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Research article

## The Futures Circle - A Framework for Hermeneutic Technology Assessment

Wenzel Mehnert (✉) 

Austrian Institute of Technology, Giefinggasse 4, 1210 Wien, Austria  
Technical University Berlin, Straße des 17. Juni 135, 10623 Berlin, Germany

[mail@wenzelmehnert.de](mailto:mail@wenzelmehnert.de)

### Abstract

Technofutures, meaning statements about new and emerging technologies (NEST) disrupting the world as we know it, often follow a purely hypothetical and thus also speculative manner. At the same time, they shape the way we think and discuss NEST and leave an impact on the development of the actual technology. Scholars from Science and Technology Studies (STS) and Technology Assessment (TA) have turned towards technofutures as objects of interests, to better understand the content, the spreading, and the impact of techno-visionary communication. The shared characteristic of these approaches is that they view technofutures not as predictions of what may or may not happen, but as reflections of current state of affairs, i.e., compositions of existing knowledge, values, and attitudes. One of these approaches is Hermeneutic Technology Assessment (TA), which focuses on analysing how technofutures attribute meaning to NEST. This paper gives an insight into the different perspectives on technofutures and suggests a framework for the hermeneutic assessment of technofutures: The Futures Circle. The framework gives guidance through an otherwise often rather erratic research and contributes to the methodological reflection on Hermeneutic TA.

**Keywords:** Hermeneutic TA; Technofutures; Technology Assessment; Method; Framework; Ricoeur

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Научная статья

## Круг будущего – основа герменевтической оценки технологий

Венцель Менерт (✉)

Австрийский технологический институт, Гифинггассе 4, 1210 Вена, Австрия  
Технический университет Берлина, ул. 17 Июня, 135, 10623 Берлин, Германия

[mail@wenzelmehmert.de](mailto:mail@wenzelmehmert.de)

### Аннотация

Технобудущее, то есть заявления о новых и появляющихся технологиях, которые меняют мир, каким мы его знаем, часто следуют чисто гипотетической и, следовательно, также спекулятивной манере. В то же время они формируют то, как мы думаем и обсуждаем новые и появляющиеся технологии, и оказывают влияние на развитие самой технологии. Ученые из области исследования науки и технологий (STS) и оценки технологий обратились к технобудущему как к объекту интереса, чтобы лучше понять содержание, распространение и влияние техно-визионерской коммуникации. Общей характеристикой этих подходов является то, что они рассматривают технобудущее не как предсказания того, что может или не может произойти, а как отражение текущего положения дел, то есть совокупность существующих знаний, ценностей и отношений. Одним из таких подходов является герменевтическая оценка технологий, которая фокусируется на анализе того, как технобудущее придает значение новым и появляющимся технологиям. Эта статья дает представление о различных взглядах на технобудущее и предлагает основу для герменевтической оценки технобудущего: “Круг будущего”. Данная концепция дает руководство для в противном случае часто весьма беспорядочных исследований и способствует методологическому осмыслению герменевтической оценки технологий.

**Ключевые слова:** Герменевтическая оценка технологий; Технобудущее; Оценка технологий; Метод; Рамки; Рикёр

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## INTRODUCTION

New and emerging technologies (NEST) come with the promise of disrupting the world as we know it while at the same time lacking the proof of their actual impact. Technologies such as humanoid robots, smart lenses, synthetic biology, quantum computers, carbon dioxide removal, in-vitro meat, nuclear fusion reactors, and many others share the characteristic of not yet being fully functional devices but being expected to become part of our society in the near future (Rotolo et al., 2015). This means that, except for a few prototypes in R&D departments or research institutes, NEST exist primarily in the way we talk about them, meaning the shared expectations of these technologies and their potential applications. These expectations are called „technofutures“ (Grunwald, 2012). They exist in many forms and have different origins. Among others, technofutures can be the outcome of foresight processes to assess potential impacts of a technology as in classical or consequentialist Technology Assessment (TA) (Grunwald, 2010); they can be authored by science managers who promote a certain technology in the political or public sphere, so called Visioneers (McCray, 2013); they can be written by science fiction (SF) authors, who are inspired by emerging technologies to explore potential futures in thought experiments or use them as metaphors to reflect on current social issues (Mehnert, 2022). In sum, technofutures form an important discourse surrounding NEST. They communicate the technology towards a diverse group of stakeholders, attribute a certain meaning to the technology and create expectations long before it can be said that these might actually be fulfilled. While technofutures deal with potential future scenarios, they are created at a time when there is limited or no existing knowledge regarding the likely trajectory of the respective technology, the potential products that may emerge from its development, or the possible repercussions of utilizing such products. This being said, technofutures often follow “a purely hypothetical and thus also speculative manner” (Grunwald, 2014, p. 276). At the same time, they shape the way we think and discuss emerging technologies and leave an impact on the development of the actual technology, which creates a paradoxical dynamic between fiction and actual impact.

Facing the situation that technofutures, despite (or because of) their fictional character have an actual impact on the development of the technology, scholars from Science and Technology Studies (STS) and TA have turned towards technofutures as objects of interests. They developed approaches to better understand the content, the spreading and the impact of techno-visionary communication (Brown et al., 2000; Jasanoff & Kim, 2015; Lösch et al., 2019). The shared characteristic of these approaches is that they view technofutures not as predictions of what may or may not happen, but as reflections of the current state of affairs and compositions of existing knowledge, values, and attitudes. One of these approaches is Hermeneutic TA (Grunwald, 2016, Grunwald et al., 2023), which focuses on analysing how technofutures attribute meaning to NEST, rather than predicting the impact of NEST. Hermeneutic TA is concerned with understanding the cultural context, the creation, and the impact of technofutures on the development of NEST, with the goal to better inform society and policymaking.

This paper offers an insight into the different perspectives on technofutures and offers a framework for a structured assessment. Building on Ricoeur's narrative



hermeneutics, the framework will take into consideration different forms of figurations that become relevant when understanding how meaning is attributed through technofutures. Therefore, in a first step, I will explain what I understand technofutures to be, will then highlight different research perspectives, and at the end bring them together in form of the aforementioned framework. With this paper I aim to contribute to the methodological reflection on Hermeneutic TA and offer a structured guidance through an otherwise often rather erratic research approach.

## A DEFINITION OF TECHNOFUTURES

### Futures as Different Worlds

Technofutures are statements about the world changed by the consequences of a new technology (Nordmann, 2014). While these statements may occasionally incorporate a loosely defined timeframe, the primary emphasis lies in the nature and quality of the claimed change(s). Depending on the statement, the consequences are framed as positive or negative, concluding in ethical, cultural, economic, social, political, or ecological changes (Lösch et al., 2016). Nordmann (2014) describes this relation between future consequences and our current world in the following way:

The future begins when a difference arises that sets the world of the future apart from that of the present. In the discussion of emerging technologies, for example, one usually posits a transformative innovation that introduces a qualitative difference, and then wants to know what the consequences of the innovation will be in that future world. (p. 132)

Consequentialist thinking is at the centre of technofutures and aims at creating pathways into the alleged future. These pathways represent a plausible sequence of implications originating in our present (i.e., if X occurs today, it might result in Y tomorrow, and this, could lead to Z the day after). The method of thinking in implications facilitates the envisioning of a world that deviates from our own, as these ramifications might change minor or, at times, major aspects of our already known world (Mehnert, 2023b). Based on the depiction of these worlds through technofutures (i.e., talks, presentations, videos, actual images, and other media), we can judge whether we would like to live in such a world or what we should do to prevent it. Nordmann (2014) writes:

[Technofutures] are made to be beheld and judged not by future generations but by people like us who, akin to tourists, encounter another way of living, consider its pros and cons, and might end up trying to integrate it with their world at home. (p. 90)

Nordmann therefore proposes changing the way we talk about technofutures. Instead of saying that this imagined future is a different world, he removes the temporality from the phrase and says: it is a different world that is being imagined here (p. 89). With this rhetorical trick, Nordmann takes away the predicative effect of technofutures and understands them as one of many possible alternatives to the actual world. This takes away the heaviness of framing the future as determinant prediction and instead positions



the depicted future as one alternative world. The perspective on the imagined world also allows to weigh the advantages and disadvantages and, in the end, to decide to support this world in its emergence or to prevent it. Technofutures thus become discussable in terms of their implied hopes rather than the probability of their realisation.

### **The Attribution of Societal Meaning**

As change is at the core of technofutures, we can break them down to a causal structure of “if-and-then” (Nordmann, 2007). This structure suggests a function of an emerging technology (“if”) and continues with a positive or negative consequence that demands attention (“then”). Typical examples are: if it should be possible to create a direct interface between brains and machines, then this device threatens an invasion of privacy (Nordmann, 2007); if we can grow meat in a lab, then we can solve today’s devastating effects of meat production (Ferrari & Lösch, 2017); if we produce autonomous weapon systems, then these systems might be hacked and used against citizens (Mehnert, 2019); if we create devices that capture carbon dioxide from the air, then we can solve the looming climate crisis (Ornella, 2022).

Through implying that a technology will have a certain function (“if”), and that this function will cause an impact on society (“then”), technofutures attribute meaning to the emerging technology way before the technology is available. It also involves associating a potential benefit or risk to society, individuals, or nature with the specific technology under consideration. This way the technology becomes societally meaningful (Grunwald, 2019, p. 105) and appears to be relevant for different actors who will have to position themselves towards or against the technology and the implied world. With regard to the actual development of the technology, the attribution of meaning becomes crucial for the social acceptance or rejection of the respective technology as it forges alliances (Ferrari & Lösch, 2017) or guides policy and decision-making processes that ultimately determine whether research and development should be promoted or regulated (Grunwald, 2019, p. 106). As technofutures shape the discourse on emerging technologies the analysis of technofutures and understanding the process of attributing societal meaning to the technology becomes relevant to offer better orientation. This highlights a necessity formulated by Grunwald (2016), in the following way:

We must deal explicitly with the issue of how these meanings are created and attributed, what their contents are, how they are communicated and disseminated and what consequences these attributions of meanings have in the RRI debates and beyond, e.g., for public opinion forming and political decision making. (p. 14)

Instead of looking for potential consequences of an emerging technology, this perspective on technofutures addresses questions such as: What assumable functions and consequences are attributed to the technology? What are these assumptions informed by? How is the attribution of meaning constructed and communicated? Are the consequences framed as positive and negative and who is framing them? To answer these and similar questions, Grunwald (2016) proposes to deconstruct the attributed meaning through an approach he calls Hermeneutic Technology Assessment:



The hermeneutic approach (...) will contribute to the development and application of a new type of reasoning and policy advice in debates on future technology beyond traditional consequentialism. Its objective is to allow deciphering the meanings assigned to NEST developments as early as possible in order to allow and support more transparent and enlightened debate. (p. 4-5)

The aim of hermeneutic analysis is to reflect on existing technofutures and thereby deconstruct the inherent attributions of meaning. According to Grunwald (2016), hermeneutic analysis contributes to a critical-reflective and enlightening attitude towards the various debates on emerging technologies (p. 169).

When delineating the methodological approach, Grunwald remains broad, primarily because hermeneutics employs diverse methods depending on the research question and the objects of interests. For example, discourse analysis enables the investigation of actor networks and communication dynamics, methods of qualitative social research, such as laboratory research or participant observation, allow the investigation of the construction of technofutures, while deconstructive methods of philosophy of science illuminate the genealogy and history of concepts and ideas conveyed in technofutures (Grunwald, 2016, p. 180). Regarding text formats, Grunwald refers to hermeneutic approaches from linguistics or cultural studies, while for artistic formats he suggests analysing stylistic devices or the transfer of connotations, as such transfers often also implicitly provide attributions of meaning through associations and metaphors, which must be made explicit to make technofutures the subject of a comprehensible discussion. Furthermore, the literature often points towards a set of questions like these:

What are the cognitive and normative elements? Is the overall construction of a vision with the identified elements ‘rational’? What are the hidden premises and inexplicit norms of the visions? How are visions used in public debate? Where do the visions originate from – culturally or historically? What do visions tell us about us today? What are the differences between the diverging visions? (Grunwald, 2013, p. 31)

These questions point at a critical, deconstructive and reflective research approach towards technofutures. However, if taken together, the questions are often rather large, include diverging perspectives and appear to be overwhelming when being treated all together. Therefore, I want to offer a structure for a hermeneutic process that follows the narrative hermeneutics by Ricoeur (1984) which he lays out in his work on “Time and Narrative.” Ricoeur describes an approach to narrative that does not only look at the plot structure and inherent constellations of a story but rather at the larger context. For this, he suggests a hermeneutic approach that follows three perspectives that he calls Prefiguration (or Mimesis 1), Configuration (or Mimesis 2) and Refiguration (or Mimesis 3). This approach of narrative hermeneutics separates the analytical process of hermeneutic TA into three distinct perspectives which I will explain in the following.



### THREE PERSPECTIVES OF HERMENEUTIC TA

As we do not have any direct access to the future, the only knowledge we can use to think about futures is our present-day knowledge, meaning our values, fears and expectations, our culturally shared assumptions of the future, and our ways of ‘constructing’ visions. This “immanence of the present” (Grunwald, 2012, p. 99) also situates futures in the present. Therefore, hermeneutic TA understands visions of the futures not as pointing to future technologies or to their anticipated consequences, but rather as present processes of attaching societal meaning to new technologies. The following perspectives move the content as well as the processes of generating, disseminating, and contesting technofutures to the focus of TA.

#### **Prefiguration: Cultural context of Technofutures**

Although visions of technological futures describe ideas about future developments they are always tied to the respective present of the actors, whereby (consciously or unconsciously) the present, i.e., the authors perspectives, perceptions of the world and deeper cultural patterns, are inscribed. Therefore, the culturally shared imaginaries, where these imaginaries come from, which hopes or fears they express, what values they hold and how this refers to the culture of origin play an important role in hermeneutic TA. In this regard, Wei-Kang Liu (2023) points out that part of hermeneutic TA should be a cultural-linguistic analysis which “uncovers the cultural-historic background of visions together with their implicit meanings” (p. 25). The following examples will give a better understanding of the perspective on prefiguration.

Grunwald uses the term ciphers to describe that technofutures refer to themes, that are implicitly presupposed but not always explicitly addressed. He understands ciphers as signs or abbreviations that have a function and a meaning in a certain context, which, however, remains blurred to some extent: “Ciphers refer to something outside of them, but without uncovering it in its entirety” (Grunwald, 2012, p. 121, authors translation). Technofutures refer for example to already existing imaginaries of human beings (*Menschenbilder*), human-machine interactions, social imaginaries (Castoriadis, 1975; Taylor, 2003), or worldviews. In this way, technofutures are prefigured by culturally shared imaginaries, hopes, fears, and ideas of a better world – while at the same time claim, that this better world could (only) be achieved through the technology. For example, the vision of human enhancements follows an understanding of the human as a machine that can be upgraded to become more efficient. Not only is this understanding of the human a debatable image, it is also only one of many understandings of what it means to be human, which leaves out the necessary imperfection and submits to a capitalistic logic of growth (Coenen, 2010). While the development of the technology continues, this understanding of human as a machine will be inscribed into the actual technology. Hence, technofutures are not just about the future but point at current problems, longings or hopes, as well as bigger issues beyond the vision itself.

This dynamic is also interest of research in the field of STS, when tracing the social, cultural and historical peculiarities in the development of technologies. Suchman (2006) points out that imaginaries spread within a society through information and communication networks and materialise in new technologies. In this regard, Haraway



speaks of materialised refiguration (1997) and emphasises that in new technologies the immaterial histories, longings, and needs of a culture connect with the material world. According to this perspective, technoscience and culture do not exist in a vacuum, but are intertwined, as can be empirically examined, as has been done when analysing visions of robots and how imaginaries spread through different cultural spheres (Telotte, 2016) or how the development of artificial intelligence (AI) is inspired by cultural imaginaries and driven by the wish to achieve something outside of the actual technology (Cave et al., 2020).

Connecting to existing imaginaries can also blur the view on the actual development. Barbrook (2007) for example examines how imaginaries of AI have overshadowed the actual development of the technology. From the 1950s on, computers were perceived under the imaginary of becoming sentient machines, while the technology was used for the production of cybernetic weapon systems (p. 40). The assumption was that once the technology matured enough, thinking machines would be inevitable and artificial consciousness (AC) would be achieved within the next decade (p. 19). This imaginary, which was spread by AI-pioneers, was taken up by IBM which announced in 1961 that it would give top priority to the development of AC, while IBM's computer machines continued to be used mainly as weapons systems. According to Barbrook, the imaginary and hope of an artificial consciousness legitimized the continuous research for smarter weapons.

To examine the influence of the cultural present on technofutures in the realm of policy making, Jasanoff & Kim developed the concept of sociotechnical imaginaries, meaning collectively shared, institutionally stabilized, and publicly enunciated visions of desirable futures shaped by a culturally shared understanding of social coexistence and social order which will be achieved using emerging technologies (Jasanoff, 2015, p. 19). With a background in political science, Jasanoff & Kim focus primarily on publicly available, nation-state positions on emerging fields of technology. In their study “Containing the Atom” (Jasanoff & Kim, 2009), for example, the two scholars compare the U.S. government's stance on nuclear technology with the position of the South Korean government. They show that the cultural-historical background plays a decisive role in envisioning the technofuture and therefore in acting upon the technological development in the present. To be precise, against the backdrop of reactor accidents such as Three-Mile Island, the US-government saw itself in the role of containing nuclear risks and developed the self-image of a responsible regulator who develops effective containment strategies. In South Korea, on the other hand, the technofuture of nuclear energy followed the assumption that nuclear power would promote prosperity and growth. Rather than seeing the future of nuclear power as an uncontrollable risk that needed to be contained, the Korean government viewed nuclear technology as an important step in the nation's economic and military construction. With their comparison, they showed how different imaginaries of social life and order and the imaginative resources available are co-producing the visions of goals, benefits and risks of science and technology in the future (141).

The role of the *Zeitgeist* is also expressed in the artefacts of everyday culture, like SF. Using the cyberpunk genre as an example, Mehnert (2021) traces how the popular





framing of the future as techno-determinist nightmares depicted in these stories points at the structure of feeling of the 1980s. Cyberpunk fictions tell stories of dystopian worlds, in which a fictional society is entangled in high technologies of various kinds. Often, the characters are enhanced by cybernetic-implants, connect to a shared cyberspace-matrix through bodily sensor-stimulations, and interact with human-like A.I.s on an everyday basis. Despite the technological progress, though, the inhabitants of this world struggle to survive, as the sociotechnical environment renders them powerless – left with the only option to hack the technology to redeem some form of autonomy. These stories represent a feeling of losing oneself in an ever-faster pace of technological progress, mixed with the paradigm of a neoliberal economy and the false promises of free markets postulated by politicians like Margaret Thatcher and Ronald Reagan in the 1980s. This feeling became the breeding ground for cyberpunk and defined an aesthetic of a technofuture that endures to this day.

These and other examples show that technofutures link societal hopes and fears to the ideas of new technologies and provide a glimpse of a social future, perceived as utopian or dystopian, to be achieved or prevented by technology. Iser, pointing at the cultural prefiguration, mentions that every text inevitably contains a selection from a variety of social, historical, cultural, and literary systems that exist as referential fields outside the text (Iser, 1993, p. 4). Or as Ricoeur (1984) puts it, the author is composing the plot, “grounded in a preunderstanding of the world of action, its meaningful structures, its symbolic resources, and its temporal character” (p. 54). They select and rearrange the elements they find, inevitably leave out elements, overemphasize others and bring them into a deliberate coherence. Hence, besides the elements that are mentioned in technofutures, it is also important to reflect on which elements are not mentioned and (intentionally or unintentionally) left out. Read in this way, technofutures tell us more about the desires of a particular cultural than the potential of technologies themselves (Sturken et al., 2004, p. 7).

### **Configuration: Mediatization of Technofutures**

To be analysed hermeneutically, the imaginaries, that inform the thinking about the future, need to be lured into a form or a *Gestalt* (Iser, 1993) – in other words: a medium. Although imaginaries of futures, i.e., fantasies, daydreams or other purely cognitively existing futures that individuals hold, also have an impact on individual actions and decisions, they cannot be analysed unless explicitly expressed and shared. Thus, it is important to call to attention that technofutures are constructed and that the construction process is shaping their meaning:

Techno-visionary futures do not exist per se, nor do they arise of their own accord. On the contrary, they are ‘made’ and socially constructed in a more or less complex manner. Futures – be they forecasts, scenarios, plans, programmes, visions, speculative fears or expectations – are ‘produced’ using a whole range of ingredients such as available knowledge, value judgements and suppositions. (Grunwald, 2013, p. 29)



As Grunwald emphasizes, the way how futures are constructed, that is, which ingredients are used and coherently assembled, is decisive for their content and becomes relevant for the assessment of the vision (Grunwald, 2010, p. 100). In this regard, Wei-Kang Liu (2023) speaks about “visioneering assessment”, emphasizing that the content of visions are usually analysed in great detail, while the process of constructing is often overseen. Consequently, visioneering assessment has the task to uncover the process in which visions are constructed. This process, of course, differs from medium to medium, as each medium asks for different construction processes. In the context of hermeneutic TA, technofutures are usually part of a mediated discourse on NEST in scientific, policy and public spheres. Thus, they are present in form of texts, pictures, presentations or performances, slides, objects, prototypes, tables, film or video, sound, and many other media formats. These mediated futures become the corpus of a hermeneutic analysis while the process of mediatizing technofutures in itself is also impacting the content.

The role of the medium plays a decisive role in constructing technofutures, as it predefines a certain set of codes that authors have to submit to. To assess technofutures thus also means to address the affordances and restrictions of the medium. In this context, Ernst and Schröter ask about the mediality of futures and how the medium, with its respective design rules but also as epistemology, contributes to technofutures. They refer to the concept of technoimagination by the media philosopher Villem Flusser (1998, p. 209), whose thesis is that new media lead to a new form of imagination and media upheavals thus change the power of imagination itself (Ernst & Schröter, 2020, p. 61). Dickel (2023), relating to McLuhan’s (1964) famous quote “the medium is the message,” emphasizes that the materiality of technofutures, the question of how and by which material means and practices technofutures are expressed, as well as the media technologies that enable, structure, and shape the production and reception of technofutures become important (Dickel, 2023, p. 159). He points out, that each medium requires not only different processes of production but also assembles different actors and requires different technologies. This, in return, also has an impact on the content: If futures take the form of texts or are turned into movies, the technologies of writing texts or producing movies will shape the outcome. Working with movies, for example, forces you to become specific by showing the technofuture, whereas text allows to stay more abstract and use more general concepts. Or in other words, it is easier to say “in the future, everyone will be happy” than to show, how happiness will look like in the future and what it is caused by.

The most intuitive medium to express visions of futures is language. Texts thus become important, which in turn necessitates literary studies and textual analysis as means for a hermeneutic assessment. In particular, the role of metaphors used in visions about emerging technologies become of interest for critical reflection (Inayatullah et al., 2016). Metaphors are crucial to how we make sense of our world and how we conceptualize things through another. As emphasized by Lakoff and Johnson (2003), metaphors shape not only our understanding of the world but also our experience of and actions within it. Analysing the metaphors used to express visions allows to reflect on the underlying prefiguration – and also offers creative and playful approaches to reimagining alternative futures (Fischer & Marquardt, 2022). To provide an example, Nordmann



(2014) points out that the term emerging technology is already a metaphor, as it suggests the emergence of new technological capabilities which “can be linked to a rising tide – it will just go on and on, and at some point, the dams to a new world with new capabilities, opportunities, and risks will simply break” (p. 92). Framing a technology as emergent, hence, already attributes the meaning that this technology will one day flood our world and create impact. The metaphor implies that the coming of the technology is inevitable and that it will have some kind of an impact, thus reducing the questions of its development to the question of when rather than if, why or how.

Beyond metaphors, the way technofutures are told and the storylines in which they are embedded also become of interest to a hermeneutic TA. Gransche (2015, p. 252) and Grunwald (2016, p. 3) emphasize the similarity of technofutures to stories, as both articulate processes of change. Thus, an important mechanism for giving meaning to NEST is the narrative about future impacts and consequences. These narratives include perceptions, issues that are seen as problems, expectations and hopes, concerns and fears that lead to questions and controversy. In other words, technofutures can be seen as stories that represent a systematic imagination of the interplay of future technologies with future society (Lösch et al., 2019, p. 1). The simplest storyline of technofutures follows the beforementioned “if-and-then statement” (Nordmann, 2007), which suggests a technological development (“if”) and continues with a consequence that demands attention (“then”).

The storylines (i.e., patterns of argumentation) and the tropes being used (i.e. recurring motifs or arguments) show similarities across different technologies, as they have become an often used repertoire for moral argumentation about NEST (Swierstra & Rip, 2007, p. 4). Therefore, technofutures are not simply an expression of individual attitudes or preferences, but they can be seen as expression of a culturally shared inventory of narratives, which are used to give meaning to a technology that is yet unknown. Typical examples of such a narrative are opening Pandora's box, as has been observed in the context of nanotechnology (Macnaghten, et al., 2010), or the inverse King Midas narrative, defined by Swierstra and Rip in the following way: “Whereas the mythical Greek king turned everything he touched into gold, modern (Western) civilisation turns everything into a means of destruction (and both Midas and civilisation got into trouble)” (Swierstra & Rip 2007, p. 9).

While aforementioned narratives are attributing a rather alarming meaning to the technology at hand, more positive narratives emphasize the potential benefits created through the technology. A popular one is the narrative of technological progress, in which tools and machines promise relief from physical labour, new forms of industrial value creation, unlimited prosperity, and better medical care for a longer and healthier life. Following this narrative, emerging technologies are always accompanied by the promise of social, cultural, and moral progress (Grunwald, 2010, p. 22). This narrative has been severely challenged, in particular as the societal benefits of technological progress are increasingly overshadowed by the emergence of modernisation risks that pose an irreversible threat to nature, animals, and human life (Beck, 1986, p. 17) or by overemphasizing on the progress idea and following the logic of technological solutionism (Morozov, 2014), implying that emerging technologies are capable of solving



social problems while overshadowing alternative pathways that would build on social instead of technological innovation.

Language is one of many vehicles being used to present technofutures. In addition to text, visualizations of new technologies also play a central role. For example, the debates around human enhancement, nanotechnologies or synthetic biology are largely driven by futuristic-looking images and inspired filmmakers to join in artistic debates (Grunwald, 2014, p. 285). In the context of film, “diegetic prototypes” (Kirby, 2010) help to envision the debated technology and share their potential impact with a greater audience. Kirby highlights that Filmmakers, scientists, and engineers use cinematic representations of new technologies to reduce fears of the technology, to create a desire in the audience for these technologies to become reality, or to normalize new technologies by depicting their use in familiar contexts. The visualization of technologies shares the meaning attributed to the technology in a low-threshold way, which is why visualisation of different forms play an important role in the public perception of technology. A hermeneutic analysis thus also takes the design of the diegetic prototypes, the context in which they are depicted, the visual references the awake but also the design of the images or films themselves into focus. This ultimately emphasizes the importance of media- and design-theory for the discussion of technology futures.

Furthermore, technofutures of similar media (e.g., film, text, images, etc.) do not only follow the specific codes of the medium but also of the specific genre. Steinmüller (2016) speaks of different forms of symbols (*Zeichensorten*) that are used in the exploration of the future. Examples are trend-reports written by a research institute, a descriptive scenario as an outcome of a TA process, a corporate vision or an advertisement for a future product or a SF-story written by an author. Each of these examples can come in the medium of text but represent different genres, as they are differently aestheticized, i.e., constructed in accordance with the aesthetic codes of each genre. To give an example, unlike the scientific experimenter or the future researcher, who is bound in his thought experiments to the principles internal and external consistency, stringent argumentation, plausibility, and more (Grunwald, 2009), the SF-author is bound to the aesthetic principles of a narration: How does a coherent and exciting plot develop? How can the fictional characters act psychologically convincingly in unusual situations? Which conflicts and which resolutions are suitable to convey the message? (Steinmüller, 2016, p. 329) In other words, one reason for the dystopian depiction of technology in SF is the restriction of the genre and its dependence on conflicts. Conflict is a necessity in the genre of SF-stories, which often resolves in framing of future technology as an evil actor responsible for a dystopian future (Mehnert, 2019).

The difference between the genres is often hard to identify. For example, technofutures by tech companies, so called “*Leitbilder*” (Dierkes et al., 1996, p. 18), are a genre which follows its own codes but has overlaps with SF. In terms of content, terminologies like Cyberspace or Metaverse originated in SF but got adopted by the industry as a common vision, as using popular semantics can be useful to translate abstract innovation processes to stakeholders outside of research and improve communication between research and industry or fundraising for research projects (Schröter, 2004, p. 32).



However, while both genres follow the same speculative epistemology, they pursue different goals: Whereas SF visions can be understood as fantastic entertainment, tech visions demand potential plausibility from the recipients to legitimise the companies research of the technology, to find strategic partners or to attract new fundings (Haupt, 2021). To achieve this goal, actors pursue different rhetorical strategies and use particular aesthetic codes that postulate the projected change not only as desirable and necessary, but rather as familiar and natural (Mehnert, 2023a). This goal oriented and strategic perspective will become relevant in the next chapter.

### **Refiguration: The reception and impact of Technofutures**

There has been a considerable increase in technofutures in recent decades (Grunwald, 2018). One reason for this is the increasing socialisation of development processes. Innovations arise from collaborations between, for example, entrepreneurs, developers, sponsors, communication experts, politicians, and others. Coordinating this cooperation requires shared visions that enable the actors to understand the importance of innovation and work together to realise (or prevent) these technofutures. Therefore, the third perspective, the refiguration, looks at how technofutures are impacting the discourse on emerging technologies.

Technofutures are used as strategic resources in political and technological agenda-setting processes. For example, they can create hypes and motivate actions through a fear of missing out or stimulate other activities necessary to realise or prevent the respective technology (Rotolo et al., 2015, p. 28). They also attribute roles and responsibilities, as van Lente & Rip emphasize. technofutures contain a script of the future world in which relevant actors, explicitly or implicitly, are positioned exactly as characters in a story. This positioning is strategic and has an impact on the present. Since the visions are often public or semi-public statements, they require a response from the actors being positioned. An actor who rejects the role must react (e.g., by protesting against or contesting the nature of the vision). In this way, alliances get forged, positions defined, and discourses formed (Van Lente & Rip, 1998, p. 218).

Due to this discursive character, technofutures can be understood as “socio-epistemic practices” (Lösch et al., 2019). They can shape the actual development paths by, for example, legitimising or defaming research on the technology, coordinating the cooperation of different actors, mobilising supporters for or against development, and much more. As said before, technofutures are socially constructed, that is, there are authors and producers who create these futures with a certain intention and a strategic goal in mind. This goal can vary and can either be to entertain, as in some form of SF, or to persuade its audience, as for example in corporate visions of emerging technologies. Regarding the later, the term *Leitbild* is used for technofutures that are intentionally guiding the development process of an emerging technology (Mambrey et al., 1995, Dierkes et al., 1996). Dierkes et al. describe the *Leitbild* as a general ideal or vision of a desirable future moment associated with the means of technology, a family of technologies or a technical system (p. 18). Dierkes emphasises that *Leitbilder*: (1) are mediated translations of an abstract innovation process into tangible ideas; (2) explain the special significance of a technology to politicians, industry managers and sponsors to



forge alliances; (3) and give purpose to the developers work by embedding it in a larger idea (e.g., fighting climate change or progressing the future of humanity) (p. 29).

However, whether a particular technofuture is accepted as a *Leitbild*, or whether it will have any impact on the actual development, depends on whether it is ascribed validity. technofutures that leave an impact in one way or another are those that portray the described technology and its effects as inevitable (Nye, 2004, p. 160) – and are persuasive enough to be believed in. According to Grunwald, the validity of technofutures is decided discursively (Grunwald, 2009, p. 30). It is therefore not only the content of technofutures that determines its validity but rather its social acceptance. In this sense, technofutures entail a paradox: As said before, they are speculative and therefore fictional, however, to be impactful, they have to be accepted as if they would become an actual future present and convince addressees of their non-fictional character. Thus, an impactful Technofuture becomes “a fiction that masks its fictionality” (Iser, 1993, p. 13).

However, fictionality might not become a sufficient criteria to judge on technofutures (as all technofutures are necessarily fictional by definition). Esposito emphasises that reducing technofutures to the opposition between real (plausible) and non-real (fictional) would neglect their social relevance. Fictions, Esposito continues, should rather be understood as useful and functional concepts that are developed based on comprehensible rules on which there is agreement among the participants (Esposito, 2007, p. 57). Roßmann (2021) stresses the fictional character of technofutures and compares them to a “make-believe game” (Walton, 1990), a children's game in which all players imagine an object as something else and adjust their behaviour accordingly. Roßmann gives the example of children who pretend that tree stumps in a forest are bears and react to the stumps as if they were encountering a bear. Transferring the analogy to technofutures, the bears become the technology and the children become the stakeholders (e.g., developers, politicians, users, etc.). The premise of the ‘game’ is, that the technology will arrive at a time later than now and all stakeholders involved have to react as if the premise would be true, for example by supporting the development, discussing on potential impacts and defining regulations to prevent them. With this regard, van Lente & Rip give the example of Moore's law (Van Lente & Rip, 1998, p. 203). This ‘law’ claims that the calculation power in an integrated circuit doubles about every two years. Although it is far from an actual law, the vision is treated by the actors as if it would become a reality in the future. By acting upon this vision, Moore's law has become a self-fulfilling prophecy, trapping the actors in a game-theory dilemma in which each actor strongly suspect the other actors to continue the research and progress the development, while no one wants to run the risk of falling behind. Moore's law has become a plausible fiction in this sense. Thus, the attribution of validity to a technological future depends only to a limited extent on its content, its rhetoric, and its arguments, but also on the perception and the way stakeholders relate to it – or in other words, to refigure the social dynamics surrounding emerging technologies and to leave an impact, technofutures demand from their recipients the willing suspension of disbelief (Coleridge, 1817).

This invites for a reflection on the concept of plausibility, which is not an objective attribution but rather subject to social negotiation processes and individual imaginative capacities. As Fischer and Dannenberg note, plausibility arises on the basis of coherence



with previous concepts and thus coherence with the socially constructed perception of reality. In the social constructivist sense, one's own perspective on reality also prefigures the judgement of futures and limits the space of possibilities to those futures that align with current concepts and are considered conceivable from the present (Fischer & Dannenberg, 2021, p. 10). When referring to previous concepts or to be considered conceivable from the present, clearly indicated fictional technofutures from SF play an important role. To give an example: the brain-machine interface is part of several technological vision, including *Leitbilder* as well as SF-novels, films and games. These visions form a discourse on human enhancement (Coenen et al., 2010; Jebari, 2013) and evoke different ideas of what the device could do or might cause; e.g. the interpersonal communication without the use of language (Nicoletis, 2015; Dugan, 2017), the promise of salvation and the fusion of human and machine as the next stage of human evolution (Kurzweil, 2006), or a form of socio-economic division between people with and people without access to the neurointerface which can be called neurocapitalism (Meckel, 2018). Some technofutures also imagine the possibility to upload the mind to a computer and promise to hold the key for life after death (Cave, 2020). These visions do occur in SF but are also shared by researchers like and visioners like Elon Musk (2020, 46 min) or the neuroscience company Nectome, which announced to be able to scan the brain structure of a living person to revive their mind on a computer (Regalado, 2018) – which would inevitably lead to the death of the person. Although these claims have soon be revoked by the company, the vision of mind-upload still exists a strong and disputable *Leitbild* within the discourse on neurotechnology and is validated by some (Mehnert, 2023a). One of the reasons why companies can publicly announce their work on presumable imaginative technology is that these technologies are conceived as plausible, as they are coherent with previous concepts and are conceivable from the present – at least in SF. Besides the technological discourse, mind-upload and brain-computer interfaces are an established trope in SF since the cyberpunk movement in the 80s (Mehnert, 2022). The different stories, films and video games that surround this technology normalize the technology and create a familiarity with something otherwise strange. Or as SF-researcher Sherryl Vint (2020) puts it:

Ideas such as mind-uploading and other human augmentation have similarly become normalized by a milieu in which things such as self-driving cars or smart AI assistants that respond to voice commands have created a perception that futures envisioned by yesterday's sf seem destined to become our futures. (p. 173)

What this example shows is that SF-visions on neurotechnology refigure corporate technofutures and not only shape the meaning of the technology, i.e., their functions and their potential impact, but posit the technofuture as a valid and plausible pathway of development. On the one hand, we can say that the corporate technofutures on mind-upload are prefigured by the human need for immortality, as “heaven is a really powerful computer” (Seung, 2012, p. 254). On the other hand, SF mind-upload visions refigure the way we think about neurotechnologies today. They normalize a mechanistic image of man, as well as ideas of what would be desirable – or supposedly necessary – improvements. This is also accompanied by a refiguration of the concept of 'mind', which



was previously defined by philosophy or religion, and is now defined as that which is measurable; everything that can be measured by technical devices becomes the mind while everything that cannot be measured because science considers it irrelevant or because the devices cannot capture it technically, is ignored and is therefore no longer part of the refiguration of the concept of mind. Technofutures thus refigure our idea of what is possible, refigure existing concepts (like mind but also intelligence in the context of A.I.) and construct expectations of the future.

### FRAMEWORK TO ASSESS TECHNOFUTURES

As became apparent from the above examples, hermeneutic TA has different focal points. Defining a clear method that fits to all would necessarily reduce the complexity of the topic to an unintended degree. Rather than a strict set of rules, hermeneutic TA suggest an approach to technofutures to reflect on their role in the present. For this purpose, different methods, depending on the research question and the formats being analysed, become useful.

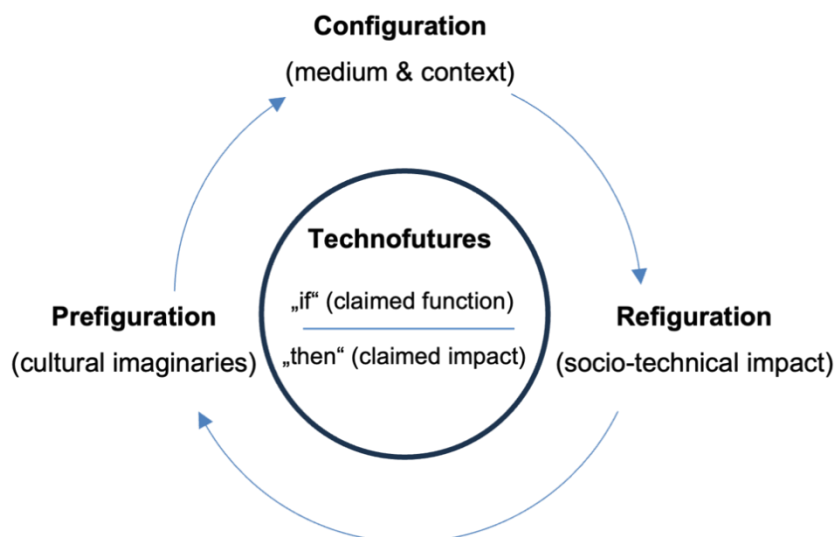
One promising structure for an assessment process builds up on the narrative hermeneutics of Ricoeur's mimetic circle (Ricoeur 1984, p. 71; see Gransche 2015, p. 241). Ricoeur brings into focus the intertwining of the sociocultural fabric and narrative from three different perspectives. He writes:

Hermeneutics (...) is concerned with reconstructing the entire arc of operations by which practical experience provides itself with works, authors, and readers. (...) What is at stake, therefore, is the concrete process by which the textual configuration mediates between the prefiguration of the practical field and its refiguration through the reception of the work. (Ricoeur 1984, p. 53)

This creates a holistic view that analyses technofutures by focussing on the three perspectives described above: (1) prefiguration, (2) configuration and (3) refiguration. These three perspectives create a circle (or rather a spiral with different altitudes), as the refiguration informs the prefiguration and one vision can become the basis for another. With a cultural studies approach to narrative analyses, Erll (2010) summarizes Ricoeur's circle as follows:

A narrative text is (1) prefigured by its cultural context with its specific symbolic order. It (2) configures (...) extra-literary elements (...) into an exemplary temporal and causal order. In the act of reading, finally, the narrative composition is actualised. It becomes part of the symbolic order of a cultural formation, which is thereby (3) refigured and here the circle closes. (p. 93).





**Figure 1.** The Futures Circle Framework to hermeneutic TA based on Ricoeur's (1984) narrative hermeneutic

With regards to hermeneutic TA and the aforementioned characteristics of technofutures, Ricoeur's narrative hermeneutic allows us to assess the societal meaning of technologies, attributed within technofutures, by analysing the three perspectives in the following way:

**(1) Prefiguration**

The first perspective looks at the content of technofutures, how they are entangled in cultural presumptions and informed by socially shared imaginaries. This perspective also reflects on the expressed desires, hopes, fears and needs that are inscribed into the respective visions. It understands technofutures as ciphers and identifies the larger themes addressed as well normative statements made.

**(2) Configuration**

As technofutures come in different forms, e.g., scenarios, simulations, diagrams, trend-extrapolations, plans or pop-cultural artefacts, this perspective looks at the way they are constructed. This perspective reflects on the form (e.g., the role of the medium, the performance, the context in which it is embedded), the rhetoric (e.g., the language, narratives and verbal or visual metaphors used), as well as illustrative material (e.g. tables, pictures, movies or other pieces of art).

**(3) Refiguration**

Lastly, the third perspective focusses on the impact of technofutures and the way they change current discourses or change already established concepts. Although technofutures are always an expression of current states and processes, they have an impact on the present and shape these states and processes. This perspective includes, among others, the way that stakeholders position themselves towards the future but also how the technofuture impacts other discourses and is spread through society.



## CONCLUSION

Technofutures are socially constructed narratives about the impact of a potential technology at a moment later than now. They are created at a time, when there is no sound information available on the claims made, thus rendering them as fictional or speculative expressions of how the world might change due to the impact of this technology. Although they are speculative in nature, they have an impact on the development of technologies as they forge alliances, give arguments for or against the technology, create hypes through which funding is stimulated, and many more. As technofutures are an important communicative element in the context of technological development, it becomes necessary for a conclusive Technology Assessment, to not only theoretically understand impact and role of technofutures on the development process, but also to have the empirical methods and structured approaches to analyse technofutures, their cultural context, their process of creation as well as their spreading through society.

This article offered a framework to structure a hermeneutical Technology Assessment process. It follows the heuristic of Paul Ricoeur's narrative hermeneutics and separates the analyses into three perspectives: (1) Prefiguration, looking at the cultural imaginaries inscribed into the Technofuture, (2) configuration, looking at the process of constructing the mediated technofuture, and (3) refiguration, looking at the socio-technical impact of the technofuture. This structure allows us to organise the process of hermeneutic TA and to deliberately consider the three different perspectives for a holistic analysis.

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#### СВЕДЕНИЯ ОБ АВТОРЕ / THE AUTHOR

Венцель Менерт, mail@wenzelmehmert.de,  
ORCID 0000-0002-3869-1770

Wenzel Mehnert, mail@wenzelmehmert.de,  
ORCID 0000-0002-3869-1770

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