "compensate for or prevent anticipated negative effects of technology" and emerged from broader debates in society and science on issues of "risks and chances, potentials and side effects, control and responsibility" (Grunwald, 2014).

Newer developments in TA are - again according to Grunwald - conceptualised as "responsible innovation" and/or "responsible development" and have the same ethical concerns as the latter (gauging potential benefits of technology from the viewpoint of societal values, as opposed to market benefits) but situated closer to innovation processes, i.e. in the research and development (R&D) phase of technological innovation. Grunwald describes how "Science institutions, including research funding agencies, have started taking a proactive role in promoting integrative research and development."

We adhere to the proposition that TA responds to social challenges of the greatest importance, notably in fields like energy, traffical infrastructure, and bio-technology, where the stakes are high and risks potentially catastrophic, for many people. The negative impact of developments where TA has not been applied or has failed to meet its criteria is also a sad, empirical fact: the list of preventable disasters is long.

Does educational technology deserve the same scrutiny? Are potential negative effects comparable to, say, the risks associated with nuclear power plants, emerging genetic technology, or pharmaceutical innovations? It might seem overly dramatic to make such comparisons, but we want to propose four arguments for analysing educational technology from a TA-perspective.

1: Near-ubiquity: the devices used for education have populated both private spheres and professional lives within a very short timeframe (boosted by the popularity of the smartphone, the

Apple Iphone in 2007 e.g.), and consequently have had a considerable influence on many peoples' cognitive environment (how they seek and produce knowledge, how they experience relationships through digitally mediated communication technologies e.g.) as they also have inside educational institutions. This marks a radical environmental shift that might have unanticipated effects.

2: Decade-long claims for the revolutionising potential of educational technology, as expressed by influential political institutions globally, deserve scrutiny, especially when contrasted to reports that few improvements can be measured. Has ICT for education succeeded in fulfilling the promises, can it carry the weight of such political expectations on its shoulders, or put more bluntly: does it deserve the status as an important driver for reform, and for more effective societies?
3: A lack of TA of educational technology at the political level (in contrast to academic scrutiny of educational technology in local settings).
4: Growing concerns that educational ICT is counterproductive to the intentions of increasing learning attainments through technology, and that they distract the student instead, and introduces actors into education whose interests are mainly commercial.

In other words, the pervasiveness of digital artefacts combined with the expectations that institutions pin to them - coupled with various warning signs - deserve assessment.

'Mixed results at best'

In 2015, OECD published the report *Students, Computers and Learning - Making the Connection*. Many of the findings in the report are startling, and undermine long-standing political intentions with the digitisation of education (including OECD's own).

> *These findings, based on an analysis of PISA data, tell us that, despite the pervasiveness of information and communication technologies (ICT) in our daily lives, these technologies have*

> *not yet been as widely adopted in formal education. But where they are used in the classroom, their impact on student performance is mixed, at best. In fact, PISA results show no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education.*

The report finds no appreciable improvements where substantial investments have been made. Asian countries that have invested relatively less in ICT do much better on a range of parameters, and students who use computers very much tend to be worse off. "Many of the evaluation and task-management skills that are essential for online navigation may also be taught and learned with conventional, analogue pedagogies and tools" (OECD, 2015, p. 16). In other words: much time and money has been invested, with little to show for it.

The absence of effects is echoed by numerous academic studies, and think tank reports. We will cite a few here, in chronological order:

> *In the schools we studied, we found no clear and substantial evidence of students increasing their academic achievement as a result of using IT.* (Cuban, 2001)

> *The positive impact of ICT use in education has not been proven. In general, and despite thousands of impact studies, the impact of ICT use on student achievement remains difficult to measure and open to much reasonable debate.* (Trucano, 2005)

> *Taken together, the correlational and experimental evidence does not offer a convincing case for the general impact of digital technology on learning outcomes.* (Higgins et al., 2012)

> *Even if teaching was successfully replicated using technology, it still leaves unanswered questions about what has been enhanced. The experimental comparative approach is associated with behaviourist/cognitivist views of learning and usually*

> *assumes that enhancement involves a quantitative improvement (higher scores equals more learning). This approach reveals nothing about whether students have developed a qualitatively richer or deeper understanding.* (Kirkwood & Price, 2014)

> *Another distraction is the demand for teachers to adopt new technologies. We have been hearing that 'the technology revolution is coming' for the past thirty years or more and how the advent of desktop computers, iPads, smartphones, the Cloud and so on will radically change classrooms. We are told that WiFi is fast, available, cheap and will transform education; that there are terabytes of information available and that schools need access to the web to find it; that kids are now digital natives, wired and on social media and that classrooms need to run to catch up. So why has a transformation in teaching not yet occurred?* (Hattie, 2015)

How did we get there? And are these failed investments not a problem that TA was developed to prevent?

One way we will try to deal with the questions above is to lean on a conceptual framework from one variant of TA, as it is described by Schot and Rip in "The past and future of Technology Assessment" (Schot & Rip, 1997). We will use it to analyse an institutional example of TA in "Skole og Medier" (henceforth named "School and Media", our translation) from the Danish Board of Technology Foundation. As mentioned earlier, we will enrich Schot and Rip's societal concerns with Boltanski and Thévenot's theory of justification.

'Le marriage du siècle': a short history of digital advocacy

Since the early 1970s, with the advent of the affordable personal computer, it has been a theme in policy papers concerned with education that the computer represents a drastic potential to improve education.

In *Education and Technology*, Neil Selwyn (2017) argues that micro-electronics and the birth of educational computing start a fourth wave of excitement about the potential of educational technology,

preceded by educational film, educational radio, and educational television. First instances of accessible and affordable microcomputing (as opposed to mainframe systems) are portable devices like the Texas Instruments' *Speak and spell* machine from 1980, followed by stand-alone microcomputers from Apple and IBM. The quote above is from the then French minister of education, declaring "the combination of information technology and schooling as nothing less than 'le marriage du siècle'" (quoted in Selwyn, 2017, p. 60).

One early and interesting example of what we call institutional thinking on the matter is Unesco's *Prospects in education* (Unesco, 1970). The bulletin is concerned with the potential of "Computer assisted instruction", and introduces many of the themes and arguments used to this day, namely potentials of higher productivity in the educational sector, improved learning processes, the introduction of more objective feedback models, etc.

More political thinking from international institutions followed suit, as exemplified in

World Economic Forum's "Global Information Technology"-reports (published biannually from 2001, annually from 2012). These reports do not at all focus exclusively on education but identify IT in education as a "key issue", and often treated as such in dedicated chapters.

Since 1985, OECD has published the Digital Economy Papers" (the count is at 270 today), and some of them dedicated exlusively to educational technology, others incorporating aspects of educational technology, e.g. "Access to and Use of Information Technologies at Home" (#26, OECD, 1997).

The European Union has also been a productive actor in this field. Early examples of reports are *The e-learning action plan* (2001) and influential whitepapers like "Teaching and learning - towards the learning society" (EU, 1995) where access to digital technology is formulated as a common goal for all member states: "In the long run every class should have the necessary equipment allowing young people access to the world of computers."

The list is by no means exhaustive but should demonstrate that educational technology has been the focus of consistent, institutional attention for more than four decades. As it is evident, the matter

has not quietened down: the amount of actors participating in writing policy papers, and the amount of different institutions pitching in with their advocacy, seems to have been on a steadily growing curve. In Denmark, we have until now identified 18 institutional organs that have authored policy papers on the value of ICT in education[3].

The arguments?
Through an extensive reading of documents from WEF, UNESCO, EU, and Danish governmental institutions, we identify seven clusters of arguments for digitisation, relating to:

* Increased access to knowledge and learning materials.
* Mobility: convenience and access to cooperative platforms, knowledge ressources, and learning programs, unbound from educational institutions.
* Differentiation: the capability of software to tailor learning to the individual learners' needs.
* Internationalisation: ease of access to the rest of world, through e-mail, videochats, and social media.
* Building of digital competencies: acquirement of digital skills for a future that is predicted to become more and more digital.
* Peer-cooperation between students (pooling cognitive resources virtually).
* Student engagement: students and pupils are claimed to be more excited by digital learning tools than by traditional tools and methods.

Education itself, of course, is subsumed under more general concerns. Put together, one could say that the arguments listed rally efforts to alleviate

> *...worldwide concerns over the relative inflexibility of workforces [...] subsequent global uncompetitiveness of economies have therefore prompted many countries to focus on the necessity for individuals to continue learning and reskilling throughout their lifetime* (Selwyn, Gorard, & Williams, 2001).

In an economic context, digitisation of education represents the means by which societies can increase productivity by offering the individual possibilities to educate herself/himself, independent of physical barriers, suited to her/his level of competence, and in an engaging manner, while she accumulutes generic digital competencies for the future workplace.

It is not within the scope of this paper to tell the story of the development of policy papers and the role of ICT in them, but to try and pin a singular (and a relatively current) one down.

Better technologies in a better society: what TA is for

As described by Botin and Børsen in the introduction to this anthology, the history of TA is rich and its applications cover a wide array of technological phenomena.

In "The past and future of constructive TA" Johan Schot and Arie Rip describe an overall TA-philosophy as a commitment:

> *...to reduce the human costs of trial and error learning in society's handling of new technologies, and to do so by anticipating potential impacts and feeding these insights back into decision making, and into actors' strategies.*
>
> (Schot & Rip, 1997)

In their historical overview and attempt at categorising various concrete manifestations of TA, the article advocates for "Constructive Technology Assessment", and its different methods for "the translation of broader societal scenarios and agendas into actual design criteria and other orienters of technological development" (Schot & Rip, 1997, p. 255). A core tenet of this school of TA is "to distribute the responsability for managing technology over more actors" (Schot & Rip, 1997, p. 257), and to "ensure a balance in the access and various constituencies involved in technical change" (Schot & Rip, 1997, p. 26). The article summarises different institutionally led attempts to implement TA practices, but also notes that these attempts often lead to nothing more than publicising results "and hoping that actors will respond" (Schot & Rip, 1997, p. 255).

The primary aim of TA - to build better technologies in a better society - and the method of integrating multiple constituents (producers, consumers, and institutions) affected by technological change into TA, serve as a useful guide when reading policy papers about the use of digital technology in education, by asking two simple questions:

First: which societal parameters (other than deployment/adoption of technology itself) is technological progress assessed against? Secondly: how are constituencies balanced, represented, and addressed?

Societal values

It is common, both in Grunwald's and Schot and Rip's articles, to refer to 'societal values'. Technology, e.g., should be developed with "broader societal scenarios" in mind, or societal aspects should "become additional design criteria" (Schot & Rip, 1997). Another example, quoted by Grunwald, is that TA should add reflexivity to technology governance by "supporting the evaluation of technologies according to societal values and ethical principles". We find the use of 'society' and 'societal values' in the examples above underdefined and of little analytic value. Society is, needless to say, complex (by virtue of the number of actors alone), and societal values are often re-negotiated and in flux. If adoption of technology for technology's own sake becomes a dominant societal value (however narrow such a value might seem), TA or CTA might seem redundant to some observers. It seems that we could be much clearer about which specific societal values technology should adress, and have a clear understanding of which values actors (tend to) adhere to, and typical conflicts that manifest themselves when values collide. One way to develop this issue is to integrate Boltanski and Thévenot's theory on justification (1991), and further elaborated by Boltanski and Eve Chiapello in *The New Spirit of capitalism* (2017). It is essentially a theory of value-regimes ("worlds") that delegates societal values into seven distinct orders: the inspired world, the domestic world, the world of fame, the civic world, the market world, the industrial world, and the "networked world". The sociologists themselves propose yet another "green world", dealing with environmental concerns, as a seventh or eighth justificatory regime, according to how you count[4].

Boltanski and Thévenot's book *On Justification* is a theory of agreement and disagreement, i.e. an account of how actors resort to justifying actions and viewpoints, by activating, pointing to, or retrieving arguments from an internal catalogue of polities. A polity, in this respect, is a theory about societal economics in a broad sense that balances the idea of a higher common good with a principle of differentiation. One example of a polity is the *market* polity, as developed and canonised by Adam Smith in *A theory of moral sentiments* (Smith, 1759). A polity manages to justify inequality, e.g., by a) stating that competition is a universal good (creating universal benefits by creating jobs, and offering consumer goods in the market place), b) that it is a system to which everybody has access (everyone can become affluent with the right attitude, work ethic, etc.).

Boltanski and Thévenot's theory places this range of political justifications within societal actors in political forms of worth - not necessarily in conscious, reflexive, and political literate forms but as inherited political grammars sourced from seminal political thinkers sedimented in the public collective, each offering their version of a coherent and essentially moral vision of how society should be ordered, and consequently activated to settle disputes. Each polity is identified from a thorough reading of a western political philosophy, and the first thinker to formulate a consistent and systematic theory (with the characteristics described above) is used to describe each polity. The foundational/canonical philosophers for each polity are: Adam Smith (market), Saint Simon (industrial), Jean Jacques Rousseau (civilian), Jacques Béningne Bossuet (domestic), St. Augustin (creative), and Thomas Hobbes (fame).

For each polity, we can attach modes of evaluation, tests, relevant proofs, qualified objects, and qualified human beings. In the market polity, those would (respectively) be price/cost, competetiveness, monetary, market goods, and customers/merchants. According to Boltanski and Thévenot, conflicts arise when actors will not recognise that they have

1: failed a test (e.g. provide arguments that do not justify market competetiveness, within a market polity),

2: when there is a more fundamental disagreement about which world of justification is relevant to the situation at hand,
3: or finally, when there is a simultaneous presence of worlds - creating confusion about which political framework should provide the testing criteria to settle a dispute.

Boltanski and Thévenot fold out their theory of agreement by identifying common conflicts when common worlds collide: how actors draw on polities (or political forms of worth), and how compromises are typically produced. Their theory is demonstrated by analysing French management literature from each world, and identifying how criticisms and compromises are performed in the empirical material.

A simple proposal we make in this chapter is that to assess digital technology fruitfully, it might make sense 1) to identify its justification and attach it to the relevant world 2) apply the thesis that this also creates a potential for conflict with competing worlds. To illustrate, an actual example of this, could be to translate the current conflict between corporations' data-collection practices and individual's right to privacy as a conflict between *industrial* principles and *civilian* principles. The value of such a categorisation is both the acknowledgement, the anticipation and perhaps even the reliable prognosis of social problems, curiously absent from political thinking about educational ICT. But also a structured way of tying digital tools[5], relevant tests, and qualified objects together. Our initial analytical model, adopted from CTA, is thus developed to ask the following questions:

1) Which societal parameters (other than deployment/adoption of technology itself) is technological progress assessed against - which worlds of justifications can we attach them to?
2) Which conflicts, if any, might the mobilisation of more than one world of justification cause?
3) How are constituencies balanced, represented, and addressed?

A pragmatic analysis of "School & Media", Danish Board of Technology Foundation

Our proposal is to use analytical inquiry, using document analysis, "in order to elicit meaning, gain understanding, and develop empirical knowledge", to "identify overarching themes", and finally to "generate new research questions" (Bowen, 2009).

The Danish Board of Technology Foundation (DBTF) is part of the European Technology Assessment Group that "has been providing scientific advice for the European Parliament on social, economic, and environmental aspects of new technological and scientific developments since October 2005"[6]. Other member states of this group are Belgium, Germany, the Netherlands, and the Czech Republic - and is thus part of a larger, concerted effort at institutionally embedded TA in Europe. Just recently (i.e. in 2017), Mexico and Japan joined as associate members.

DBTF is the antecessor of the Danish Board of Technology, formerly an independent consulting agency within the Danish ministry of Science, Technology, and Development.

> *The DBT Foundation assesses and advises decision makers on the consequences of the introduction and use of new technology on the society and people in the society. The DBT Foundation is working systematically with a number of technology assessment methods*[7]

The methods mentioned are TA, foresight, outlook, policy analysis and scenarios[8].

Under the headline "publications" on their website[9], DBTF lists 29 published reports (of which four are translated to english), dealing with phenomena like drones, climate change, e-voting, obesity, IT-security, biometric challenges, and one report that matches our focus: IT-supported learning. The report "School and Media" (2011) is the document that we will use as an exemplary instance of politically funded TA. Are there instances of TA-thinking in the report that foresee the dramatic problems that OECD mentions in their report from 2015?

> *Mange undervisningsformer har 20, 30 ja op til 100 år bag sig, og tager ikke højde for, at eleverne i dag går forbi lærebøgerne, forbi skolebibliotekaren og direkte ud på nettet. Derfor kan lærerne ikke udnytte de muligheder, som teknologien giver* (School and Media, p. 10)

> *Many teaching methods have 20, 30, yes up to 100 years behind them, and do not consider the fact that students take a detour around school books, around the school librarian, directly onto the internet. That is why teachers can't use the possibilities that technology offers*. (our translation)

"School and Media" is a 34-page long report, consisting of a set of recommendations, authored by a working group under DBTF. The group is formed by six members, representing four different educational institutions (ITU, DPU, SDU, and UCC[10]) and an independent pedagogical development consultant.

The report starts summarising recommendations, based on investigations that are detailed in four chapters dealing with each their theme: "The potential of technology", "Courses and materials", "Anchorage in the pedagogical practice", and "Learning approaches". Each chapter starts with the working group's recommendations, derived from conclusions with workshops where various constituents have discussed how ICT can be applied concretely to learning. In total, 46 people have participated in the workshops. The majority of the participants come from learning institutions, and a minority from private companies like Microsoft, Digiteach, and Alinea - commercial providers of digital learning materials. Each chapter is supplemented with case stories, and interviews relating educators' hands-on experiences with learning technology. There are no references to academic literature. A quick note on academic references: it strikes us as startling that academic, scientific literature is not invoked, but is it a staple of TA? For Armin Grunwald, one could say that the 'act of attribution' is closely linked to responsible innovation. In this optic, it might have been fruitful to attribute the views on 'differentiated learning' to researchers or research communities occupied with the thematic. In a further elaboration on the notion of responsability,

Grunwald lays out a four-place "reconstruction…suitable for discussing issues of responsability", where item four is "quality of available knowledge about the consequences of the actions". We interpret this point as a normative requirement for innovation that wants to be categorised as responsible.

In the introduction (a composite of a) premise is set in one sentence[11].

a) Everybody agrees that we learn differently[12] (a theory of 'learning styles')
b) There is a problem with the lack of using IT that could support these differences

ICT is implicitly set up as the one and only solution that can support different learning styles, and subsequently: if more schools adopted ICT, more learning styles would be supported. Any scientific basis of these claims are not referenced. In CTA terms, there is clearly an attempt to invite different constituents into the inquiry. Schot and Rip mention three types of constituents: producers, consumers, and institutions. Producers and institutions are represented in the report, but consumers - children and their parents - are absent. On the surface, the integration of societal parameters is dominated by the aim to support different learning styles.

Polities and political forms of worth

Earlier, we introduced political forms of worth as a concept for the polities that actors navigate, or draw upon, to justify themselves.

In "School and Media" we identify three polities, (i,e, the names for the categories of justification that Boltanski and Thévenot have constructed). Each appeal to a higher common principle: the civic polity, the market polity, and the inspired polity.

The civic category consists of words, phrases, and terms that reference *inclusion*, *diversity*, and *individual needs* (as members of learning style communities/minorities). "In this world, the ones who accede to higher states of worth are not human persons but rather the collective persons that they constitute by meeting together."

The market category consists of words, phrases, and terms that reference *sales*, *commercialism*, and *market*. "In the market world, actions are motivated by the desire of individuals, which drive them to possess the same objects, rare goods whose ownership is alienable… Worthy objects are salable goods that have strong position in the market." (p. 196)

The inspired category consists of words, phrases, and terms that reference *engagement*, *desire*, and *passionate souls*; in S & M, mostly in the guise of "firesouls" ("ildsjæle") - the passionate IT-users among teachers[13]. "In an inspired world, the the state of worthiness has the attributes of inspiration itself, in the form of illumination, a gratuitious benefit that is at once external and internal, felt in the experience of an inner movement that takes over and transforms." (p. 159)

Results, forms of worth:

<u>*Civic*</u> (13 references coded).

All the instances of civic thinking revolve around inclusion - tapping their argumentative power from civic orders of worth. IT has the capacity to differentiate teaching, accommodate different learning styles, creating opportunities for diversity and inclusion of pupils with learning difficulties.

<u>*Market*</u> (5 references coded).

A market polity is invoked to formulate 1) a vision of remunerating teachers who create IT-based learning materials, 2) a description of how difficult it is, in a small language area, to expect that the necessary number of teaching materials can be provided purely by market mechanisms (advocating for government support), 3) a description of how a project has *not* created an attractive market for teacher-produced materials, 4) a description of how teachers demand an efficient market place for the materials they have developed, and 5) a school that looks forward to the day the market proposes mobile interactive whiteboards - to create a practice that stops old practices of a frontal, teacher-based education. The market polity is invoked to create

demand and financial incentives for teachers to produce instructional material, and is invoked in the hope that it will create products that are more in line with a vision of 'spreading' technology to the pupils, and break the monopoly of teachers' classic frontal teaching.

Inspired (3 references coded)

In S & M, the inspired polity is invoked when it has to deal with 1) technology enthusiasts among teachers, who are first adoptors, and instrumental in spreading the message about the values and potential of educational technology, 2) as part of a problem with unprofessionally (and disengaging) produced courseware (a synonym for instructional software), and 3) the effect of educational technology on students (pleasure and engagement).

The DBTF monster

Our simple model of teasing out traits from common worlds, applied to a singular document, reveals what we could call a 'monstrous composite'[14] that introduces three orders of worth to the domain of teaching and learning, and the multiple roles of ICT for improving education.

In a value-rational context, this creates tensions. How do you assuage the conflicts between a) the individualistic nature of creativity with b) the notion of an order of worth that is based around values that transcend the individual? Is the teacher to be tested on this ability to transcend personal ambitions (i.e. the common good of the educational system itself) or his/her value as an improvising avant-garde? How does the collective bootstrap the minority of "ildsjæle", without excluding members of the collective? Should the teacher be tested on his/her contribution to the coordination of the collective unity, or his/her passionate relationship with the potential of technology? In Boltanskian terms, creating confusion about the nature of the test creates tensions.

In Boltanski and Thévenots theory, there is an irreducible conflict between civic values and market-values. The Danish educational system is financed collectively by taxes, on the notion that education is a collective good and benefitting the society as a whole. But, in S

& M, one problem with the quality of learning materials for new educational media is the deplorable fact that the individual teacher's effort at creating learning materials is not remunerated. In other words, this introduces a new tension to the civic polity: to make technology work, and to support the civic aim of the institution, an introduction of a market mechanism is needed. One can foresee different problems with such a construction: time needed to produce learning materials must either be taken from teaching obligations, or be incentivized by financial remuneration for work done in 'the spare time', as a result of passion. This could threaten the basic equality between teachers within the system and create fundamental confusion about the role of the teacher.

What are the problems in S & M?

As we described earlier, the premise itself (IT as necessary for supporting learning styles) is not problematic, it rather takes on an axiomatic character. From this starting point however, problems and controversies arise. The dominant problem, in the report, is that existing teaching forms do not account for the new technological reality. But there are many more problems - 49 instances of *problems* were coded, represented by concepts like "inhibitors" (hæmmere), "lack" (of focus, time, investments, knowledge, and competencies), "difficulties", "forced upon", "unprofessional firesouls", "insecurity", "skepticism", "costly", "barriers", "obstacles", and "unfulfilled". The density of problems is high in S & M. Human actors are behind a majority of the problems. Politicians that do not provide funds enough. School leaders that do not set aside the time necessary for teachers to learn and implement the new technologies. Teachers lean on old habits in favour of new technology. The "ildsjæle" are unprofessional and the teachers are insecure.

But to be fair, also one problem with technology itself: it develops faster than the educational system can follow[15].

The purpose of the document is to create unity among the actors behind the problems, in other words: the constituents. In the document, they are: the schools themselves, the teacher education, politicians and producers of learning materials.

One notices the lack of technology providers like Google, Facebook, and Pearson[16] (besides one Danish Microsoft representative), mirroring the proportional representation of technology in our list of problems, i.e. technology itself does not seem to be a root cause of challenges. The absence of technology providers in the group of constituents makes it difficult to see how TA-insights, in the document, could be fed into technology providers' design criteria, as is an ideal for CTA.

Conclusion

In the introduction, we proposed to develop an extended model of TA, using Boltanski and Thévenots theory of justification, and to apply this model to an instance of institutional TA.

This resulted in a tripartite analytical model, focussing on three aspects: social values that the value of ICT are assessed against, potential conflicts arising from multiple modes of justification, and how constituents are invoked. After surveying the field of TA and ICT in education, we proceeded to analyse a document assessing the use of technology in education.

Our reading of "School and Media" revealed blind spots within DBTF's way of performing TA.

First of all, the lack of theoretical grounding/references to academic pedagogical literature permits an unchallenged, axiomatic view of what educational problems essentially are rooted in (lack of technology uptake, for the support of differentiated education). The 49 problems with ICT could have been avoided entirely, if DBTF had consulted the controversies about the scientific value of learning styles, simply by accepting that this is 1) a weak framing of the problem, and 2) thus there is no basis for attributing educational ICT reformatory power in itself, even though this probably would have been a controversial conclusion. Regarding CTA's emphasis on the necessity of broad constituencies, the vision of involving multiple constituents is realised but shows a gap in the most significant constituents: the big providers of ICT, and the consumers (pupils and their parents). Finally, the proposed solutions to the problems introduce new problems, by confusing orders of worth or ignoring the potential conflicts between differing polities. If we were to apply CTA

in a Boltanskian fashion, we wouldn't take ICT as a starting point to adress the subject at hand ('schools and media') but would undertake an analysis of problems in education through a perspective of competing value-debates, including the ones embedded in the technology discourse. A natural step would be to measure these against relevant orders of worth in the domain (the civilian especially, connected to education's long-standing adherence to democratic values). Secondly, by invoking constituents from the three different spheres conjured up by CTA. If different orders of worth are detected, we would identify potential conflicts and reflect on how meaningful compromises could be made between them, in a debate between constituents.

This, of course, opens the avenue for a much larger research question: what is the appeal of the composite of justifications that educational ICT seems to represent, compared to one that concludes that investments in technology cannot be justified as primary drivers for problem solving? Or that the solution to the problems that ICT is supposed to alleviate can be solved by other means? Why does the DBTF, and many other institutional actors, put educational media (and its potentials) at the forefront of the analysis?

This article does not solve the mystery of the 'missing effects' of the investments in ICT for education, and it does not explain the 'lack of uptake', nor does it confirm or deny theories about barriers to the potential. Instead, we have tried to put forward a flavour of risk analysis that can identify and perhaps explain the presence of tensions, resistance, and problems when different orders of worth are confounded, and by invoking technology-discourse as an actor in value-regimes.

Pointing forward, it seems we ourselves could strengthen our analysis by building a much larger corpus of institutional reports that claim to assess the potential of educational technology, and analysing them as we analysed "School and Media" above. As we have seen, there is an abundance of material that could be relevant in that respect. In such a work, the questions could be forced on a larger scale: is there a major tendency in political publications to irresponsibly ignore academic research, to include a sub-optimal amount

of constituents, of perceiving ‘social values’ too abstractly, and to ignore the conflicts when different value-regimes collide?

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Endnotes

1 In England, state funding of over five billion pounds were directed towards education, over a ten-year period. "Nonetheless it can be confidently stated that investment in the United Kingdom has been significant and unprecedented. Selwyn (2008a), for example, states that between 1997 and 2007, over 5£ billion of state funding, in various forms, was directed toward educational technology infrastructure.» (Selwyn & Facer, 2013)

2 The 'ICT for education' query in scholar.google.com returns 2880 results.

3 The corpus this extensive reading comes from consists of PDF-files published 1985-2015 from three international organisations: the World Economic Forum (WEF), the European Union (EU), and UNESCO, and from Danish branches of government: ministries, municipalities, and councils. The documents are found using search engines, through queries like the ones mentioned above - i.e. documents that explicitly adress themes concerning ICT in education. The documents are stored in NVIVO, a software that enables corpus queries. The purpose of consulting the corpus is to identify overarching themes. Questions at the back of our minds, while building the corpus, have been: What are the arguments for, and which problems are adressed in policy thinking concerning ICT for education, if any? Which literature is used as knowledge-base in referenced policy papers? Is it possible to detect a dominating conceptual schema in policy papers that structures reality in certain ways?

4 "One can wonder, for example, whether a green worth…is not being set up at the moment." (Boltanski & Thévenot, 1999)

5 A final note on this brief summary of a comprehensive and complex sociological theory is the role of artefacts as qualifying objects: they can of course have functional value but can also be interpreted as rhetorical agents that galvanise a desired

order of worth. Investments in digital artefacts can be interpreted as demonstrations of adherence to a polity.

6 www.itas.kit.edu/english/parliamentary_ta.php: accessed 2nd of april 2019.

7 www.tekno.dk/ydelser/?lang=en, accessed 2nd of april, 2019.

8 www.tekno.dk/ydelser/?lang=en, accessed 2nd of april, 2019.

9 www.tekno.dk/ydelser/?lang=en, accessed 2nd of april, 2019.

10 The IT-university of Copenhagen. The Danish School of Education, The University of Southern Denmark, and University College UCC (now called Københavns Professionshøjskole).

11 "Der er bred anerkendelse af, at menneskers optimale måde at lære på er meget forskellige, men i den danske skoleverden kniber det med at anvende it til at understøtte de behov som forskellene afstedkommer." Translation: "It is broadly recognised that humans' optimal way of learning is very different, but in the Danish school world there is a problem using IT to support the needs that the differences lead to."

12 Four examples of research that the efficiency of learning styles is a myth: Kennedy (2010), Riener & Willingham (2010), Davidman (1981), Curry (1990).

13 We are not claiming that creativity necessarily results from these individual characteristics, but sort the traits under a Boltanskian order of worth that associate them to the 'inspired' individual.

14 Referencing "The monstrosity of composite setups" in "On Justification" (Boltanski & Thévenot, 2006, p. 225).

15 Echoing concerns in "Fools Gold" (Cordes & Miller, 1991): "Teachers need three to six years to learn how to fully integrate technology into their teaching. But technology should be updated every three to five years. So a teacher's learning curve is thus unlikely to ever level off entirely".

16 Global leader in provision of ICT for education.

CHAPTER 7:

A Quick and Proper Ethical Technology Assessment Model

Tom Børsen

1. Introduction

Techno-Anthropology is a study programme and research topic at Aalborg University that addresses the human-technology interface. Technology assessment is a central tool in the techno-anthropological toolbox because it sets out to assess the impacts of technologies on humans, human culture, and the human condition. Techno-anthropological technology assessment generates an understanding of how technologies influence the daily lives of humans, society, and humankind as such. In doing so, technology assessment synthesises many individual/idiographic techno-anthropological studies and examples of technologies in practice to form a nuanced and comparative picture of the possible impacts of the technology under assessment. Technology assessment draws on different sources when painting a picture of the effects of a given technology.

Technology assessment's mapping of technological impacts is a prerequisite for designing technological solutions where notice is taken of both intended and unintended effects. This endeavour is also central in Techno-Anthropology that has as its mission to promote robust and responsible technological innovation that explicitly aims at preventing undesired technological effects.

The understanding of technology, and hence what one sets out to assess, is central to technology assessment. Through the techno-anthropological lens, a technology is seen and understood as a socio-technical configuration. According to Tom Børsen and Torben Elgaard Jensen (2016), it entails that technologies consist of entangled

socio-technical matters. The essence of technology is not only technical. It also involves humans, cultural elements, interests, and values. The effects of social-technical ensembles are localised, to some extent unpredictable, and results of complicated interactional processes. Technologies are furthermore entangled within societal and historical transformations and therefore often controversial. They often evoke discussions about ethics, futures, politics, sustainability, and humanity. Technology assessment, in a techno-anthropological perspective, sets out to assess the actual and possible, and the intentional and unintentional implications of either existing or imagined future socio-technical configurations.

To decide whether the actual and possible, the intentional and unintentional implications of a technology are ethically desirable, the author has developed the so-called 'Quick and Proper ethical Technology Assessment' (QPeTA) model that this chapter presents and applies. Different technologies have been assessed using the QPeTA model or elements of it. Tom Børsen and Pia Danborg use the model to assess Health Information Systems Technologies with a special focus on preventive breast cancer surgery (2015). Tom Børsen and Søren Nors Nielsen's contribution to a four-part special issue of HYLE – International Journal for Philosophy of Chemistry on 'Ethical issues in Chemistry' applies the QPeTA model to ethically assess the use of DDT (2017). The QPeTA model is inspired by, but not identical to, Klavs Birkholm's ethical technology assessment model (2012, 2013, 2016).

In this chapter, two exemplary ethical analyses are included to illustrate the application of the model: preventive breast cancer surgery based on analysis of health data and digitisation of professional judgment. The first example is real. The second example is imagined in the sense that the technology is not fully implemented.

Three wicked questions guide this paper's presentation and application of the QPeTA model:

* How can we predict the impacts of technologies on human wellbeing, human institutions, human societies, human cultures, and humanity?

* What are the criteria for assessing a technology as overall beneficial or harmful to humans?
* How can stakeholders' input be incorporated in technology assessment?

The first question is epistemological and relates to uncertainty, and constitutes one part of technology assessment. Most foundational work in technology assessment addresses this question (Børsen & Botin, 2013). The second question is ethical and answers to this question constitute the foundation for technology *assessment* – when should a socio-technical configuration be assessed positively or negatively? A central and important techno-anthropological intellectual competence is the ability to make contextualized ethical estimates of existing, new, and emerging technologies. A central assumption underpinning the QPeTA model is that the normative criteria for technology assessment are *ethical values*. The third question is methodological, and reflects the fact that technology assessment must be based on empirical input from those affected by the technology being assessed. These three questions will inform this chapter's introduction and application of the QPeTA model.

Techno-Anthropology's inclusion of ethical technology assessment as an internal and central element makes it relevant to the 'Responsible Research and Innovation' (RRI) thematic embedded in the European Commission's funding framework Horizon 2020, and in several funding schemes administered by national research councils.

RRI contains two elements. It encourages stakeholder involvement in research and technological innovation in the sense that stakeholders are expected to collaborate and mutually bend their agendas to promote collaboration. RRI also suggests that research and technological innovation should be directed towards solving, managing, or otherwise addressing typical epochal challenges. The two elements of RRI are interrelated:

> *[RRI is] a strategy of stakeholders to become mutually responsive to each other, anticipating research and innovation outcomes aimed at the 'grand challenges' of our times, for which they share responsibility.* (von Schomberg, 2013, p. 4)

According to René von Schomberg of the European Union's Directorate General for Research and Innovation (2013: Table 3.1), RRI involves

* Technology assessment and foresight
* Application of the precautionary principle and other normative/ethical principles when doing research and technological innovation
* Innovation governance, stakeholder involvement, and public engagement of/in research and technological innovation

These three bullet points are reflected in the research questions posed above and guide the discussions of the QPeTA model in this chapter.

2. The Quick and Proper ethical Technology Assessment model

This chapter presents and applies a method developed at Aalborg University to conduct a quick and proper ethical analysis of issues and dilemmas related to the development and use of technology (Børsen, 2013; Børsen & Danborg, 2015; Børsen & Nielsen, 2017). The model is useful for techno-anthropologists and others who want to make a quick and proper ethical assessment of a real or imagined socio-technical configuration. It splits up the ethical assessment into four steps:

1. Identification of intended beneficial consequences, potential misuse, unintended adverse side effects, and long-term consequences for society
2. Linkage of intended consequences, misuse, adverse effects, and cultural implications of the uses of the assessed socio-technical configuration to appropriate ethical values
3. Identification of unethical situations and ethical dilemmas related to the socio-technical configuration under assessment
4. Formulation of appropriate technological and institutional design criteria that can resolve the identified ethical dilemmas

The third step of the quick and proper ethical assessment method introduces a distinction between an unethical situation and an ethical

dilemma. An unethical situation occurs when it violates ethical standards without being justified by any other ethical value. An ethical dilemma is defined as a situation where different ethical values are in collision or where there is a collision of different interpretations of the same ethical value.

The quick and proper ethical assessment method is inspired by the so-called common-sense morality. Common-sense can be understood as what Aristotle named *Phronesis* - practical wisdom and functioning judgment. Phronetic judgment strives after the good life and the individual or collective ability to define actions pointing in that direction, in a context of contradictory but legitimate values. The ambition of common-sense morality is to balance ethical concerns, which point in different directions when formulating ethical compromises. Common-sense morality is an ethical theory differing from many other ethical theories by not providing universal answers or decision methods. The ethically correct action is context-dependent, where one must independently evaluate his/her options and choose what seems most ethically correct in a context of conflicting concerns. As the name *common-sense* implies, this ethical theory cherishes common-sense and believes in the ability of humans to make judgments that are as informed and reasoned as possible. On one hand, common-sense morality accepts that established ethical approaches reflect legitimate ethical concerns. On the other hand, it does not insist on only one ethical principle but instead emphasises ethical reflection and common-sense.

2.1 Ethical values

This ethical technology assessment model takes a number of ethical concerns into account. Ethical concerns are reflected in ethical values that play a central role in the analytical tool presented here. An ethical value is understood as a normative criterion against which one can compare the wider consequences of and circumstances surrounding the use of a given technology. Do uses and misuses, resulting in both short and long-term effects, align with or violate different ethical values? Over time, a long list of ethical values has been prepared against which one can compare the uses of a technology. The list is included as annex 1, and was constructed as follows.

A central aspect of common-sense morality is the desire to combine and balance different ethical concerns of involved stakeholders. The founders of common-sense morality, Tom L. Beauchamp and James Childress, suggest that the fulfilment and balance of four ethical values – respect for autonomy, compassion, no harm, and justice – can guide decisions regarding concrete ethical dilemmas (Beauchamp & Childress, 2001). These four values are included in the list of ethical values.

Beauchamp and Childress' value of no harm is split up into the two values 'safety' and 'security', which aims at safeguarding humans from, respectively, unintended and intended harm. To link up better with utilitarian ethics, the list of values has also been supplemented with the value 'utility/more good than harm' to incorporate the idea that harm can be tolerated if it results in good consequences that outbalance inflicted harm (Chalmers, 2003). Similarly, the value 'privacy' is separated from 'autonomy', as the right to privacy has an inherent value equal to the right to make informed decisions promoted by autonomy.

The identification and selection of additional ethical values has been an iterative process, and new values have been added by each new application of the method. The need to add new ethical values to the original values of common-sense morality has been discussed at two seminars at Aalborg University and with the students of Techno-Anthropology. These discussions have shown a need for ethical values originating from Aristotelian ethics that Beauchamp and Childress did not include in their work. Therefore, three Aristotelian ethical standards have been added: 'humility', 'social stability' and 'authenticity'.

Ethical values originating from environmental ethics have also been added. Hence, I have included three different ethical value from this branch of ethics: 'Precaution', which is a well-established concept in the regulation of the European Union (Communication from the commission on the precautionary principle, 2000); 'Stewardship for the Earth', which originates in Hans Jonas' philosophy (1984); and 'Respect for nature', which is extracted from Arne Næss' writings on deep ecology (1973).

A number of processual ethical values have been added that include a focus on the ethical decision-making in technological innovation and techno-science: 'inclusion' of legitimate stakeholders, 'transparency', and 'trust' (Kønig, Børsen, & Emmeche, 2017).

Common-sense ethics are sometimes criticised for being western-centric. Hence, the ethical value 'Ubuntu', originating from African philosophy, is added to the list of ethical values in annex 1, although it is not used in the assessments presented in this chapter. Other non-Western ethical values could also be added to the list.

As in annex 1, I have included short definitions of all the ethical values mentioned above. The list is not complete. New values can be added if users of the model find other values more relevant to their analysis.

2.2 Quick and proper

The ethical technology assessment model presented in this chapter is characterised as 'quick' and 'proper'. 'Quick' because it is quick to use compared to doing a full ethical analysis from scratch. The model includes two heuristics that when applied will save time and guide the technology assessment in a direction that accommodates identification and ethical analysis of intended and unintended implications of the assessed technology.

One heuristic is the list of ethical items that all quick and proper ethical technology assessments starts from: intended actual effects, misuse, unintended consequences, and long-term cultural implications. This heuristic quickly enables the user to identify a technology's ethical issues.

The other heuristic is the compilation of ethical values annexed to this chapter. The idea is that the assessor does not need in-depth knowledge of philosophical ethics nor a degree in philosophy to identify, set up, and apply the normative criteria of the quick and proper ethical technology assessment. Hence, this heuristic can also save time, as the list of values sums up a large number of ethical theories in easily read language.

One should be able to do a first iteration of a QPeTA in two weeks. Each year, honorary associate professor in Techno-Anthropology Klavs Birkholm and I offer a PhD course for post-graduate students

at the Technical Faculty of IT and Design at Aalborg University where the course participants are required ethically to assess their own research projects. The course participants are expected to do this assessment in 70 hours. The model is also adequate for use in undergraduate and graduate ethics teaching of non-philosophers as well as in continuing education in technology ethics targeted technical experts.

The QPeTA is 'proper' because it results in a technology assessment that includes both estimates of short-term and long-term as well as intentional and unintended effects of a given technology. Furthermore, it bridges gaps between ethical judgment and ethical action as it supports redirection of the assessed technology in ethical direction. Ethical estimates resulting from the application of the QPeTA model are never final and one can always add new iterations to a previous assessment.

2.3 Alternative Ethical Technology Assessment approaches

Of course, there exists more approaches to ethical technology assessment than the QPeTA model presented here. The common denominator of these approaches is a critique of more conventional technology assessment models for neglecting technologies' ethical implications.

The eTA Model

Elin Palm and Sven Ove Hansson presented this critique in a paper published in *Technological Forecasting & Social Change* (2006). In the paper, they discuss the historical development of technology assessment, and they present their technology assessment model 'ethical Technology Assessment' (eTA).

Philip Yeager invented the term 'technology assessment' in the 1960s to capture concerns regarding the technological development's effects on society, human health, and the environment. In 1972, technology assessment institutionalised in the 'American Office of Technology Assessment' (OTA). OTA's methodology was standard setting for technology assessment until the office closed down in 1995 and even beyond, as it had heavily influenced the German pendant, 'Office of Technology Assessment at the German Bundestag' (TAB). TAB opened in 1991 and later transformed into the independent

'Institute for Technology Assessment and System Analysis' (ITAS). Also within the European Union, technology assessment institutions emerged during the 1990s and 2000s in form of the 'Scientific Technological Options Assessment' (STOA), now 'Panel for the Future of Science and Technology', and the 'European Parliamentary Technology Assessment Network' (EPTA). Research-wise the 'Global Technology Assessment Network' (globalTA) organises technology assessment conferences every second year.

During the last 40 years, a myriad of technology assessment models have appeared that cover different impacts of technology ('Social Impact Analysis' – SIA, 'Environmental Impact Analysis' – EIA, 'Risk Analysis' – RI), different technology domains ('Health Technology Assessment' – HTA, 'Privacy Impact Assessment' – PIA), or specific assessment models ('Constructive Technology Assessment' – CTA, 'Innovative Technology Assessment' – ITA, 'participatory Technology Assessment' – pTA). It is in the aftermath of the impact-oriented technology assessment models that Palm and Hansson suggest a model that explicitly focusses on ethical impacts of new technologies.

Palm and Hansson argue that there is a need for ethical technology assessment models because a) the established models and approaches do not address ethical issues, b) technical experts are seldom trained to discuss ethical issues, and 3) there is a growing cultural lag between technical and non-technical cultures. Hence, they suggest a model for 'ethical Technology Assessment' (eTA).

The purpose of using eTA is to identify "adverse effects of new technologies at an early stage" (Palm & Hansson, 2006, p. 543), and to establish dialogue with technical experts designing, developing, and implementing new technological solutions. Their model is a nine-point checklist of ethical concerns that one can compare the assessed technology against, i.e. how does the technology deliver and compare against the following criteria:

1. Dissemination and use of information
2. Control, influence and power
3. Impact on social contact patterns
4. Privacy

5. Sustainability
6. Human reproduction
7. Gender, minorities and justice
8. International relations
9. Impact on human values. (Palm & Hansson, 2006, p. 555)

The model is eclectic and draws on input from many ethical theories and traditions.

The eCTA approach

Ethical Constructive Technology Assessment (eCTA) is an approach to technology assessment based on the postphenomenological understanding of technology and ethics. It employs a micro level perspective on the human—technology interface, and hence complements Constructive Technology Assessment's focus on the meso and macro levels (Kiran et al., 2015). The CTA approach to technology assessment aims at bringing organisational, environmental, financial, etc. implications of a technology into the technical design process.

Asle Kiran, Nelly Oudshorn, and Peter-Paul Verbeek criticise Palm and Hansson's eTA model. First, they argue that eTA only include ethical reflections on the assessed technology's adverse effects, secondly they criticise that eTA is a checklist assessment tool that does not stimulate ethical imagination nor reflection, and thirdly that eTA is not sensitive to unforeseen and unanticipated consequences.

The starting point of the eCTA approach to technology assessment is the postphenomenological idea of technological mediation – e.g. fusion, embodiment, hermeneutic, alterity, background, and immersion (Rosenberger & Verbeek, 2015; Børsen, 2020) – and that technologies always have intentionalities and that ethical technology assessment starts with technology-in-use.

Technological mediation can inform technology assessment in three ways: it can stimulate technological anticipation, accompaniment, and design. The eCTA approach enacts all three levels. One can anticipate a technology's ethical implications by imagining how it may mediate the individuals' perceptions and actions when used.

In order to anticipate mediations, users, designers and policy-makers can use their imagination, guided by the theory of technological

mediation, to develop a realistic idea of the potential influences of a technology that is under design, about to be used or about to be implemented. (Kiran et. al, 2015, p. 11)

It can also facilitate ethical reflections on the assessed technology. Individuals can reflect on how they can live a good life and how they can form themselves with or without the assessed technology. Hence, the ethical reflections point to conscious decisions on e.g. how a technology scaffolds or enacts the good life, or when one should not use the technology.

Finally, the idea of technological mediation can integrate ethical reflections in technical design processes. The technical designer can aim at designing specific forms of technological mediation.

How does QPeTA compare to eTA and eCTA?

There are a number of similarities between QPeTA, eTA, and eCTA. They are all aimed at identifying ethical aspects of technologies, although they differ in regard to what is included as an ethical item: the eTA model is concerned with adverse effects of technology on the meso and macro levels, eCTA with intentional effects on the micro level, and QPeTA with both intentional and adverse effects (misuse, side effects, cultural impact). Hence, postphenomenology and eCTA can inform QPeTA's technology assessments in regard to intended actual effects where the model is not very explicit on how to proceed. Many of eTA's checklist concerns are overlapping with QPeTA's list of ethical values.

All three approaches scaffold the identification of possible impacts of a technology: the eTA model with a checklist, eCTA with technological mediation, and QPeTA with its categories of implications – intended beneficial consequences, potential misuse, unintended adverse side effects, and long-term consequences for society. All models' theoretical gaze must be supplemented with empirical input from stakeholders related to the assessed technology. It is through the empirical material that stakeholders are represented in technology assessments. Hence, it is important for a technology assessment that the central stakeholders are voiced.

Technical experts are in all approaches considered a very central stakeholder group, as technology assessment should inform and be

done in dialogue with those who design and implement new technologies. The underpinning idea is that the experts take the insights of a technology assessment into account in their work. Technology assessment is techno-anthropological in the sense that it builds bridges between technical experts and other stakeholders' experiences, impressions, opinions, and attitudes.

The eCTA approach does not explicate the ethical assessment criteria underpinning its analysis because this approach assumes that ethical values are formed by the use of the assessed technology. Hence, the formulation of the ethical assessment criteria are done during the technology assessment. I believe this requires a solid background or training in philosophy and ethical reflections. The assessment criteria are implicitly embedded in the nine checklist items of the eTA model. I also think that making them explicit requires solid philosophical background or training. An important part of the QPeTA model is a list of ethical values that serves as the model's assessment criteria. These are intended to be easy to use and require little or no philosophical training to apply.

Theoretically, QPeTA is inspired by 'common-sense morality' that combines a number of different ethical theories and has 'ethical judgment' as its most important outcome. Palm and Hansson's technology assessment model, eTA, also combines different ethical positions but does that in an eclectic manner without paying much attention to how that is done. Here, the primary output is a list of the assessed technology's adverse effects. Kiran and co-authors' eCTA approach is built upon one ethical theory – 'postphenomenology' – and has as its most important output the understanding of how a technology influences its users. The eCTA approach can be incorporated in the two technology assessment approaches that combine different ethical concerns.

3. Risk reducing breast cancer surgery

Risk reducing breast cancer surgery is based on interpretation of results from Health Information Systems Technologies (HIST). Here, HIST is understood as information and communication technologies mediating between human interpretation of e.g. patients or health professionals and the material health condition of oneself or others.

If health care professionals using HIST predict a high probability for developing breast cancer, then breast surgery is an option for women to consider.

In 2015, Pia Danborg and I applied the Quick and Proper ethical Technology Assessment model on risk reducing breast cancer surgery (Børsen & Danborg, 2015). To gain an overview of the intended effects, misuse, adverse effects, and societal/cultural effects, we both analysed the discussions relating to this socio-technical configuration at a hearing on ethical aspects of Health Information Systems Technologies organised by the Danish Council of Ethics, and articles found at InfoMedia that addressed the topic. InfoMedia is a database that includes news articles from all major Danish news media outlets since 1990.

Our analysis of the discussions at the hearing on ethical aspects of Health Informatics Technologies summed up to this list of ethical implications:

* The intention of Health Informatics Technologies is to generate an understanding of disease, so that public health can be improved by better prediction, prevention, and treatment. This relates to the ethical values of utility/more good than harm and compassion (when an individual in need is cured).

* Misuse: spreading of private data by e.g. coupling of registers and databases beyond legislative permission, as well as commercialization and sale of health data. Here, the ethical values of privacy and trust are violated, and warns against certain kinds of application of Health Informatics Technologies.

* Unforeseen adverse effects of Health Informatics Technologies are related to uncertain interpretation of health data and inadequate data security. If such consequences show, they violate trust in public health authorities and privacy.

* Long-term consequences for society and culture: Health Informatics Technologies entangle individuals and their families and friends. This might justify the use of Health Informatics

Technologies if it leads to trust between patients and their families and friends, and an inclusive ethical debate on health issues in society. It can also generate enhanced normality and false feelings of illness, which might violate, respectively, the ethical values of autonomy and trust.

* Ethical dilemmas of Health Informatics Technologies reflect potential collisions between on the one hand improved health and the values of utility/more good than harm, compassion, and possibly trust between patients and their family and friends, and on the other hand wrongful spread of health data, wrongful interpretation, false feeling of illness, lack of privacy, autonomy and possibly trust in authorities.

We based our ethical assessment of risk reducing breast cancer surgery on news articles found on InfoMedia: it sums up to this list of ethical implications:

* The intention of risk reducing breast cancer surgery is potentially improved health via better, targeted prevention and treatment of disease. The ethical values of safety, utility/more good than harm, and compassion are underpinning that intention.

* Identified potential misuses circulate vested and special interests of different sorts biasing data interpretation and suggested action. Misuse also encompasses unauthorised access to survival profiles potentially conflicting with privacy. It might also lead to stigmatisation, which violates the value of justice. If this kind of misuse becomes mainstreamed, the result might be social instability.

* Adverse effects count unintentional bias in interpretation (cf. misuse). If less privileged groups are prevented from accurate diagnosis due to high prices, it will violate the ethical value of justice.

* Societal and cultural effects can be a change in perception of disease and normality, which again might not correspond with justice, autonomy, authenticity, social stability, or safety.

* Ethical dilemmas related to this case regard improved health (and the values of utility/more good than harm, compassion, and possibly safety) versus wrongful data interpretation (violating values like social stability, privacy, and possibly safety), unjust exclusion of less privileged groups, and a possible changed perception of illness (associated with violation of justice, autonomy, authenticity, social stability, and safety).

The paper identifies three areas for techno-anthropological intervention: first of all, health data must be protected properly, and this includes the formation of a data protection culture. Hence, how can the formation of a data protection culture be promoted in the health sector? How can individuals be supported when they are required to take decisions about their health data?

Secondly, the paper also identifies wrongful or biased interpretation of health data as an ethical issue. Here, the suggestion is to design a new independent institution that handles screenings, tests, and diagnoses. These activities are carried out by specialised and experienced centers of interpretation of health data. These centers should be separated from hospitals and care units with expertise in surgery and recovery that are responsible for treatment. The rationality behind this suggestion is to remove the incentives for caretaking of own vested and special interests.

Finally, Pia Danborg and I touch upon how Health Information Systems Technologies can both create trust and mistrust. This calls for techno-anthropological casestudies of both phenomena, so that socio-technical features that promote trust rather than distrust can be set up.

4. Digitalisation of professional judgment

The second example of the application of the Quick and Proper ethical Assessment model addresses the possible future digitalisation of

professional judgment. Professional judgments are made every day by e.g. medical doctors when they diagnose patients, judges when they rule in court rooms, social workers trying to help vulnerable citizens, politicians when they suggest and negotiate regulations and other solutions to societal problems, and techno-anthropologists when they assess technologies.

This quick and proper ethical assessment of technologies that aim at digitalisation of professional judgment is based on a techno-anthropological research anthology: *The Hidden Algorithms: Techno-Anthropological perspectives* (in Danish), edited by Klavs Birkholm and Niels Frølich (2018). As an ethical estimate is never final, it is allowed to start with a limited amount of material. The material can be expanded at a later stage and the ethical estimate maintained or revised.

The purpose of *The Hidden Algorithms: Techno-Anthropological perspectives* is to generate public and scholarly debate on the algorithms that govern social media and public IT systems. In the first chapter, the reader learns that algorithms and related concepts – big data, digitalisation, AI, disruption – mean something different than what one should expect:

Concept	Meaning
Big data	The important new element is not the amount of new data generated. What is new is that computers have become so powerful that they can store and manage huge data sets without previous data categorisation. Computers can inductively find patterns and themselves categorise huge sets of data.
Digitalisation	Digitalisation does not mean storing digital versions of analogue material (text, sound, image, moving pictures, etc.). Today, digitalisation rather refers to automation of human working tasks.
Algorithm	An algorithm no longer refers to a mathematical operation. It rather means a mathematical model that includes a number of system assumptions.
AI (Artificial Intelligence)	There is no intelligence in an AI. AI refers to a huge calculation power of modern computers that enables it to recognise patterns in huge sets of data.
Disruption	Disruption refers to new business concepts that replace existing and well-established business practices and public institutions.

Table 1: Conceptual clarification of the terms big data, digitalisation, algorithms, AI, and disruption.

The applied procedure for conducting the assessment is as follows: the first step is to read all chapters in the anthology and write paragraphs summing up all chapters' main messages. The formation of these summaries informs the first step of the quick and proper ethical technology assessment method: to identify intended consequences, misuse, adverse effects, and cultural impacts of algorithms. If two or more chapters address a similar issue, they are merged under the same headline that identify a central topic introduced in the anthology. Then, it is shortly discussed what ethical values that are at stake, and what actions that could be undertaken to counter the identified ethical problem with digitalisation. Four topics are identified: fake news and black boxed information selection, wicked algorithms, digitalisation of public administration, and political consequences of the Internet of Things. These four ethical issues are related to the digitalisation of professional judgment.

Fake news and black boxed selection of information

Extreme right-wing organisations and authoritarian regimes are circulating fake news, hate speech, and ideological world views that are enhanced by bots, the algorithms of social media, and search engines to an extent where it infects the whole internet, influences peoples' choices, and threatens conventional and reliable journalism and news distribution (Cadwalladr, 2018).

Technologies form people's perceptions of and actions in the world. This is also valid for algorithms that promote acceptance and 'black boxing' of digitalisation technologies. People tend not to reflect on the algorithms that govern social media and public IT systems and reproduce commercial values (Birkholm, 2018; Mazzotti, 2018).

There is an overload of information in the digital world, and if we do not know what information we do not see, or if the information that reaches us is true or false, we cannot make informed decisions or judgments (cf. transparency). This endangers our autonomy and possibly social stability. Trust is undermined, and we will meet other people, public authorities, scientific institutions, and companies with skepticism rather than trust.

A focus in research and in public deliberations on the algorithmic mechanisms underpinning fake news and the selection of information might counter this development.

Wicked algorithms

Algorithms try to predict future events based on historical patterns. Some algorithms are wicked in the sense that they discriminate or otherwise harm people. O'Neil (2018) identifies four types of wicked algorithms. Algorithms might be wicked because of 1) underpinning historical patterns (e.g. when racist results top a Google search), 2) neglect of the designers (e.g. when Google tend to characterise photos of black people as gorillas), 3) wicked but legal intentions (commercials targeted at vulnerable groups – e.g. quick loans targeted the poor), and 4) wicked and illegal intentions (e.g. surveillance of civil rights activists).

Two chapters (Frølich, 2018; Mottelson, 2018) present examples of wicked algorithms:

1. Tools intended to help voters to find the candidate to vote for favour right-wing candidates. Prior to elections, Danish media present tools to help voters decide which candidate their opinions resemble. They do so by asking on a five-point Likert-scale whether the voters agree or disagree with different statements. If you strongly agree, you type in 1, if you strongly disagree, you type in 5, and if you do not agree or disagree, you type in 3. However, the tools and underlying algorithms are biased, as they promote candidates whose opinions are located in the middle of the scale and disfavours candidates who strongly agree or disagree with the statements. Mottelson (2018) took the test 60,000 times where he typed in random answers and most of the time, the test suggested the author to vote for a right-wing candidate.

2. Algorithms that make wrong suggestions on whom to dismiss: a high school teacher from Washington DC, whose students were doing well with a steep learning curve, was fired because a new algorithm, supposed to measure the progress of the

students, stated that her students progressed to a lesser degree than her colleagues' students. The problem was that the primary school teachers, who also were evaluated by the algorithm, had inflated their pupils' performances to improve the evaluations of their performances in fear of being dismissed.

3. Predictive policing where algorithms based on previous crime patterns predict that crime is likely to happen in poor areas because algorithms do not differentiate between different types of crime. The problem is created when the algorithms do not distinguish between different forms of crime. In poor areas, the rate of so-called 'antisocial behaviour' – like graffiti painting or marihuana smoking – is higher than in rich areas (where financial crime is more frequent). If these types of offenses are not differentiated from serious crime such as burglary, violence, and murder, the algorithms will predict more and more crimes in poor areas and fewer and fewer offenses in rich areas.

If algorithms replace professional judgment and for different reasons turn wicked, it might lead to violation of both the no harm principle (safety and security) and the principle of justice. One way to counteract the unethical effects of wicked algorithms is to clarify who holds the responsibility for the undesired consequences of wicked algorithms, and hold them accountable for their deeds in the same way that society holds professionals responsible for their flawed professional judgment.

Digitalisation of public administration

Public administration in Denmark and elsewhere is being digitalised as IT systems are replacing tasks previously performed by humans in two ways: digitalised communication – files and documents are digitalised – and automated decisions and professional judgment – decisions made by an AI underpinned by machine learning (Gottrup, 2018; Motzfeldt, 2018). Especially, the second wave of digitalisation challenges public administration in four ways:

1. Can citizens only communicate digitally with public authorities? Here, the ethical values of justice and inclusion might be violated if the digital communication excludes e.g. elderly with no experience with ICT. A possible solution could be to allow parallel and alternative means of communication with public authorities.

2. How can citizens be informed and advised when public administration is digitalised? If citizens are not properly informed, they will lose trust in the system, and they will not be able to make informed decisions (autonomy). The public library has been suggested as a possible source of advice relating to digitalised administrative issues. This requires that libraries possess both digital and legal qualifications.

3. How can a digital system in concrete cases decide whom to involve and in what regard? The ethical value of inclusion is at stake here.

4. Delegation of data management to private actors. When public administration is digitalised, authorities delegate both the system development and the management of sensitive citizens' data to private IT companies but maintain the responsibility for the digital system and its data management. Several examples suggest that public authorities are not always fulfilling their responsibilities (cf. the misuse of sensitive health data described above in the analysis of risk reducing breast cancer surgery) and lack knowledge of and control over the companies' data management. Often, data management is not overseen or regulated, and systems' functionalities are poorly documented. Digital tasks are not put out to tender because only the company that developed the initial system has the necessary insight to maintain and operate it.

Before public administration is digitalised, an analysis is needed that explains how administrative routines and decisions could be made digitally in a responsible way. External actors could be asked to make

such analyses when applying for contracts. Linking up with a techno-anthropologist when doing so is in my opinion a smart move. Only then can the resulting criteria be transformed into a digital system. Both phases can be delegated to private actors. The first phase of responsible data management requires primarily legal insight. The second phase regarding documentation of the systems' functionalities is underpinned by primarily technical qualifications. Often the two phases are entangled.

Political consequences of the Internet of Things

Industry expects business opportunities in the Internet of Things (IoT) – technological artifacts linked to the internet – in city planning (smart cities), building development (smart houses), and our bodily condition (quantified self). The purpose of the technological embeddedness in the internet is to collect data from the users to facilitate a more effective energy use, make our daily lives more comfortable, or increase our individual self-control. IoT rests on an assumption of control of the human condition, but full control is a myth and something that endangers our humanity (Greenfield, 2018). Being human is entangled with coincidence (cf. the ethical value of humility).

Facebook's algorithms can with a likelihood of 97% estimate whether two photos from different angles and with different lighting show the same individuals. This can be used to individualise advertisement in the public space. This feature violates the ethical value of autonomy if we cannot turn it off. Face recognition algorithms might be biased if they e.g. recognise black males better than white females. Luke Dormehl (2018) brings an example where a designated driver's face wrongfully was recognised as the face of a driver caught in speeding. The authorities put the burden of proving his innocence on the accused.

Digital technologies collect and link data about citizens. It is now possible to decide if individuals violate legislation (speeding, using their smartphones while driving, avoid paying taxes, etc.). It is also possible to estimate if individuals live healthy lives or burden the environment. According to Evgevy Morozov (2018), policy-making risks being reduced to choosing the most effective means to nudge citizens to live in certain ways. Effective means towards 'good' be-

haviour are peer assessment of individual performance (cf. Uber and AirBNB's rating systems) and restricted and conditioned access to goods and services (cf. the social credit scoring system being implemented in China). This is problematic because it shifts the focus away from the underpinning causes. Alternatives to this development are: access to public goods that is not dependent on paying something back (e.g. basic income), and use of ICT tools in policy-making that are redirected towards identifying underpinning causes.

7. Discussion and conclusion

In this chapter, the Quick and Proper ethical Technology Assessment model is introduced, compared to two other technology assessment approaches, and applied to two different technologies: risk reducing breast surgery (health information systems) and digitalisation of professional judgment (algorithms and machine learning). One of the assessed technologies is well-established (risk reducing surgery) while the other is emerging (digitalisation of professional judgment). The paper lists all the technologies that the QPeTA model has been applied to. This indicates that the presented technology assessment model has a wide range of possible applications in different technology domains.

To answer one of the research questions posed in the introduction, 'what are the criteria for assessing a technology as overall beneficial or harmful to humans?', the chapter illustrates how the two assessments use ethical values as assessment criteria, and includes in annex 1 a long list of values that also can be applied in ethical assessments of other technologies. Different technology assessments draw on different values in their analysis.

Regarding the other research question, 'how can we identify the impacts of technologies on human wellbeing, human institutions, human societies, human cultures, and humanity?', the chapter illustrates how input for quick and proper ethical technology assessments can be collected and generated. The two assessments presented collected input in different ways: a review of news articles, an output from a hearing, and a review of an anthology. Additional methods to generate input for the technology assessment model are reviews of research literature, analyses of documentaries, ethnographic ob-

servational studies, and qualitative interviews. I recommend that future technology assessments also include these sources as input.

In response to the final research question, 'how can stakeholders' input be incorporated in technology assessment?', the paper argues that it is the responsibility of techno-anthropologists doing the technology assessment to collect input from the central stakeholders of the assessed technology, and to communicate it to the technical designers. In this perspective, technology assessment translates concerns and experiences of the technology users, spokespersons of the environment and future generations, and others to technical experts responsible for designing, developing, improving, or implementing the assessed technology.

The paper finally argues that an ethical estimate is never final and objective. Techno-anthropological technology assessment is an iterative process where new layers can be added to qualify the ethical analysis. Hence, the author encourages readers to make their own ethical judgments and challenge the presented conclusions.

The two presented ethical technology assessments propose partial solutions to the identified unethical situations and ethical dilemmas. They point to a formation of new institutions, cultural change, clear location of responsibility, the generation of new ethnographic knowledge, and innovation in both the social and technical parts of the assessed technologies.

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Annex 1: Definitions of Ethical Values in the Quick and Proper ethical Technology Assessment Model

Ethical value	Description
Authenticity	Authenticity can be defined as the right to pursue one's own authentic perception of oneself. This includes the right to follow one's ethical orientation system, rather than blindly reproducing the norms of society. Authenticity is an ethical value because every person has a right to unfold herself by pursuing what she finds valuable.
Autonomy (or 'informed consent')	Everyone has a right to self-determination as long as it does not prevent others from their right to self-determination. Autonomy can be deduced from Kant's categorical imperative: no one must be treated only as a means and not also as an aim in themselves. Autonomy requires information and is often called 'informed consent'. It requires mental abilities and freedom to choose what one considers best. No external pressure must be put on the autonomous individual.
Compassion (and 'vulnerability')	This ethical value states that a person is obliged to help another person who is suffering, e.g. if the person is ill or in pain. Compassion is related to vulnerability that obliges a person to help another person to withstand a hostile environment if this person is not able to do it herself.
Humility	This ethical value is the antithesis to committing hubris. One commits hubris when one loses contact with reality and overestimates one's own competencies, does not listen to criticism, and thinks one-dimensionally without giving alternatives any consideration. According to a Greek myth, one will be punished by nemesis if one commits hubris. One is humble when one is self-restrained.
Inclusion	This value requires i/ simultaneous attention to the interests of all legitimate stakeholders, and ii/ a balance between this multiplicity of interests (including self-interests).
Justice (or 'fairness')	Here is included two different definitions: 1) just actions are to generate the greatest benefit to the least-advantaged members of society, and 2) everybody must be treated according to merit and effort; two people can only be treated differently if their merits or efforts are different. Discrimination and stigmatisation are in direct conflict with the ethical value of justice. One sometimes adds words to specify different aspects of the value, e.g. 'global justice' – to indicate an unjust distribution between the North and the South – or 'intergenerational justice' – to indicate unjust distributions between current and future generations.

No harm (covers both safety and security).	No harm requires that everybody has the right to be protected from harm, and safeguarded from illness, hunger, accident, and other dangers. This value encompasses protection from undesirable events and malicious actions. Sometimes a distinction between safety and security is made where safety refers to the right to be safeguarded from unintentional harm, and security refers to the right for protection against intentional harm (e.g. from terrorism).
Precaution	This value requires that an action should not be undertaken if there are reasonable grounds for concern, though no scientific evidence, for it having dangerous effects on the environment, public health, or civilisation.
Privacy	Everybody has a right to personal privacy, which means to have control of one's personal (digital) information. The value of privacy limits external and inappropriate access to private information and derived social control exercised by e.g. governments, public organisations, corporations, and others.
Respect for nature	According to this value, all forms of life have intrinsic or inherent value and are to be respected for their own sake. Humans are part of nature and the well-being and flourishing of human beings are not considered more important than the well-being and flourishing of other forms of life. Diversity of different life forms are contributing to the well-being of both individual species and individuals. This value derives from the notion of environmental rights.
Social stability	This ethical value focusses on how the various parts of society fit together and strives for establishing equilibrium by balancing different aspects and interests, and as a last resort forcing out extreme actions, ideas and individuals that disagree with popular opinion.
Stewardship for the earth	This ethical value claims that humans are responsible for the world, and therefore are obliged to take care of it, by shaping trajectories of social-ecological change at local-to-global scales to enhance and balance ecosystem resilience and human well-being. This ethical value has religious origins, as it can be derived from the believe that humans are guardians of God's creation. Nature and natural resources are considered as a gift.
Transparency	Transparency requires one to operate in such a way that it is easy for others to see what actions are performed and what decisions are made. It also commits visibility of the underpinning foundation with which actions and decisions are justified. Transparency implies openness, communication, and accountability.
Trust	Trust is about the elimination of doubt in oneself, in other persons, and in technologies. This ethical value commits a person to act in a reliable way, so that other people can trust in her, and other persons to treat the first person as a person to be entrusted. A person must not say one thing and do something different. Similar reflections regard technologies. A technology should enact according to specifications, information material, and advertisement.

Ubuntu	*Ubuntu* means humanity towards others, and can be defined as a commitment to establish stable and viable human relations on different levels – the micro, meso, and macro levels. This value is central in African philosophy.
Utility (or 'more good than harm')	This ethical value has the foreseeable consequences in focus, and states that the ethical correct action is the one that generates the maximal well-being for the highest number of people. Well-being can be defined in different ways: as the feeling of hedonistic pleasure, realisation of personal potential, a prosperous life, etc. This value sometimes is called 'more good than harm' because a harmful action can be justified if it generates more good than harm.

The table shows and defines a list of ethical values that can be used in the Quick and Proper ethical Technology Assessment model. The values are listed alphabetically in the table, and new values can be added to the list.

CHAPTER 8:

Technology Assessments: A Philosophical Approach Towards Deconstruction of the Concept of Assessment

Lars Botin

In this chapter, I shall try to 'enframe' Technology Assessment from a phenomenological and postphenomenological perspective. This means that I am going to create a rack, frame, and/or scaffold that will gather a variety and multiplicity of understandings and practices within the philosophy of technology, which hopefully will inform decision-makers, designers, and users as they engage with concrete technologies. It also means that understandings and practices in relation to technological innovation, development, and implementation are constantly questioned and put under scrutiny concerning responsible and sustainable solutions, processes, uses, and appropriations. It is the overall idea that humans and technology are ontologically intertwined and intermeshed, and that this has always been the case. Humans have always been shaped by technologies, as technologies have been shaped by humans. The chapter argues that this intertwinement is constituent for a human technology assemblage/hybrid which transcends all dualistic and dialectic approaches to how to deal with technology.

The chapter has been divided into chunks where different takes on technology assessment are thematized from perspectives of controversy, planning, hybridity, and disruption. These perspectives are gathered in the interdisciplinary field of Techno-Anthropology, which

accordingly will constitute the elements of the rack/scaffold mentioned above for responsible and sustainable assessments of technology.

Technology Assessment: wars and mediations

Accordingly, there has been a 'war' going on for the past half century between various perspectives on what science actually is and, furthermore, how technology should be considered as part of this war. Trenches have been dug and arms developed in order to fortify and defend the trenches and missiles have been fired in order to defeat the enemies. This has turned out to be a fairly unfruitful and in some cases even counterproductive situation, where exponents of the various paradigms of positivism, constructivism, social constructivism, holism, etc. have harnessed their positions and denied any opening towards new possible ways of connecting and interacting. I think that time is ripe for opening Pandora's box, and see what may happen if different and even opposing perspectives on problems of the real converge for what concerns immanent action and intervention in relation to issues that are in need of *quick and proper* solutions (Botin et al., 2015).

My take is pragmatic in the way that it does not exclude consequentialist (positivist), constructivist, critical, and/or comprehensive understandings and models of technology assessment. My approach and understanding are by nature multiple, multistable, and malleable, and technology is considered a crucial and vital 'partner' in finding solutions that makes way for possibly a better life, a better society and a better world. In order to do that, we have to identify aims and goals for our co-constructions because they cannot be relativistic or, for that matter, anything. They are by nature relational, which means always in touch with what and whom are at stake, and possibly also looking, touching, and reaching towards who or what that might be invisible at first sight. I am, together with some of the exponents of postphenomenology (Verbeek, 2011; Rosenberger, 2017) and critical constructivism (Feenberg, 2017), of the opinion that original democratic values of modern western societies have to be refreshed and reconsidered when co-constructions with technology are launched.

The French revolution aimed to establish freedom, equality, and brotherhood (solidarity) as ideals for and of how society should work and function. Karl Marx brought into focus how the oppressed should be empowered in the 'machinery of production', and the original Critical Theoretical position from the 1920s and 1930s heralded emancipation from structural systemic thinking as the aim of every kind of practice within and outside of academia (Horkheimer, 1937). We all know that this path led to utopian and, in some cases, dystopian solutions and societal models, although this should not prevent us from refreshing and reconsidering some of the ideas and virtues of this understanding of science, society, and technology. On the other hand, there were more individualistic and often opposite understandings of science, society, and technology. Phenomenology has been blamed for its existentialist focus on the individual and has often been coined with liberal and/or conservative political ideologies, especially present in the overwhelming figure of Martin Heidegger. I think that Heidegger's personal conservative political belief, and the analyses of that in relation to his philosophy, has obscured some of the most important things in Heidegger's work on time, space, and technology.

Heidegger wrote that there is nothing technological in technology (Heidegger, 1954/1977, p. 311), meaning if we focus on the instrumental and technical in technology, then we do not understand what technology really is and more important, we do not understand what it means to be human. According to Heidegger, we must have the courage to get closer to technology, and not keep it at a distance as something we are in control or afraid of.

We must dare to be 'intimately' together with technology in order to find out what it really means to be human. Heidegger got fairly pessimistic in the concluding 15 years of his lifetime, and, unfortunately, we are left with this pessimistic heritage, which the critique of Heidegger also has focussed upon. But according to the earlier Heidegger (1920s-1950s), there is salvation at hand in our being together with technology. We just have to embrace it and be aware of the fact that this embracement can turn out lethal to us, but, still, we have to make the move. So, things are risky, stakes are high, and outcomes unpredictable. This is what Heidegger teaches us, and

without pointing in any given direction. This is where Critical Theory of Technology/Critical Constructivism, Pragmatism and postphenomenology tries to give some answers and solutions in relation to values that should indicate directions/assessments of human-technology interaction, or as postphenomenology would have it: human-technology-world relations and mediations (Ihde, 1990; Verbeek, 2006; 2011; 2015; Botin, 2015; 2017; 2019). So, perhaps we are no longer talking about Technology Assessment because technology is no longer out there to be measured and counted upon. Rather, we are dealing with how interactions, intersections, and interdependencies *should/ought* to take place, i.e. responsible technological assemblages.

The Dutch philosopher of technology Peter-Paul Verbeek has made up *Mediation Theory* (2015) that, with an outset in Don Ihde's work on human-technology-world relations (1990), tries to unravel different types of mediation where, and in the mediation process, both humans and technologies are present, and how we act and interpret in different ways in relation to how we are together with technology in different everyday life settings. Accordingly, we practice and act in the world through technology, and the world reveals itself through our experiences and interpretations. These experiences and interpretations are also mediated through technology. The outcomes are, in the vocabulary of postphenomenology, multistable, hence and to some degree unpredictable, but it does not mean that any outcome is possible. A hammer can be used for many purposes but many of them can be imagined, and thereby we can exclude certain impossible uses such as using the hammer as a pillow. Verbeek is also of the opinion that we, as designers and users, should take a moral stance as we design and use technology (Verbeek, 2006; 2011). We should foresee imaginable and probable applications of technologies and make decisions on what to design and not to design; and what to do and not to do as users and consumers. In other words, we should make ourselves, designers and users, accountable for our actions.

Verbeek points to a triad of possible mediations and how these are mutually engaged with each other. The first type of mediation is the classical *extention* relation where "technologies appear primarily as tools or instruments" (Verbeek, 2015, p. 28). Verbeek emphasises

that extension is not purely instrumental but that, and in this relation, technologies are also the extension of human being, i.e. harbouring intentionalities and practices. Technology is part of human functioning. The second mediation is *dialectical* where technologies are perceived as forces that alienate and overcome people, which is the classical Marxist and Critical Theoretical conception of technology. Here, Verbeek points to the fact that the dialectical dimension of human-technology interaction is also more productive and positive. Machines give us the possibility of relating to ourselves as we delegate physical and cognitive powers and capacities to them. The third type is *hybrid* where humans and machines are intertwined, and not separated in a dualistic and/or dialectical perspective. "Technologies and humans help shape each other" (Verbeek, 2015, p. 29). Verbeek has a very precise and eloquent statement on this intertwined relation, wherein the request of reflections on this relationship is also present: "Rather than being opposed to humans, or mere extensions of us, they need to be seen as media for our connection with the world. Technologies help shape perceptions and actions, experiences, and practices. In doing so, they help shape how human beings can be present in the world and how the world can be present for human beings" (Verbeek, 2015, p. 29). The presence of Heideggerian conceptualisations of being-in-the-world is impressive, and we shall return to how some of the early Heidegger essays on being, time, space, and technology has to be reread in the perspective of technological mediation.

In the conclusion of Verbeek's short introduction to Mediation Theory, he claims that: "Mediation Theory can help us shape relations between users and their environment. Mediation Theory can help us analyze the various shapes these relations can take, the points of application between a technology and its user, and the specific types of mediation at play. Designing interactions is designing relations between human beings and the world, and, ultimately, designing the character of the way in which we live our lives" (Verbeek, 2015, p. 31). Technology Assessment is in this perspective not reactive towards some technological input made by a specific technology, which would be a consequentialist cause-effect approach, but rather trying to foresee

and imagine the "various shapes that these relations can take" in order to make possible designs for how things should/ought to be.

Technology Assessment: assemblages and plans

Technology Assessment originates from a *political* need to regulate the use of technologies that have undesirable consequences: "Its (TA) initial and still valid motivation is to provide answers to the emergence of unintended and often undesirable side effects of science, technology and technicization" (Grunwald, 2015, p. 68). Hence, the overall objective of TA has been to collect knowledge of the effects of technologies, intended as well as unintended, with the purpose of identifying possible actions to prevent undesirable consequences and promote desirable effects. This means that since the first moves towards establishing models for TA, there has been a desire to 'look into the future' in order to make reasonable and rational decisions in relation to technology (innovation, development, etc.) and implementation. The reason why some of the actions in relation to technology have been put into brackets is that various models for TA have different focusses. The earlier models focussed on the implementation part, which meant that it was after the actual design process that reflection and assessment took place. The question was if this particular technology should be implemented or not? Should we use biochemical weapons in warfare, just because we had them at our disposal? Should we implement the uranium and/or plutonium based atomic technology, which we had developed, to supply our energy consumption because we were (and are) in need of a steady and reliant energy resource in order to uphold our modern society, which builds on the principles of constant growth and increasing consumption?

The examples are many, and where different kinds of societies made different kinds of decisions. But also fairly similar societies have made radically different decisions, which is one of the triggering and puzzling enigmas of how we deal with technology on an almost ontological and sometimes seemingly 'religious' level. An example of this is how Denmark and Sweden thread different paths in the 1960s in relation to atomic energy. Denmark decided, probably under the pressure of geo-politics and from a strong anti-atomic

movement, to abstain from the implementation and use of the technology, whereas Sweden decided that atomic energy should be the main resource replacing coal energy, although supplemented by water energy. Water and atomic energy were considered as clean and safe energies, hence good technological resources on both an environmental, economic, and political/ethical level. In Denmark, fossil energy is still the major resource for energy production (50%), supplemented by wind and solar energy. And even though there has been some sporadic debate on the possibility of engaging with atomic energy, and in order to get self-sufficient and rely less on fossil energy, this has never really reached the level of a serious discussion. One of the reasons why atomic energy has been refused, in a Danish context, is partially based on the emotional (and irrational to some) fear of a possible disaster, which eventually became a reality at Chernobyl (1986) and Fukushima (2012).

The essence of this brief excursion, into the basic different understandings and choices between two fairly similar societal models, is to emphasise the importance of emotions (and irrationality) when it comes to technological innovation, development, and implementation. Humans are rational and emotional creatures at one and the same time. In some cases, societies are different and make different choices without any seemingly logical explanation. Why did two similar societies choose very different paths? Are Swedes more rational than Danes, and Danes more caught up by their emotions than Swedes? Independent of the possible answer, we are lead to the conclusion that the assessment of emergent and 'risky' technology has to take into account both the rational and the irrational aspects of the technology as it is thought and designed because both are present as the technology gets implemented and appropriated. Theodor W. Adorno wrote that: "Society is full of contradictions and yet determinable, rational and irrational in one, a system and yet fragmented; blind nature and yet mediated by consciousness" (Adorno, 1976, p. 106).

Another question that must be raised when it comes to assessing technology is who, or what, is doing the assessment? Who, or what, do we assign to make crucial decisions of whether to move forward with a certain technology or not? In other words, who, or what, is in power?

In the early years of technology assessments, it was governmental bodies that performed the decisions and these were based on the analyses made by assigned experts within the specific field. The processes could be characterised as typical Mode 1 scientific procedures (Gibbons et al., 1994) where the analyses had to have some sort of hold within that specific mode of reasoning. The knowledge produced by scientific experts was based on empirical data that could be tested and verified, hence leading to predictions of what would happen in the future. These types of judgments and assessments were addressed towards simple and 'complicated' problems (Figure 1) where things seemingly were, or are, visible, structured, and ordered. We have an explicated and systemic methodology, vocabulary, and terminology that cut the mustard and through categorisations, classifications, and analyses, we will be able to trace cause-effect relationships and our predictions will have credibility, trustworthiness, and veracity.

Figure 1: The Cynefin Model on the character of problems and solutions (partial reproduction).

In the 1980s and 1990s, there was a change in how technology assessment was thought and performed that was mainly due to the fact that the scientific and political environment underwent radical changes. Mode 1 science was under pressure by what Gibson et al. (1994) coined as Mode 2 science where multiple actors/stakeholders are involved in the production of knowledge. Science is no longer an exclusive and monistic activity, which is reserved for the chosen and elected few, but rather a construction in which the needs and requirements of society are present: finance, politics, and science itself. Science (and technology) is considered a social construction, hence and within the paradigm of TA, we are currently in what has later been coined as *constructive technology assessment* (CTA) (Grunwald, 2015).

Even though things get more complicated and entangled, tending towards unordered and unstructured conditions where evident cause-effect relations are invisible and hidden, and as multiple entities are present in the process of assessing, then there is, still, the overall ontological and epistemological conviction that technology is something outside of us, and that we are in the position of controlling, steering, and hence assessing any given technology. The social groups, might they be scientists, companies, governmental entities, NGO's, etc., are set in conditions where negotiations, discussions, quarrels, and disagreements are performed in more or less public spaces. This means that the actual advisory and decision processes, in some cases, are moved from the segregated realms of governmental commissions and councils to spaces wherein, to some degree and extent, the abovementioned social groups are present.

During the past two decades, there has been a further move within TA processes and procedures that are characterised by a direction tending towards state independent entities under the guise of analysis, consultancy, and advisory organisations and institutions. These entities are mainly funded by both private and state money, which means that the precedent central control has been delegated and, in some cases, deranged into fairly flurry and invisible 'bodies'. The analyses, consultancies, and advices are, as mentioned above, funded by a variety of sources that have different interests in the outcomes, which, of course, is a critical element when it comes to assessing the assessments, and, furthermore, it raises the questions of credibility,

trustworthiness, and reliability to an even higher degree than before. These latter models for TA have been coined as *comprehensive, participatory, holistic,* etc. and in these conceptualisations, an opening towards social groups that were not there before is present, i.e. the public, represented by engaged citizens, and/or groups of citizens (NGO's), and users/consumers that should be entailed and embraced by the concepts of comprehensiveness, participation, and holism.

Often these typologies of TA are based on *a division of labour* where technical experts and science advisors map the risks and opportunities of technologies under assessment, and politicians and other policy-makers decide on appropriate actions to prevent the undesirable effects of assessed technologies, meaning that the knowledge and experience of citizens, users, and consumers seldom are taken into account, even though ideally they should be.

Even though we can identify a movement towards participation, comprehensiveness, and holism that engages with the everyday life of people and social groups, we can still see a fairly instrumental way of considering technology as a blunt tool that we have the capacity for controlling and steering. Admittedly, we are, within the *participative*, *comprehensive*, and *holistic* realms, not capable of foreseeing what might happen in the future when it comes to implementation and use of technology, and unpredictable and unintended consequences are often the result of these processes.

The focus on unpredictability and un-intendedness has characterised TA during the past 15 years. Actually, since the seminal article by Ash, Berg, and Coiera, "Some unintended consequences of information technology in health care: the nature of patient care information system-related errors" (2004), was published, there has been, specifically within health care technology and health informatics, a fixed view on the concept of un-intendedness. Ash, Berg, and Coiera looked into technology implementation in the health care sector and how these implementation processes could be rather risky and have severe outcomes, especially considering the fact that the health care sector deals with health, hence life and death. They recommended that we always have to be alert to the possible negative outcomes of technological innovation, development, and implementation. And the earlier in the process that this awareness is present, the better we

will be able to make the right decisions. They also pointed to the fact that analyses of the situational context were necessary anytime that a new technology was to be introduced and their advice on that is still, and to a high degree, valid and relevant today. But, still, we are left with technology as a blunt tool in our hands and what causes undesired side effects is due to inappropriate human behaviour, which we cannot control, exactly because technology is used by humans. In this perspective, we tend to replace humans with technology in our solutions in order to eliminate the human factor that accordingly creates this uncertainty and unpredictability.

I am of the opinion that this paradoxical, original positivist and social constructivist perspective on technology is what actually prevents us from getting a more nuanced and facetted perspective on the role of technology *itself* in these processes, mainly because technology is not just a tool or some technical instrument at our disposal. This has been discussed by a variety of philosophical, anthropological, and sociological positions within mainly STS during the past three decades, but the discussion has not spread into the realm of TA that has been left with paradigms that only consider the 'toolness' and instrumentality of technology. Actor-Network Theory (ANT), and later evolutions of ANT, is among the most significant contributors to a new understanding of the relationship between humans and technology, and it has defied the notion of *assessment* because this means that the symmetry and balance in between actants (humans and non-humans), which is paramount in ANT, is eliminated. In the end, ANT questions the fact that it always and exclusively is humans or 'bodies' of humans that perform the assessments in all of the existing models of TA.

Hermeneutic, phenomenological, and postphenomenological approaches to Technology Assessment have been, in comparison to ANT, very sporadic and weak, and have mainly been represented by one figure in the past decade, i.e. Armin Grunwald and his work on developing a *Hermeneutic Technology Assessment Model*. Here, an attempt is made to qualify (human) utterings and statements on future outcomes of technological evolution. Grunwald's article on "The hermeneutic side of responsible research and innovation" (2014) and his chapter on "Technology Assessment and Design for Values"

(2015) have directed Technology Assessment reflections and actions in a more 'proactive' direction where future implications of technology innovation, development, and implementation are at the core. Grunwald argues that in relation to new and emergent science and technology (NEST), we should create a: "new TA tool addressing not directly the assessment of *technologies* but rather the v*isions* …. In particular vision assessment aims at reconstructing normative elements of the visions under consideration including inherent values" (Grunwald, 2015, p. 71, original italics). In this perspective, we are no longer assessing a concrete technology in order to advice or inform decision-makers on what to do in relation to a specific technological innovation. Assessments of technological visions or techno futures require the competencies and skills of both the assessor and the receiver of the visions and possible futures. This means that the involved in these processes possess capacity of imagination and lateral/associative thinking. It also means that we cannot leave the assessments to consequentialists or scientific experts because what is needed is an expertise of interdisciplinary/transdisciplinary character. Constructivists and experts on participation can inform visionaries and imaginaries, but these are not enough when it comes to actual advice and consultancy for design, and for the development of tools for visioning and imagining. The German philosopher of technology Andreas Spahn has pointed to the fact that we are actually in need of these tools and that these have yet to be developed, and one way could be to link participatory technology design and constructive technology assessment with mediation analysis, and their common effort should thus be to develop: "An elaborated methodological tool and systematical reflection on the best ways to reflect on mediation in the design phase…" (Spahn, 2015, p. 263). And this in order for the original Aristotelian virtues of *poiesis* and *praxis* to be 'performed' at one and the same time in technological innovation, development, and implementation.

Grunwald's model (Figure 2) is an attempt, on a fairly abstract level, to deal with this lack and try to put designers and users in a position where they can evaluate possible outcomes of their visions and actions.

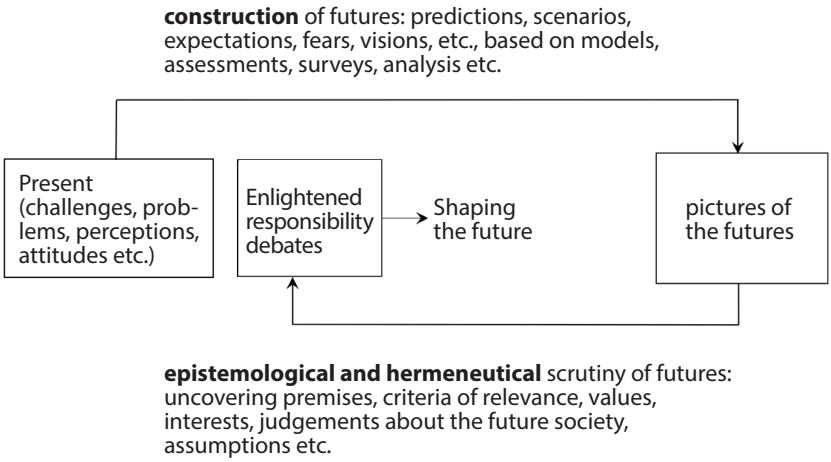

Figure 2: The hermeneutic model of Technology Assessment (Grunwald, 2016).

I am of the opinion that Grunwald's model still pertains some of the original Cartesian dualism of subject and object, where technologies are seen as something instrumental, neutral, and technical, because what is pointed to in the various phases of iteration is, exclusively, human activity and reflection. Nevertheless, we should be inspired by the opening towards processes that are characterised by interpretations of technological visionaries and techno futures on new and emerging science and technologies because pointing at possible futuristic rearrangements of interrelations between humans and technology might involve a focus on technological intentionality.

In this anthology, many of the various models on Technology Assessment are present, including our own sketch elsewhere in this anthology which is characterised by a certain and specific kind of pragmatism which, again, is influenced by phenomenological and postphenomenological understandings of technology and the meaning of technology. This again is complemented by a *Critical Constructivist* (Feenberg, 2017) approach when it comes to considering the systemic and institutional impact of technology in everyday life implementation and use. Hence, we are creating a patchwork of possible and meaningful construction where technology is considered as co-creator, co-shaper, co-constructor, co-producer, and co-constituent

of assessments. How this should be performed and practiced on a methodological and model level will be dealt with later in this chapter. For now, I shall turn my attention to the actual patchwork, and why I think that it is necessary to *thin(g)k* in the metaphor of the patchwork, assemblage, and bricolage. By introducing the '(g)' in 'think', I try to show how *things* are involved in the process of thinking because in both cases - thing and think, as Heidegger emphasises (Heidegger, 1971, p. 163-184) - there is a *gathering*, which means that thinking is not an exclusive monistic and homogeneous cognitive process of reflection that is performed out of touch with material reality but interdependent with the messy and heterogeneous *gathering of things.* Heidegger is very precise on how thinking and reflection is not a de-contextualized and monistic endeavour but rather a complex and constant search of and for meaning and direction: "Everything here is the path of a responding that examines as it listens. Any path always risks going astray, leading astray. To follow such paths takes practice in going. Practice needs craft. Stay on the path, in genuine need, and learn the craft of thinking, unswerving, yet erring" (Heidegger, 1971, p. 184). Here is a clear example of how Heidegger connects and bridges theory and practice, mind and body, and how we cannot be sure of where we are going and what we will find, but, nevertheless, we have to walk in order to gain practice of walking and we have to think in order to gain practice of thinking, and these practices cannot be separated. Things gather as we are on the path, and we build the raft as we swim.

In the following, I shall try to connect the philosophical elucidations made above with what has been coined as Value Sensitive Design (VSD) in order to produce a model that meets the deficiencies and omissions of hitherto attempts of combining TA with, for instance, participatory models for design and constructive TA.

Technology Assessment: hybrid and interdisciplinary design

The original outline of Value Sensitive Design (VSD) was made by Batya Friedman and her research group at Columbia University, Washington, which exactly tries to bridge ethical pre- and post-conceptualisations, actual and possible use, and technical analysis of concrete artefacts. Friedman et al. (1999) divide this into three phases:

a) conceptualisation, b) empirical analysis, and c) technical analysis. Here, by conceptualisation means the identification of the political, ethical, and philosophical values at stake. Empirical analysis consists of qualitative and quantitative analyses of the identified users and stakeholders, and technical analysis is quite bluntly what is meant, i.e. an analysis of the technical elements in the actual technology. Friedman et al. are quite aware of the fact that VSD is an interdisciplinary process where a variety of different experts are involved, from philosophers/ethicists to engineers. From a techno-anthropological perspective, I agree on this kind of interdisciplinarity, but I fear that the trenches dug between for instance philosophers and engineers are too deep to overcome, and that some kind of 'mending' and/or bridge building has to take place. By this, I suggest that the hybrid competencies and skills of techno-anthropologists, having insight and practical knowledge for what concerns both philosophical reflection, qualitative research, and technical analysis, could steer and guide a process on how to evaluate and assess emergent human-technology assemblages.

Shortly after Friedman introduced VSD, Mary Cummings fixed a set of concepts (Cummings, 2006) which were highly influenced by the human rights chart. Later elaborations of VSD point to UN's 17 sustainable development goals. Both the human rights chart and SDG values are considered as general and universal and, of course, they have to be the backbone of any kind of technology assessment, even though the universality of the values could be criticised, as these are 'invented' by representatives of modern (male) western society, hence not representing those who do not consider themselves as part of modern (male) western society. Furthermore, technology itself is not considered in the conceptualisation part, which again mainly builds on classical philosophy and ethics. I am of the opinion that the universality of the conceptualisation is a problem because each and every *real* problem calls for situational and contextual conceptualisation and crystallisation, meaning that the 'germ'/diamond should reflect the process of contextual crystallisation. It should be a *condensation* of the situation. So, if the technological problem calls for equality of health on a universal level, then the condensation could be *empowerment and emancipation of the weak patient* on a more local and situa-

tional level. Returning to Heidegger and his quest for getting closer to technology, I have made this move by addressing empowerment, emancipation, and weakness. I am quite aware of the fact that this intentional value-oriented move might bring us in quite an opposite, or other, direction because we are not capable of being in total control, but still the move has to be made. So, I do not defy the universal values but rather intend to 'get closer', or what Bruno Latour has coined as 'critical proximity' on a methodological level (Latour, 2008; Birkbak et al., 2015), in order to produce advice and counselling to decision-makers on what to do in order to 'empower and emancipate weak patients'.

These conceptualisations are not abstract, as can be seen, but derived from knowledge and experiences of the real, which means that my take on VSD is neither top-down or bottom-up. We do not move from concepts to technical solutions, nor from technical problems to abstract and ideal concepts, but rather, we move into the 'middle' and make a quick and proper empirical analysis of socio-technical character. This means that the empirical analysis is not restricted to qualitative and quantitative analyses of human actors and stakeholders but also imply the intentionality and morality of technology. We ask the question: *how and why things matter?* To phrase Gilles Deleuze and Felix Guattari, we seek the *in between* because it is where things exponentially gain speed and where radical transformations take place (Deleuze & Guattari, 2007).

I also think that this is a sort of 'compression' process because where VSD is a three-layered model with distinct layers of conceptualisation and empirical and technical analysis, this threading/moving into the middle deflates the model, and concepts 'sink' down into the empirical world as technics 'float' up into that very same world. Things are intertwined and enmeshed, yet crystallisations are possible and we may find small *Queens of Africa.*

In the 'toolbox' of the table that was presented in the introduction of this anthology, we pointed to the fact that one of the main 'tools' for moving into the empirical world was *intervention*. By saying this, we build on Action Research and Science (Lewin, 1946; Argyris, 1984), but we take it a step further because Lewin's and Argyris' conceptualisations and methodological reflections on types of *action* are to a

high degree present in the comprehensive, participatory, and holistic/critical approaches to TA. We urge intervention where radical and imminent change takes place in order to alter the current situation. This is not a call for disruption, as was also stated in the introduction, but rather a concerned approach where we try to care, cure, and nurture through our intervention.

Intervention as a concept and practice is not interdisciplinary, democratic, or inclusive per se, and most often somebody is in charge and responsible for the actual intervention. The doctor leads his team in the surgical intervention as the general leads his troops in the military intervention. We have to reflect on that as we make our moves, and change reality with an aim of nurturing, caring, and curing. Who, or what, is in charge? Who, or what, is responsible? The radical movement of intervention through and with technology might go terribly wrong, and we need to be able to adjust on the way in order to prevent disaster. It is a thin line, but all the same, we have to set foot on that line in order to bridge the gap. As I mentioned before, Heidegger points in that direction. We might err and we might end in cul-de-sacs, but we need to stay on "the path of a responding that examines as it listens" (Heidegger, 1971, p. 184).

Technology Assessment: disruption and hubris versus configuration and hybrids

I have questioned whether Technology Assessment should be called assessment at all because in the term an indication of someone doing the assessment is present, and furthermore there is some sort of finality at stake. I think that processes of constant and iterative evaluation and reflection should be part of any kind of technological innovation, development, and implementation and that the various and different Technology Assessment models could and should be applied in relation to what the actual and current technological problem/situation requires. In this way, my take on Technology Assessment is utterly pragmatic where simple and complicated problems call for consequentialist and constructive TA and complex/chaotic problems call for deeply integrated models for getting a grip, or hold, in order to navigate towards (hopefully) better solutions, hence prevent chaos and disorder. We have pointed

to the fact that the current focus on disruption (see introduction) as a mind-set for solving complex problems is at its best one way of dealing with future implications of technology, but disruption is also a total rupture with past and present that can lead to annihilation and extinction of humans and humanity on both an existential and structural level. I also think that disruption is yet another representation/manifestation of human *hubris*, where humans paradoxically are wiped out of the equation.

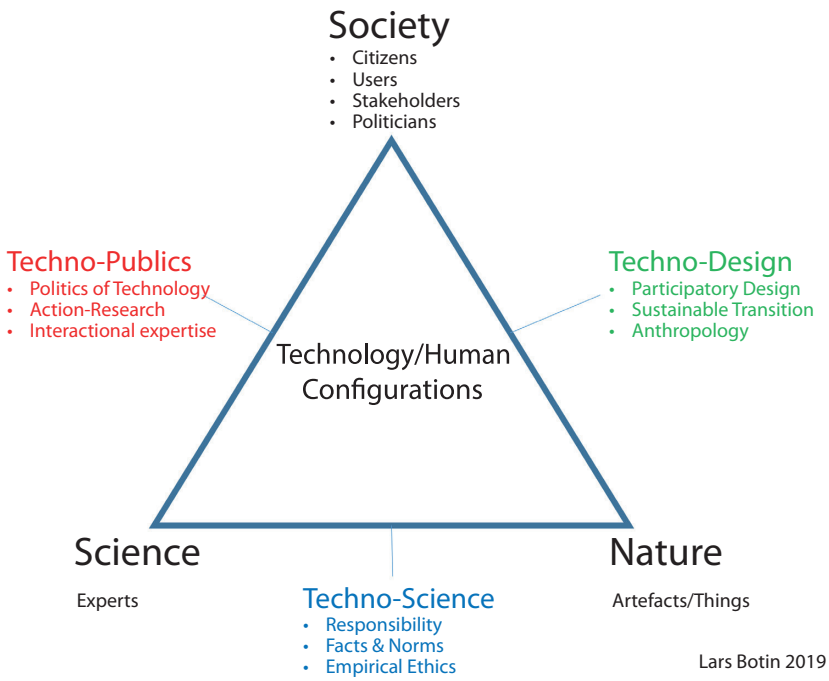

Figure 3: The Techno-anthropological model on technology/human configurations (Botin, 2019).

In the disruption concept, there is a certain kind of nihilism, as opposed to holism, where past and present is wiped out, and the historicity of things are disregarded as obsolete, or at the best anachronistic, and all this in a perspective where time paradoxically is circumscribed as the measurer of innovative and disruptive qualities. In this model on technology assessment, disruption is regarded as a quest stemming

from the political sphere and certain design environments where the slogan 'Disrupt or Die' has reached a level of biblical dimensions. The alliance of liberal capitalistic politics and libertarian design paradigms has forced, on both a systemic and a lifeworld level, states, institutions, organisations, and people to adapt to the quest for disruption. If you are not capable of incorporating and perform according to the requirements of disruption, then you are doomed to succumb, independently if you are a state, institution, organisation, or just a human being.

In the model above (Figure 3), I have tried to paint a very broad picture of how technology/human configurations can/should be framed from various points of vision and intersections. The enframing is a reduction of reality where focus on how configurations should be considered as hybrids that are constructed/created/produced/shaped by a variety of constituents: society, science, and nature; and how these human/technology hybrids are capable of creating arenas for interaction, participation, and integration between constituents, i.e. society, science, and nature. In this perspective, 'technological nihilism', as opposed to holism but also as a product of disruption, is reconsidered as a co-creative and productive force where the inner technical drive towards instrumentality and 'enframing' is used as an expansive and exterior structuring fuel in a movement towards responsibility and sustainability. Humans are in this sense given the force, through and with technology, to change direction, vision, and perspective in both points of vision (society, science, and nature) and in the intersections in between these. This force can only be performed in the intersections from which they 'spread' like electrons into the bodies of society, science, and nature. In the model, there are humans everywhere, just as there are technologies everywhere. They are omnipresent. Humans constitute society, as they do science, and are as physical entities part of nature. Technology is also part of nature, considered as the world, as science and society cannot be thought without technology. How they configure in the middle of the model as creatures, constructs, and products, is a result of the controversies, negotiations, and interactions. These are in a postphenomenological perspective multistable, which means that various kinds of stable configurations are possible and that these are hybrid forms, poten-

tially changing under external and internal pressure. In this perspective, I have extended the original meaning of multistability (Ihde, 1990) where the concept is purely framed in relation to technology and human experience of how these multistabilities mediate behaviour, practice, understanding, etc. In my perspective, humans and technology are totally and ultimately together, and what is mediated by these multistable hybrids is society, science, and nature.

Conclusion

In this chapter, I set out with the intent of showing how Technology Assessment should be treated less instrumental than has been the case and practice for the past 50 years, since it was introduced in an American context in 1972. In the various phases of the history of Technology Assessment, as we write in the introduction of this anthology, there has been attempts to conceive and perceive understandings and practices in Technology Assessment in a more constructive, comprehensive, holistic, participatory way, and lately also with more hermeneutic focusses on foresighting and imagining. Nevertheless, I think that these attempts maintain a focus on humans, stakeholders, actors, etc. as sovereign constructors, intervenors, and assessors of technological innovations, developments, and implementations. Although, this is made without considering the decisive role of technology in these processes. In this particular perspective, the sovereign has been dethroned, and a new human/technology assemblage has set instead. Not on a throne but as a dynamic catalyser of responsible and sustainable transition, which happens in realities that are characterised by in-betweenness and becoming together in arenas of constant conflict and controversy, i.e. ethico-political in their substance. The human technology assemblage revolves and is directed towards care of and concern for other assemblages/hybrids that partake in the ongoings in the arenas of politics and ethics. These politics and ethics of assemblages deconstruct the very notion of assessment because what or who are assessed and who or what are assessing in the arena of politics and ethics? We all but direct and revolve our assembled selves towards sustainable and responsible scenarios and imaginaries, taking into *account* how techno-politics, techno-publics, techno-ethics, techno-science and techno-design affect

these future, multistable possibilities and potentials. The 'assessment' is hence a dynamic process of description, accountancy, and prescription based on values that we have negotiated in the intersections/arenas, and subsequently crystallised in the meetings of these intersections, i.e. in the very construct of the human-technology configuration. This means that the configuration/assemblage is constantly moved and altered through the crystallisation process, but the 'germ' will always gain shape and form. This temporal and multistable hybrid will then 'strike back' in the process as it re-enters the arena with new possibilities and potentials, i.e. force/power to and for change in directions for evermore care and concern.

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