Shaping the present by creating and reflecting futures

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Abstract

It is a commonly used rhetoric phrase that we develop ideas how to shape the future and that we shape the future exactly by implementing those ideas. However, what does it mean to "shape the future"? We are only able to intervene into the present, by communication, by action, or by decisions to be made. These interventions then might have consequences for future developments or events. Thus, the phrase should better be reformulated: we do not shape the future itself but we intervene into present constellations and thereby influence future developments more or less indirectly. As far as we use socio-technical futures as orientation to identify appropriate interventions into present constellations – as usually is done by technology assessment – we can speak of futures contributing to shape the present. It means that in present time we create futures supporting us to shape the present.

1. Setting the stage

It is a commonly used phrase that we develop ideas how to shape the future and that we shape the future by implementing those ideas. While this is the traditional view of planning (Camhis 1979) it also applies to more recent approaches such as reflexive governance (Voss et al. 2006). Also the world of NEST (new and emerging sciences and technologies) is full of narratives and pictures why and how NEST should be developed in order to shape the future, e.g. for solving the global energy supply problem, for enhancing human performance, or for designing artificial life.

However, what does it really mean to shape the future? At any time we are only able to intervene into the present, by communication, by action, or by decisions to be made. These interventions then will usually have consequences for future developments or events. Thus, the phrase should better be formulated in the way of the title of this volume: we cannot "shape the future" directly but we only can intervene into present constellations and expect or hope that these interventions will lead to future developments in good resonance with the goals and purposes related to the respective intervention. As far as we develop and use socio-technical futures[1] as orientation to identify appropriate interventions into present constellations we can speak of futures contributing to shape the present. It means that in present time we create futures supporting us to shape the present. This perspective refers to the philosophy of time by Augustine of Hippo (Augustine 397):

[1] The term 'futures' is used in this chapter to denote *present* imaginations of future developments or events: present futures instead of future presents (according to Luhmann 1998/1992).

> Nec proprie dicitur: tempora sunt tria, praeteritum, praesens et futurum, sed fortasse proprie diceretur: tempora sunt tria, praesens de praeteritis, praesens de praesentibus, praesens de futuris (Augustine 397 XI, 20)
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> Thus it is not properly said that there are three times, past, present, and future. Perhaps it might be said rightly that there are three times: a time present of things past; a time present of things present; and a time present of things future (Augustine 397 XI, 20)

This early observation corresponds to the epistemic immanence of the present (Grunwald 2006): Futures as well as pasts are always parts of the present. There is no possibility to shape the future in the meaning of shaping directly a future present (Luhmann 1998/1992), e.g. of shaping today some elements of the German energy system for the year 2025. Today we cannot intervene into the year 2025 but only into our current present. According to this picture shaping the future only can mean shaping the present with, however, some regard to the (also present!) futures we have in mind.

In contrast to this Augustinian perspective the widespread talk about "shaping the future" involves a kind of planning optimism. It presupposes that our interventions to the present will lead (at least mostly) to the desired results so that *shaping the future* would only be an abbreviation for *shaping the present and presuming that the consequences of the respective interventions will lead (more or less) to the expected events or developments as soon as the time will have come*.

The Augustinian perspective on time radicalizes further the modest assumptions of the plannability and controllability of the sociotechnical future dominating technology assessment and STS studies since decades. According to this perspective no longer "the future" in the sense of a future present shall be shaped but rather the accent is given to shaping our today's present. By shaping this present processes can be initiated building a processual bridge to future presents – however, not aiming at shaping those futures directly because during the process many alternatives might appear. Thus, this type of reasoning combines anticipatory thinking with the idea of the openness of the future and the existence of many alternative options while proceeding from today's present to some future present.

In the following sections I will unfold the perspective opened up by the Augustinian perspective on time and search for implications for technology assessment and related approaches. First, some observations of real-world impacts of futures on the respective present will be discussed (Sect. 2), in particular taking into consideration examples from NEST (new and emerging sciences and technologies). This section shall illustrate how the present is *de facto* shaped by futures. Second, the Augustinian perspective will be underpinned by more in-depth considerations of the structure of futures (Sect. 3). Third, consequences in several dimensions will be drawn for technology assessment but also beyond (Sect. 4).

2. Observations: impacts of NEST futures on the present

Making statements about the futures always is an *intervention* in ongoing present-time communication and can have an impact on present-time issues. In particular, in everyday life statements of some developments to occur in the future impact on present-day's

issues. For example, the daily weather forecast for tomorrow may influence our plans for hiking activities. Or, take predictions in demographic change, e.g. about the number of pupils and students in ten years are taken as statements about how those numbers will really develop in the coming years. These statements might be used as information for e.g. planning schoolhouses and educating or hiring teachers and thus making decisions today, independent of whether these prospective statements will prove wrong or fals in the time to come. Futures can trigger a turn in a debate and influence decisions, possibly depending on how consistent, plausible, motivating, threatening or fascinating the respective futures are.

While this statement holds generally (e.g. the example of trend extrapolations discussed in Sect. 4) the focus of this chapter is on techno-visionary communication. In the past decades a considerable increase in visionary communication on future technologies and their impacts on society could be observed. In particular, this has been and still is the case in the fields of nanotechnology (Selin 2007, Fiedeler et al. 2010), human enhancement and the converging technologies (Roco/Bainbridge 2002, Grunwald 2007), synthetic biology (Giese et al. 2014), and climate engineering. Visionary scientists, science managers and science authors have put forward far-ranging visions, which have been disseminated by mass media and discussed in science and the humanities (Grunwald 2016) and shall be called techno-visionary futures characterized by (according to Grunwald 2013):

- They refer to a more distant future, some decades ahead, and exhibit revolutionary aspects in terms of technology and in terms of culture, human behaviour, individual and social issues.
- Scientific and technological advances are regarded in a renewed techno-determinist fashion as by far the most important driving force in modern society (technology push perspective).
- Their authors are mostly scientists, science writers and science managers such as Eric Drexler and Ray Kurzweil; but also NGO's and industry are developing and communication visions.
- Milestones and technology roadmaps are provided to demonstrate the feasibility of those futures and to demarcate a difference to narratives Science Fiction.
- Often high degrees of uncertainty are involved with severe controversies as a consequence.

The emergence of this new wave of visionary and partially futuristic communication has provoked renewed interest in the role played by imagined visions of the future. Obviously, there is no distinct borderline between different types of visions communicated in these fields and other imagined futures such as *Leitbilder* or guiding visions which have already been analyzed with respect to their usage in policy advice (Grin/Grunwald 2000). Techno-visionary futures address possible social developments in the light of visionary sciences and their impacts on society at a very early stage of development. As a rule, little if any knowledge is available about how the respective technology is likely to develop, about the products such development may spawn, and about the potential impact of using such products. According to the control dilemma (Collingridge 1980), it is then extremely

difficult, if not impossible, to shape technology. Instead, lack of knowledge could lead to a merely speculative debate (e.g. Nordmann 2007), followed by arbitrary communication and conclusions (Grunwald 2016, Chap. 3).

Indeed, one could argue that some of the NEST debates are so speculative that they should better be ignored because of lack of any practical consequence, as suggested in the context of speculative nanoethics (Nordmann 2007). They might be interesting in a merely abstract and philosophical sense to discuss some speculative questions, such as overcoming death, as a kind of thought experiment. There might also be some interest in circles of intellectuals or in the feuilletons of magazines. Yet, regarding the speculative nature of many of those questions, serious concern was expressed that the intellectual effort and the resources spent might be completely irrelevant and wasted (Nordmann/Rip 2009). However, this argumentation is misleading (Grunwald 2010). While techno-visionary futures ranging from high expectations to apocalyptic fears are often more or less fictitious in content, such stories about possible futures can and often do have a real impact on scientific and public discussions (Selin 2007). Even a picture of the future lacking all facticity can influence societal debates, the formation of opinions, issues of perception and acceptance, and even political decision making in two ways at least (following Grunwald 2016):

- Techno-visionary futures can change the way we perceive current and future developments of technology, just as they can change the prospects of future societal constellations. Frequently, the societal and public debate about the opportunities and risks associated with new types of technology revolves around those visionary stories to a considerable extent, as has been the case in the field of nanotechnology (Schmid et al. 2006, Fiedeler et al. 2010) and as is still the case in human enhancement (Coenen et al. 2009, Coenen 2010). Visions and expectations motivate and fuel public debate because of the impact the related narratives may hold for everyday life and for the future of important areas of society, such as military, work, and health care. The current debates on future perspectives of digitization are a recent illustration (e.g. Hirsch-Kreinsen 2016). Positive visions can contribute to fascination and public acceptance and also can attract creative young scientists to engage themselves there, just as negative visions and dystopias can cause concern and even mobilize resistance as was feared in particular in the early debate on nanotechnology (Grunwald 2011).
- Techno-visionary futures exert a particularly great influence on the scientific agenda which, as a consequence, partly determines what knowledge will be available and applicable in the future (Dupuy 2007). Directly or indirectly, they influence the views of researchers and, thus, ultimately also exert influence on political support and research funding. For example, the US American funding program on nanotechnology “National Nanotechnology Initiative” (NNI) was named “Shaping the World Atom by Atom” directly referring to visionary ideas of futurist Drexler (1986). Even the speculative stories about improving human performance (Roco/Bainbridge 2002) quickly caused great interest among policy makers and research funders (Nordmann 2004, Coenen et al. 2009). Projections of future developments based on NEST expectations therefore not only might have but really had heavy influence on decisions about the support, funding and

prioritization of scientific research and progress. The allocation of research funds is obviously a real intervention which usually will have a real impact on further developments.

In general, the communication of techno-visionary futures represents an *intervention* in ongoing communication. It can trigger a turn in a debate and influence decisions, possibly depending on how consistent, plausible, motivating, threatening or fascinating the respective futures are. The reception of George Orwell's novel *1984* or the consequences of the report of the Club of Rome, *The Limits of Growth,* from 1972 are examples of this. This interventional character can lead to the well-known effects of self-fulfilling or self-destroying prophecies (Merton 1948). Intervening with technology futures in present debates on technology, whether with warnings or hopes, is also a power game linked to values, interests, and intentions (Brown et al. 2000). The factual power of futures in general and techno-visionary futures in particular makes them to an object of responsibility assignments and reflections (Grunwald 2017).

A particular example of this intervention is the story of Drexler's molecular assembler (Drexler 1986). This envisioned machine would be able to form any object by selecting atoms from the environment and positioning them, one at a time, to assemble the object desired: "Eric Drexler …. believes nano-assemblers could make steaks out of grass, water and foodstuffs, avoiding the cumbersome process involving the cow" (Munich Re 2002, 3). In spite of the fact that this highly visionary and even futuristic idea was proven to be not feasible because of natural scientific considerations (Smalley 2001) it exerted a considerable influence on the emergence of nanotechnology as a research field with revolutionary potential, on the emergence of public debate, on motivating contradicting views such as proposed by Bill Joy (2000), on the NBIC movement (Roco/Bainbridge 2002, Wolbring 2008), and on public funding of nanotech research with the National Nanotechnology Initiative (NNI 1999) being the flagship of public funding of nano still today. Thus we can see highly visible consequences and traces of this future proposed more than 30 years ago in spite of the fact that there was no technological advance towards its realization at all.

The factual power of techno-visions thus contributes to shaping the present. Communication and discussion of specific futures can heavily affect a certain present time independent from whether the content of the vision will be realized at some time, independent even from the feasibility of that vision (Loesch 2006). A nice example can be taken from a branch of the German history of nuclear power. In order to close the material flow of radioactive materials in the sense of a circular economy and to realize the vision of a nearly infinite process of energy provision the technology of the Fast Breeder was developed. A reactor of this type was built in Kalkar at the cost of about seven billion *Deutsche Mark*. However, during the construction the acceptance of nuclear power in Germany decreased and almost disappeared, in particular because of the Chernobyl disaster. As a result, the power plant at Kalkar was never taken into operation in spite of the fact that it had been completely finished in 1987. Thus the vision of getting infinite nuclear energy had large real consequences at that time in terms of economic resources to be spent and of social conflict fueled while there has never been a contribution to German energy supply of that technology. The vision contributed to shape the present policies of that time (investments, subsidies by the state, demonstrations of the

opponents, growth of the antinuclear movement etc.) while it did not – as was intended – shape the future of the German energy system because it never produced electricity.

3. Reflections: The immanence of the present

We make statements about the future, develop pictures of it, simulate temporal developments and create scenarios, formulate expectations and fears, set goals, and consider plans for their realization. All this takes place in the medium of language (Kamlah 1973) and is thus part of the respective *present*. The same holds for statements of the past. Humans always live at a present time while the past and the future are present only in their minds. Epistemologically our standpoint is always the present we are living in and from which we construct our images from the past as well as from the future:

> For if there are times past and future, I wish to know where they are… Wherever they are and whatever they are they exist only as present. Although we tell of past things as true, they are drawn out of the memory, not the things themselves, which have already passed, but words constructed from the images of the perceptions which were formed in the mind… (Augustine 397 XI, 18)

Also forecasters and techno-visionary writers cannot break out of the present either, always making their predictions on the basis of present knowledge, values, and assessments. Future facts or processes can be neither logically deduced (Goodman 1954) nor empirically investigated. The only things that are empirically accessible are the present images which we make of the future, but not the future presents itself. For this reason, we can talk about possible futures in the plural, about alternative possibilities for imagining the future, and about the justification with which we can expect something in the future. These are always *present futures* and not *future presents* (Luhmann 1992/1998). Therefore, if we talk, for instance, about techno-visionary futures such as cyborgs or far-reaching human enhancement, we are not talking about whether and how these developments will really occur but how we *imagine and assess them today* – and these images and assessment mostly differ to a large extent. Futures are thus something always contemporary and change with the changes in each present (Grunwald 2016).

> When, therefore, they say that future events are seen, it is not the events themselves (…), but perhaps, instead, their causes and their signs are seen, which already do exist. Therefore, to those already beholding these causes and signs, they are not future, but present, and from them future things are predicted because they are conceived in the mind (Augustine 397 XI, 18)

Futures do not arise of their own accord. Techno-visionary futures are social constructs. They are man-made and cannot be discovered. Futures are created and disseminated by individual authors, teams, journalists, scientists, and science managers, or they emerge from discourse within scientific communities or at the interface between science and society. Futures, regardless of whether they are forecasts, scenarios, plans, programs, visions, or speculative fears or expectations, are designed using a whole range of ingredients such as available knowledge, value judgments, and suppositions. They are communicated via different channels, journals, networks, mass media, research applications, expert groups, ELSI or TA projects on policy advice, etc. Some of them, finding no resonance, will quickly disappear within these communication processes while

others will “survive” and motivate actors and groups to subscribe to or oppose the visions – in either case the story will continue and the respective futures will have real-world impacts (Selin 2007). Probably, only a few of the visions proposed will find an audience via the mass media and will therefore be able to achieve real impact for public debate and social perception or attitudes at a larger scale. Others may enter the political arena and result in political decisions, e.g. about research funding (see above). Also the significance of visionary thinking in specific NEST fields may vary over time (Lösch 2010). The history of spaceflight, for instance, is full of techno-visionary promises which regularly fail but nevertheless survive and remain fascinating to many people. The narratives of human settlements on the Mars or on artificial space stations belong to those persistent stories which again and again have real-world impacts by attracting a lot of research funding.

Because futures are man-made they have authors involving intentions, objectives and purposes. The designing of futures is purposive action, intended for example to provide orientation, to create fascination, to promote a certain line of development, to attract research funding, to raise awareness in the public, to initiate a debate, or to support partisan interests. By framing the construction of futures in the means/end rationality questions of the following type come into consideration (Grunwald 2016): Which actors – individuals as well as collectives such as project groups, institutes, or associations – belong to the authors? Which perspectives do they include and express? Which motives are they pursuing? What ideas do they have about the relationship between technology and society? What is their stand in general toward scientific, technological progress? To which contexts, networks, policy groups, pressure groups, etc. can they be assigned? Why and for what purpose was a specific techno-future designed? What shall a proposal for a definition bring about? Which diagnoses, values, or even interests are behind this choice of aims? Are there different and perhaps conflicting goals and purposes pursued by different actors? Hermeneutic analysis and discourse analysis can shed light on this unordered list of questions and help enlightening the background of the futures created and communicated.

In the construction of techno-visionary futures numerous decisions must be made about the purposes pursued (see above) and the means identified as appropriate to reach the purposes. In particular, building techno-visionary futures needs ingredients such as background data, knowledge about regularities or correlations, assumptions and estimates of relevance as well as a process of composing these ingredients into a coherent picture of the future. In order to better understand these futures in content and with regard to their background motivation the question has to be answered as to what ingredients are used in the shaping of futures and in which way these ingredients have been assembled and composed in arriving at the respective statements about the future. As far as their knowledge structure is concerned, futures are initially opaque constructs consisting of highly diverse elements. In a rough approximation, the following gradation of knowledge and other components can initially be made without claiming completeness (Grunwald 2016):

- *Present knowledge* which is proven according to accepted criteria (e.g., of the respective scientific disciplines) to be knowledge (e.g., according to the issue at stake from the field of nanotechnology, engineering, economics);

- *Estimates* of future developments that do not represent current knowledge but that can be substantiated by current knowledge (e.g., demographic change, energy needs, velocity of the technological advance);
- *Values* and normative expectations about the future society, future relations between humans and technology, or between society and nature, etc.;
- *Ceteris paribus (all other things being equal) conditions*, whereby certain continuities – business as usual in some sense or a lack of disruptive changes – can be assumed as a framework for the prospective statements;
- *Ad hoc suppositions* which are not substantiated by knowledge, but taken as given (e.g., the future validity of a German phase-out of nuclear energy, or the non-occurrence of a catastrophic impact of a comet on the Earth);
- *Utopian ideas* of worlds where everything could be different in the future, speculative proposals for futures worlds, science fiction stories and other imaginations.

Futures are thus created in accordance with available knowledge, but also with references to assessments of relevance, value judgments, and interests, perhaps normative visions and utopias and also may include mere speculation. The construct character of futures can thus be exploited, on the one hand, by those representing specific positions on social issues, substantial values, and particular interests in order to produce future visions corresponding to their interests and to employ these to assert their particular positions in debates (Brown et al. 2000). On the other, this construct character calls for enlightening analysis of ingredients and composition in order to provide better understanding.

These considerations are in accordance with the reflections on time given by Augustine of Hippo (see above). Futures are created in the present based on experiences from the past and expectations of the future which, however, both are also constructs made in present time. We cannot escape the immanence of the present. Therefore, our interventions cannot affect the future present directly but the respective present time only.

4. Consequences for Technology Assessment

Technology assessment (TA) constitutes a research-based response to challenges and problems at the interface between science and technology on the one hand, and humans and society, on the other (Grunwald 2010, 2018). Its specific mission is creating *knowledge for action* in shaping the technological advance and the usage of its outcomes. TA consists of a combination of *knowledge production* concerning possible consequences of new technology, the transparent *evaluation* of this knowledge from a societal perspective involving values and goals, the *development of options* how to proceed, and of making knowledge and options available to politics and society. TA is both interdisciplinary and transdisciplinary in nature. Recently the following definition of TA was proposed (Grunwald 2018):

> Technology assessment is a set of socio-epistemic practices[2] serving the cognitive interest of enhancing reflectivity for shaping the technological advance and the usage of its outcomes in a democratic way. Enhancing reflectivity shall be realized by providing and assessing prospective knowledge, by applying an inclusive approach to a diversity of perspectives in social and epistemic respect, and by applying systems thinking.

TA arose from specific historical circumstances in the 1960s and 1970s. Concerns in the U.S. political system, in particular in the Congress, culminated in the creation of the Office of Technology Assessment (OTA) in 1972 (Bimber 1996) as the first manifestation of TA. Parallel to this specific development in the political system, radical intellectual changes took place and resulted in the more general motivations of TA (Grunwald 2018). TA was then expected to contribute to new forms of societal orientation and legitimisation of science and technology facing those challenges: to explore possible unintended and negative side-effects of technology (Bechmann et al. 2007), to assess and weigh risks and chances, to reconcile technology and democracy, to elaborate strategies for legitimate decision-making, to help resolving technology conflicts. The first phase of TA was characterized by an underlying belief in technology determinism (Ropohl 1982) and planning optimism. TA was expected to provide predictions of future technologies and their consequences in order to allow society and politics to better adapt to those consequences.

Since the 1980s the idea of technology determinism was overcome in favour of the opportunity of *shaping technology* by early reflection on possible later impacts and consequences (Bijker/Law 1994). The adaptation of the social constructivist programme (Bijker et al. 1987) to TA was performed within the approach of Constructive Technology Assessment (CTA). CTA should and still shall serve as a reflexive think tank in society with the mission to contribute to “a better technology in a better society” (Rip et al. 1995). Major current objectives of TA are providing contributions to shaping technology towards a more sustainable development as well as to the RRI movement (Owen et al. 2013, van den Hoven 2014).

In each of the concepts proposed TA explores and assesses, on the one hand, possible impacts and consequences of technology in a prospective manner. On the other, it helps to introduce society’s expectations and needs concerning new technology into the agenda-setting processes for research and development. Regarding that there are influences in both directions, from technology development on society, but also from society’s expectations on technology, the notion of a “co-evolution” of technology and society gained much acceptance (Rip 2007), with technology assessment acting as its medium.

Anyway, the TA focus on future consequences of technology, be they intended or unintended, puts it under the consequentialist paradigm (Fig. 1). In the German translation *Technikfolgenabschätzung* even the notion of consequences (*Folgen*) has

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[2] The notion of socio-epistemic practices refers to a twofold constellation characteristic to TA: (1) its social processes of involving different actor groups are not only relevant in social but also in epistemic respect; and (2) the results of these socio-epistemic processes include knowledge for action which is not only an epistemic object but also may restructure social conditions how to act and decide.

been made part of the term. TA investigates consequences which could perhaps, plausibly or probably become reality in the futures. Prospective knowledge in TA is knowledge about consequences which do not yet exist and perhaps will never become reality. Providing prospective knowledge has a merely instrumental function in TA and is not and end in itself: the prospective knowledge is the object of assessing, reflecting, evaluating and judging, e.g. with respect to desirability, acceptability, or responsibility. At the end of this consequentialist reasoning conclusions for action and decision-making are drawn based on provision and assessment of the prospective knowledge. This consequentialist loop starts in a respective present, leads to considering some futures, and then leads back to the respective present (Fig. 1).

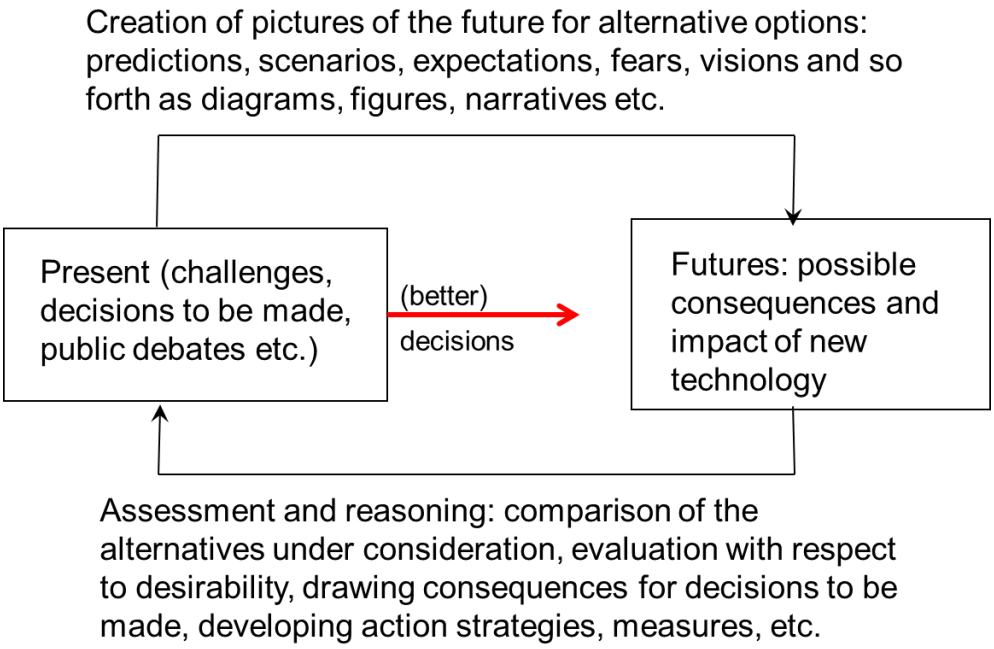

Fig. 1 The consequentialist loop of technology assessment

According to the analysis given in the sections following Augustine above two immediate conclusions can be drawn:

1) The diagnosis of the immanence of the present also applies to technology assessment which means that the consequentialist loop (Fig. 1) entirely takes place in a respective present – the futures considered are merely present constructions and images of futures, and
2) Decisions made upon advice of TA do not shape the future but rather the respective present. They are interventions into the respective present time. Whether these interventions will lead to the intended outcomes and consequences remains an expectation. The future development only will show whether they will be fulfilled or to which extent they will be fulfilled, or which unintended effects also might emerge.

While the first conclusion seems to be common sense in TA the second is not. At least many TA practitioners (including the author) again and again speak of the mission of TA as “contributing to shaping the future”. However, taking conclusion (2) seriously implies that TA should no longer be conceptualized as supporting shaping socio-technical futures but rather as helping shaping the present according to pictures of the future created, debated, and assessed. By doing this the familiar claim of shaping the future in the usual sense of a future present does not completely disappear. It only moves more to the background because in the time span between the respective intervention into a specific present time and the intended shaping of future events or developments a lot of things may happen which had not been taken into account and which could make the relation between the intervention and the consequences after some time much looser than intended or expected.

This shift of consideration might perhaps appear artificial, too sophisticated, and perhaps without any relevance to TA’s daily business. In the remainder of this section, however, I will demonstrate that there are relevant lessons to be learned from this shift, at least in certain TA constellations.

(1) Awareness-raising by trend extrapolation

According to the considerations given in section 3 in accordance with Augustine’s view on time it is obvious that extrapolations do not provide any knowledge of future presents. Rather they but are expressions of *current* respective *past* knowledge which is applied to future developments under the presupposition that things simply will go on. Extrapolations, in particular trend extrapolations are the mere continuation of the past to the future in the present. With Augustine we might say that trend extrapolations identify the knowledge about past developments with expectations concerning the future altogether in present time. While they therefore do not tell any truth about the future they can be used to shed some light on (perhaps alarming) *current* developments and have a merely instrumental function. This was indeed the most important effect of famous future stories: when, for example, Rachel Carson postulated the “Silent Spring” in 1962 she envisaged a future world without birds which suffered progressively from DDT-pesticides in those days. This projection however did not realize in the decades after because she underestimated the impact of her report on society, which effectively banned the pesticide for the sake of the environment, subsequently.[3] However, there is no doubt that Carson took up a serious observation of her time. By extrapolating it to the future she created awareness what might happen if no countermeasures would be taken. In this sense, trend extrapolations should less pretend to know the future as they could better give orientation for action what should be done in shaping the present (van der Burg 2014). The story of the “Limits to Growth” published by the Club of Rome in 1972 showed a similar effect. Pictures of the future based on the extrapolation of trends often help to raise awareness concerning problematic developments. This type of futures is as an illustrative example for futures shaping the present – which is an important mechanism of gaining orientation

[3] This is a nice example for the interventionist power of futures for the respective present (Merton 1948, cp. Section 3)

and prioritizing activities. And it is an example of the immanence of the present because it does not tell any certain message about a future present.

(2) Hermeneutic extension of technology assessment

The observation that also the consequentialist loop remains trapped in the immanence of the present together with the situation of little or almost no valid prospective knowledge available virulent in many NEST fields gave rise to propose an hermeneutic extension of the traditional consequentialist approach of TA (Grunwald 2014, 2016). The hermeneutic analysis of pictures of the future hardly tells us anything about the future in the sense of a present in the time to come, but rather *about us today*. If projections of the future are interpreted in a way that makes it clear why we aggregate certain current ingredients to specific futures and argue dedicatedly about them, then we have learned something *explicitly* about ourselves, our societal practices, subliminal concerns, implicit hopes and fears, and their cultural roots. Compared to the consequentialist paradigm with its central focus on questions as to the possible impacts of new technologies, how we assess these, and whether and under what circumstances we welcome or reject these implications, this perspective includes a set of questions into TA reasoning which were not that significant before (following Grunwald 2014):

- What are the implications of the new developments in science and technology for the present and future of man and society, which fundamental constellations (man/technology, man/nature, etc.) do they change, and "what is at stake?" e.g. in ethical, cultural, and social terms?
- How is a philosophical, ethical, social, cultural, etc. significance attributed to scientific-technological developments, which after all are nothing initially but scientific-technological developments? What role do e.g. (visionary) techno futures play in this context?
- How are attributions of meaning being communicated and discussed? What roles do they play in the major technological debates of our time? What forms of communication and linguistic resources are being used and why? What extra-linguistic resources (e.g. movies, works of art) play a role in this context and what does their use reveal?
- Why do we discuss scientific-technological developments in the way we do and with the respective attributions of meaning rather than in some other way?
- How does man as an historical being see himself in discourses about techno-futures? What future concepts are being applied if the future is presented either as though it were possible to shape it technically or politically, or as what will contingently come about and will never be quite adequate in terms of a historical responsibility to bring about a better world?

Responding to these question needs extended interdisciplinary work including contributions from sociological and philosophical discourse analysis, linguistics, the historical science, and cultural studies.

(3) Democratic dimension: opening up futures instead of closure

The emphasis on the open space of futures in hermeneutic orientation is cognate with ‘opening up’ the outputs of TA with plural and conditional advice (Ely et al. 2014). While frequently scientific reasoning about futures is in risk of closing them down to a presumed “one best solution” in the attitude that “science knows best” the analysis given above about the immanence of the present (Stirling 2008) also holds for scientifically produced futures. Keeping alternative futures open or opening up new ones by elaborating on further alternative options in TA’s tradition of “thinking in alternatives” (Grunwald 2018), however comes at a price. While many actors in politics and public debate claim that complexity must be reduced and that things must be made as simple as possible TA usually does the opposite. Instead of reducing complexity it adds further future options involving consequences and impacts of new technology to the processes of reasoning and weighing. The obligation of TA to be reflective renders simplistic views on new technology or transformations processes as well as the closure of futures impossible. This implies that more time, resources, and effort will be needed for reasoning, deliberation, and decision-making, and that TA is in charge of developing procedures to deal with this increased complexity.

5. Concluding remark

Technology assessment and other research activities investigating and reflecting the scientific-technological advance and the usage of its outcomes have become more modest concerning the possibility of predicting future technologies and their impacts on society. In particular, it is the issue of the ‘co-evolution’ of technology and society which strongly limits today’s trends and assumptions to the future. Notions such as techno-visionary futures and present futures using the term ‘future’ in the plural illustrate this development.

While this modesty seems to be common-sense in many communities today (except the newly emerging optimism of enabling better prognoses by Big Data technologies) the phrase about shaping the future still can be observed everywhere in engineering, in the economy, in the public and in politics. In this chapter I have proved that this notion is misleading in its frequent naïve usage. Therefore, a more reflected view on this and related terms should be applied.

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