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HUMAN-TECHNOLOGY RELATIONS DOWN TO EARTH

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Abstract

The climate crisis calls for to a turn to Earth/nature in design and philosophy of technology. The relations between humans and technology are studied in the approaches of technical mediation and more specifically in the post-phenomenological analysis of human-technology relations. Our Product Impact Tool is a practice-oriented elaboration of such research for application in design, both for improving interaction with products and improving the social impact of design. However, it appears that the focus has been too much on human-technology relations alone, and Earth/nature seems absent. So, how to reconsider the approach of technical mediation in such a way that it adequately acknowledges Earth/nature? In answering that question, we first explore the meaning of "world" and "earth" in Earth science and philosophy. Then we proceed by investigating the place of Earth/nature in the post-phenomenological approach of "human-technology-world relations". Our reconsidered post-phenomenological analysis leads to an alternative understanding and schematic expression of human-technology-world relations in which the relations have the character of embedded spheres:

(((human – a specific technology) world of technology) Earth).

Lastly, we also explore how these insights can be integrated in our own Product Impact Tool, which leads to an alternative model which expresses the embeddedness of human-technology relations in a Product Impact Tool-down-to-Earth.

1 THE ETHICAL CHALLENGE CONCERNING EARTH/NATURE IN PHILOSOPHY AND IN DESIGN

There is an ecological crisis, and technology has everything to do with it. It is an important ethical challenge for design to make a turn and stop the harmful exploitation of the Earth that has come with technical progress and to find a new balance between human, technology, and nature. As a contribution to this challenge, this paper addresses the search for a more explicit orientation towards nature/Earth in both design and philosophy of technology.

A note on terminology. In this paper we will refer to both *Earth* and *nature*, and often write Earth-slash-nature, or vice versa. In one context, *Earth* is more common and preferred (denoting planet Earth on which we humans, other animals and plants live, and the layer of earth on our planet in which plants grow). In other contexts, *nature* is more fitting (denoting all that grows and lives, but also the landscape including mountains and rivers that have come into existence in a natural way but are not alive). Our discussion is about both; therefore: Earth/nature, or vice versa.

Finding a new balance for nature, humans and technology is a challenge for both design and for philosophy and ethics of technology. Philosophy of technology and design otherwise have a shared interest concerning the interaction between humans and technology (without explicit reference to Earth/nature). Some currents in philosophy of technology which are rather widely applied in design (for understanding or for designing) are the approaches of technical mediation and of human-technology relations. Technical mediation is a common and general concept for denoting technology mediates the existence, history, way of living of humans, and has been employed by researchers of different persuasions in philosophy of technology and media studies (McLuhan, 2003; Ihde, 1990; Latour, 1999; Feenberg, 2002, Verbeek, 2005; Hubig, 2013). In this field one important strand is "(post)phenomenology" (Ihde, 1990), and especially the programme or approach of a philosophy of Human-Technology Relations (Verbeek, 2005; 2015). Our own Product Impact Tool[1] (Dorrestijn & Eggink, 2014; Dorrestijn, 2017) is a practice-oriented contribution to these approaches of technical mediation and Human-Technology Relations. The tool consists of a model, depicting different ways in which technology relates to humans and influences humans. To be used for understanding the multiple types of interaction and impact, for ethical reflection, and for responsible design.

The collaboration between philosophy and design -and the application of insights about technical mediation and human-technology relations- as in the Product Impact Tool means what can be called a 'practical turn' in philosophy of technology (advancing in a practical design direction the earlier so called 'empirical turn') (Eggink & Dorrestijn, 2018; 2026). The philosophical analysis of the relations between humans and technology has subsequently proven to be useful in design practice with respect to improving human-technology interaction (van Belle et al., 2018; Eggink, 2020; Voordijk & Dorrestijn, 2021) and considering social effects (Eggink & Dorrestijn, 2020; Long et al., 2020; Six Dijkstra et al., 2020; Eggink, 2021).

Will this approach in the philosophy of technology also be useful for re-orienting design towards nature/Earth? The Product Impact Tool can be applied for green design projects, however was not especially developed for that purpose and Earth/nature is not part of the model. Nature/Earth is also not explicitly part of the analysis of human-technology relations. Does that mean that nature/Earth is overlooked, left implicit, or even deceived? Following up on that question; how can Earth/nature be brought to the fore more explicitly in these approaches? This research is therefore about exploring and improving the place of Earth/nature in Human-

[1] (Product Impact Tool, n.d.)

Technology Relations and the Product Impact Tool. In other words: how can we bring human-technology relations down-to-Earth?

To further articulate our research question, we will in the remainder of this first section sketch some elements of the search for a turn towards nature/Earth in design and in philosophy. To answer our research question, we will then start with engaging in design research and design philosophy to illustrate how nature/Earth is overlooked, left implicit, or even deceived in contemporary design practice. Firstly, by referring to the work of Koert van Mensvoort who applies philosophy of technology to design and advances the notion of 'next nature' (van Mensvoort, 2020); secondly by discussing a project by design students about design and the relation to nature in the context of food.

1.1 GREEN DESIGN OR GREEN WASHING?

At least since Victor Papanek's (1995) influential book *The Green Imperative* sustainability has been an important issue in design research. Not every effort to make design sustainable does really make design green, however. For example, there is a growing concern that we will not be able to construct a sustainable and desirable future solely on the mantra of the three R-principle of 'Reuse, Reduce, and Recycle' (Ellen MacArthur Foundation, 2023). A good question is if simply adding more R's to the equation as in the 5R- or even 8R-principle (Freestone, 2017) helps sufficiently. If following ecological models makes a good impression but does not really have a greening effect, then one speaks of greenwashing, and it is not really green design. A comparable point can be made about other approaches, also in philosophy of technology. There may be a technical bias, even if there is made reference to Earth/nature.

1.2 NEXT NATURE OR NO NATURE?

Dutch artist, designer and philosopher Koert van Mensvoort is the initiator of the approach and network of "Next Nature" (van Mensvoort & Gerritzen, 2005; van Mensvoort, 2020). We refer to this approach here because Van Mensvoort combines design with philosophy and explicitly brings to the fore a view on technical mediation and the meaning of nature.

Van Mensvoort emphasises the importance of technology for human existence and history. He refers to the idea that all human technical produce has brought into being a *technosphere*, a new artificial sphere on top of the *natural sphere*.

Furthermore, van Mensvoort sees successive stages in the development of technologies and how these are being experienced by humans. Following his "Maslov style pyramid of technology" (van Mensvoort & Grievink, 2015, pp. 458-459) pictured in Figure 1, technical products are initially experienced as artificial; as functional additions to the natural world. Examples of this "functional" stage of technology are the steam engine and the stone axe. These technologies were clear, separate items that provided humans with 'power' and 'sharpness'. Contemporary examples that Van Mensvoort mentions are lab grown meat and quantum computing. He argues that over time technologies become more advanced, accommodated and naturally integrated in human existence. Van Mensvoort mentions the internet and sewage systems as vital technologies that have become so essential that we can hardly live without them. In the highest level of the pyramid technologies become "invisible" and are no longer experienced as technologies, like handwriting, agriculture, and cooking.

On the other hand, 'nature' is increasingly manipulated, redefined and enhanced by technology. From breast implants and lip-fillers, to the already mentioned lab grown meat and oil producing microbes. Van Mensvoort and his Next Nature Network address these developments with multiple critical design projects, from which the genetically modified butterfly with man-made markings on the wings is one of the more widely known (Figure 1). According to van Mensvoort, both mechanisms contribute to technology finally becoming *indistinguishable* from nature, in

other words: technology becoming natural. Hence the characterization of technology as 'next nature', where "technology is our natural future" (van Mensvoort, 2020, front cover).

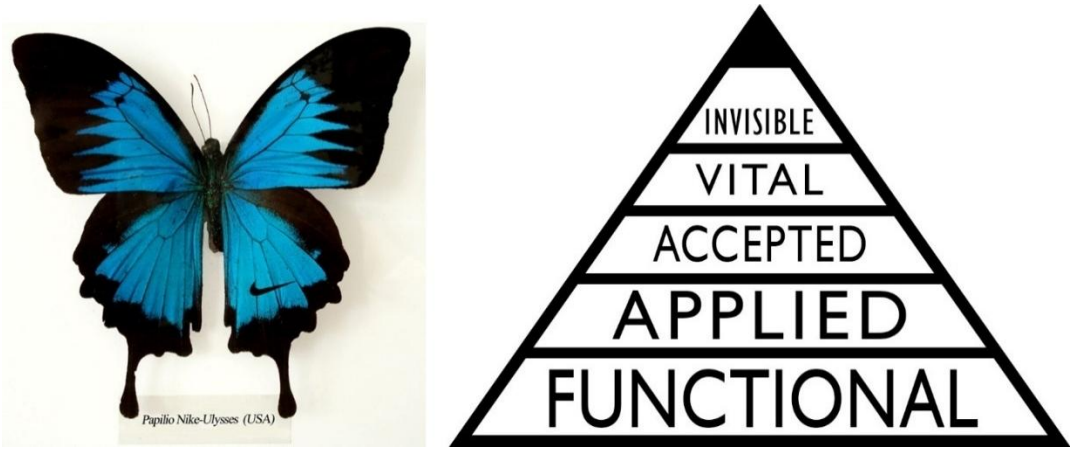


Figure 1: Left; "Papilio Nike-Ulysses (USA)" critical design project from Next Nature Network where species would be genetically modified to advertise commercial brands (van Mensvoort & Grievink, 2015, pp. 18-19), right; Maslov style pyramid of technology, after Van Mensvoort & Grievink (2015, pp. 458-459).

This analysis is intriguing, but also gives rise to a pressing question in light of the search for a reorientation to Earth/nature: does "technology as next nature" mean a profound and adequate understanding of the natural fitting with advanced insights about technical mediation and human-technology relations? Or does it come down to a forgetting, or hijacking and *concealing* of nature as it used to be and as we search to protect?

1.3 NATURE/EARTH IN DESIGN PROJECT WITH PRODUCT IMPACT TOOL

We will now illustrate the question of how Earth/nature should be considered comes to the fore in green design projects with the Product Impact Tool (Dorrestijn & Eggink, 2014; Dorrestijn, 2017). Just like Van Mensvoort's approach is an application of philosophy of technology in concrete design projects, the Product Impact Tool can also be used to apply insights from technical mediation and human-technology relations in developing technology. Therefore, we use this case to explore whether the Product Impact Tool helps adequately in addressing the relation between humans, technology and Earth/nature.

The core of the Product Impact Tool is a model showing how technology surrounds and influences humans from all sides. There are twelve types of impact, such as coercion, persuasion, and side effects. These impacts are categorized in four quadrants, depicting four types of relations between humans and technology, named: *before-the-eye, to-the-hand, behind-the-back, and above-the-head* (see also Figure 4). In Section 2, we will further explain the tool and its theoretical backgrounds. Here we will restrict ourselves to illustrating the exemplary use of the tool in a design project.

The designs we present are from an Industrial Design Engineering master course "Create the Future" (Eggink et al., 2009). Here, the students perform an exploration of the future through scenario development (Fahey & Randall, 1997). Based on trends and forecasts on a given theme, the students work in groups of five to develop three different socio-technical scenarios for 25 years ahead (Eggink & Albert de la Bruheze, 2015; 2018). Then they choose one scenario and develop a design concept to illustrate that future, focusing on the future interplay between society, culture, and technology (Wildeboer et al., 2023).

The design cases are from an instance of the course where the theme was Future of Food" (Kousi et al., 2023). Different functional, social, societal and cultural aspects of food are interconnected with both nature and humanity, and food is therefore a good theme to illustrate our research question. Moreover, on a macro level, food supply also faces challenges from population increase and climate change, while on a micro level, food relates to personal health, culture, lifestyle, and personal preferences. A lot of the current and future challenges that food faces (climate change, migration, cultural shifts) are complicated issues calling for transdisciplinary collaboration aimed at transformational change (Kousi et al., 2023).



Figure 2. "Lokaal is Lekker" [Local is Delicious] design based on food independence for local communities, by Carithea Richards, Ale Sarmiento, Jop Koning, Estefanía Moras Jimenez and Lara Monteagudo Tubau.

One group of students worked on "Lokaal is Lekker" (Local is Delicious) as a design proposal for a future scenario where food is grown locally to increase independence and strengthen social coherence (Richards et al., 2021). The students designed the structure of a community/supermarket/greenhouse complex aimed at helping local communities with food independence in several steps (see Figure 2). Preservation of food and agricultural knowledge via an *exhibit*, a greenhouse for growing local and seasonal *crops*, a *kids' area* for collaboration and learning, a *restaurant* for tasting and gathering, and a *market* offering the locally grown crops to the community. The complex aspires to be self-sustaining by integrating with the infrastructure of the community and reusing resources (such as *compost*, sewage and rainwater), while at the same time applying old and traditional agricultural methods such as crop rotation to preserve soil fertility.

Another group of students presented the "Kitchen of the Future", which would be dramatically minimized as a result of the ubiquity and increase in efficiency of food delivery systems (Figure 3). In this scenario, everyday food would have been industrialized, minimizing food waste and optimizing efficiency. At the same time, cooking ability would be decreased within the younger generations and treated as a niche hobby (Faber et al., 2021).



Figure 3. Vision for the "Kitchen of the Future" based on optimization of food delivery, by Marieke Faber, Leon Groothaar, Matthijs Mondria, Noor Nijrolder and Tessa Rutjens.

During the course, we introduced the students to the concept of human-technology relations and the principles of mediation theory. Moreover, in a half day workshop the students applied the Product Impact Tool in its original form (Figure 4) to evaluate their concept designs and improve on the intended, the possible and the unforeseen consequences of their future visions (Eggink, 2020). The student groups had to use the tool to analyse their design proposal within all the four quadrants. The interesting thing is that the tool forces to also think of the less obvious and sometimes hidden effects of technology. By making several 'rounds' through the four quadrants, these often unwanted side effects come to the fore (Eggink, 2021). This evaluation then helped to understand how the presented designs would impact the future relationships between people, technology and society. For instance, the students from the kitchen of the future project acknowledged the influence of deskilling and the loss of knowledge about food ingredients as an unwanted side-effect in their future scenario and introduced virtual reality cooking workshops as a way to mitigate this loss.

However, when we return to the perspective of our research about the reorientation towards nature/Earth, each of the two examples demonstrate a very different relation between people, technology and the *natural*. In the "Local is Delicious" proposal one could say that the "Earth" becomes closer and explicitly visible in the form of a local microcosmos that serves the needs of the community. Although one could also argue that this microcosmos is more like nature in the spirit of van Mensvoort's next-nature philosophy; the microcosmos consists of an entirely designed (or engineered) type of "nature-as-technology". This is even more true when you see that the students also envisioned that in the future predominantly genetically modified crops would need to grow in specialized greenhouse environments. In order to "[…] adapt to changing and more dramatic climates" (Richards et al., 2021, p. 4).

The "Kitchen of the Future" is a different story. Here, the relation to food production has completely disappeared 'behind' the food delivery technology. Although the evaluation of the design with the aid of the Product Impact Tool brought a lot of issues to the attention, the idea that this further alienation from the natural resources of the Earth could be seen as a problem did never occur to the students. Not that we advocate that future designers should always strengthen our relation to nature with their designs -like utopian Arts-and-Crafts artisans avant-la-lettre (Dorrestijn & Verbeek, 2013). However, for an ethically sound reflection on their designs they should at least consider it. Thus, in light of the challenges for a sustainable future in balance with nature/Earth, this emphasizes that the role of nature/Earth is underexposed in the current human-technology relations analysis with the Product Impact Tool.

1.4 A TURN TO NATURE/EARTH IN DESIGN AND IN PHILOSOPHY

What kind of conceptualization of the relationship between humans, nature and technology is needed for a turn to nature in design? We saw two practical philosophical approaches in the context of technology and nature. Technology as "next nature" affirms the hybridity of humans, nature and technology so much that it may actually abandon nature as it was. The Product Impact Tool, as yet, does not conceptually consider the relationship of humans and technology to nature or Earth. For a turn to nature/Earth, it is not yet clear if and how such philosophical approaches are adequate.

We must also consider that within philosophy of technology the place of Earth/nature is complex as well. Contemporary philosophy of technology has put emphasis on the "entanglement of humans and technologies" (Swierstra et al., 2022), with concepts such as "human-technology relations" (Ihde, 1990), "hybridity" and "agency of technologies" (Latour, 2017; 2018), as well as "technical mediation" (McLuhan & McLuhan, 1988; Latour, 1999; Verbeek, 2005; Hubig, 2013; Verbeek, 2015). At the heart of these approaches is a philosophical questioning of the meaning of nature, humans and technology and a blurring of the distinctions. Exemplary is Latour's allegation, in earlier work, that all things and humans are "hybrids" (Latour, 1999). In later work, however, Latour put emphasis on the climate crisis, and called to bring our modern way of living with technology "down to Earth" (Latour, 2018).

Therefore, the challenge for the philosophy of technical mediation and of human-technology relations is to consider how to conceive of hybrids of humans, technology, and nature, in such a way that it does not mean a forgetting of nature, but adequately acknowledges Earth/nature. Hence our research question: how can human-technology relations remain, or be brought back "down to Earth"?

As a contribution to this task we will investigate the place of Earth/nature in the Product Impact Tool, as well in the approach of Human-Technology Relations.

In the following we proceed by further introducing the Product Impact Tool and the approach of Human-Technology Relations, or more precisely the (post)phenomenological framework of "human-technology-world relations" (Ihde, 1990; Verbeek, 2005; 2015), and the question about the place of Earth/nature in these frameworks. Next, it appears important to discuss how "earth" compares to "world" in several relevant approaches in philosophy of technology. This discussion then provides a base for our proposal for a way to consider how human-technology-world relations can be completed with Earth/nature. Finally, we will conclude with what this proposal means for the Product Impact Tool, and we will present a revised design; a Product Impact Tool – "down to Earth".

2 THE PRODUCT IMPACT TOOL AND HUMAN-TECHNOLOGY RELATIONS

With the underexposure of nature in the application of the Product Impact tool in mind, we will now revisit the origins of the philosophical theories that the tool represents.

2.1 PRODUCT IMPACT TOOL: TECHNOLOGY FROM ALL SIDES

The Product Impact Tool offers a practical elaboration of the idea of technical mediation and human-technology relations (Dorrestijn, 2012b). The core of the tool is a model which expresses that humans are surrounded and influenced by technology from all sides. If our human existence is mediated by technology, then two questions can be asked: What are the effects of technology on us humans? And: Where or how do these effects of technology seize us humans? The Product Impact Tool presents a selection of answers to these questions as found in different

research disciplines: twelve types of impact, such as coercion, persuasion, side effects, and technical determinism (with in the web-version five concrete examples of technologies for each of the effects), categorized following four different types of relation, or interaction, or entanglement of humans and technology.

Here we focus on the types of human-technology relation in the Product Impact Tool. In the model these are the quadrants around a human figure in the centre (Figure 4):

- To-the-hand: Through bodily contact, technology changes gestures.
- Before-the-eye: By transferring information and meaning, technology directs decision making.
- Behind-the-back: Effects on humans, without direct contact with the technology.
- Above-the-head: Views about the impact of technology as a whole.

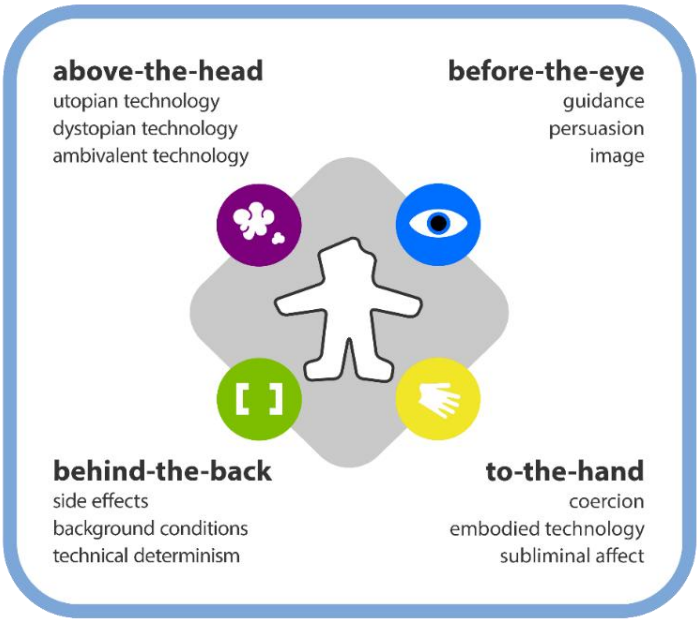


Figure 4: Product Impact tool model (Product Impact Tool, n.d.)

The basis for specifically the model with four modes of interaction drawn around a human figure comes from the work in media studies and phenomenology by Vilém Flusser. In his posthumous book *Vom Subjekt zum Projekt: Menschwerdung* Flusser (1994) reconstructs through historical and anthropological findings, etymological traces, and admirable philosophical imagination, how humans first became humans by learning to use their hands and feet (*vorderhand*). In a later stage, casting an eye (*Augenblick*) became more important, and eventually covered up awareness of the earlier way of being. This inspired the arrangement of different figures of mediation around a human: to-the-hand and before-the-eye. Then came the realization that in a comparable manner more historical and cultural approaches from philosophy of technology and of media studies could be added behind-the-back and above-the-head of the human in the centre. Thus, the Product Impact model with four quadrants was complete.

For a more extensively discussion, see *The Design of Our Own Lives* (Dorrestijn, 2012a). Here we will give a very concise summary of some references for the four quadrants. The main philosophical sources are media studies (for example, Flusser, 1994; McLuhan, 2003), phenomenology/ philosophy (Heidegger, 1977; Merleau-Ponty, 1962), post-

phenomenology/philosophy (Ihde, 1990) and general philosophies of technology (Achterhuis, 2001; Feenberg, 2002).

- **To-the-hand** reflects Flusser's 'vorderhand' and Ihde's 'embodiment relation' (see below), including the references to Merleau-Ponty's 'embodiment' and Heidegger's 'readiness-to-hand'.
- **Before-the-eye** is indebted to Flusser's 'Augenblick', as well as to fellow media studies scholar Marschall McLuhan's notion of 'an eye for an ear', a slogan summarizing his analysis of tactile-acoustic space and visual space (cf. McLuhan, 2003, p. 115). It equally reflects Ihde's 'alterity' and 'hermeneutic' relations and Heidegger's analysis of 'presence-at-hand'.
- **Behind-the back** includes Ihde's 'background relation', but another main source is McLuhan's emphasis on mediation by our 'technical environments'. As a title behind-the-back builds further on the idea of mediation from different sides.
- **Above-the-head** is not about a concrete relation between humans and technology, but is about views on technology as a whole. While beyond Ihde's phenomenology of technics program, it does however align with his program of a 'cultural hermeneutics' (Ihde, 1990, p. 124). The figures of utopian, dystopian, and ambivalent technology refer more widely to the philosophy of technology (for example Achterhuis, 2001; Feenberg, 2002).

Human-technology relations are an important part in these approaches to technology and technical mediation in phenomenology, philosophy of technology and media studies. However, in all of those approaches the *effects of technology* are at least as important. The same holds for Latour's work. Human-technology relations are important, be it in a different way, namely as an underlying relational ontology (of associations, symmetry, hybridity, actor-networks of humans and non-humans). In his analysis of 'four meanings of mediation' the focus is, however more on effects and less on relations (Latour, 1999, pp. 178-190). The Product Impact Tool combines both dimensions: twelve types of effect of technology, but also four types of human-technology relation.

For our present research question about the place of Earth/nature in human-technology relations the most important part of the Product Impact Tool clearly are the four relations. It appears that the Product Impact Tool with the model of the impact of technology from all sides is about humans and technology and technological surrounding, but not about the natural environment. On the other hand, nature/Earth can and does figure in some of the examples of impact. Side effects can concern environmental side effects. Behaviour steering and generalizing claims about technology can concern environmental issues, for example bins specifically designed to stimulate consumers to sort their waste. However, Earth/nature and the relation to humans and technology are not explicitly addressed in the model itself.

Of all the sources for the Product Impact tool, post-phenomenology most explicitly and specifically focusses on human-technology-world relations. While also for the other mentioned sources (McLuhan, 2003; Flusser, 1994; Latour, 1999) the question about the place of Earth/nature could be investigated, in this paper we will focus on the Product Impact Tool and post-phenomenology.

2.3 HUMAN-TECHNOLOGY RELATIONS (POSTPHENOMENOLOGY)

An important reference for the modes of interaction in the Product Impact Tool is the post-phenomenological approach of exploring human-technology-world relations, as initially developed by Don Ihde. In *Technology and the Lifeworld* one part concerns the research

program of a "phenomenology of technics" (Ihde, 1990, p. 72) which is about the exploration of different variations regarding the place and role of technology in the relationship between humans and the world.

This is the basic schema that Ihde draws:

human – technology – world

In a modern scientific view there are objectively existing things in the world, of which the human subject can have objective knowledge. Phenomenology, after Husserl, Heidegger, Merleau-Ponty and others, acknowledges that any perception, experience, knowledge of the world by us humans is always bound to our perspective as human beings. It is always about our experience of the world, about how everything in the world appears to us (as a phenomenon, as phenomena). Moreover human beings, subjects do not first exist apart from the world before they start to face the world. The approach of phenomenology (Husserl) was to acknowledge that there is always consciousness of something, never pre-existing consciousness still empty. Equally (following Heidegger), the human way of being is not at some point engaging with the world, but is always being-in-the-world. That consciousness always has content, is directed at something, is in Husserl's phenomenology termed "intentionality" (Ihde, 1990; Verbeek, 2005).

Ihde's postphenomenology follows up on the intentional structure of consciousness, which he (like Heidegger) extends from human consciousness to human existence. Moreover Ihde affirms that technology is often a mediator in this structure: therefore the scope goes from human-world relation to human-technology-world relation. Following Ihde this relation has not one single true form. His philosophy of technology is non-essentialist about technology and proceeds by applying a post-phenomenological approach to discover variations of the place and the role technology plays in the intentional structure of "human existence in the world".

For a schematic representations of the different types of relations that his phenomenological investigation reveals Ihde applies arrows and brackets, to indicate how human being experiences being in the world mediated by technology.

Ihde arrives at distinguishing four variants within the human-technology-world relation:

embodiment relation:	(human-technology) → world
hermeneutic relation:	human → (technology – world)
alterity relation:	human → technology (world)
background relation:	human → (technology / world)

The embodiment relation applies when technology such as glasses functions as quasi part of human being, "(human-technology)", who experiences the world around: "→ world". The hermeneutic relation applies when technology such as a thermometer function as some kind of dashboard in and of the world, "(technology-world)", which prepares human being's understanding of the world (it's warmth as temperature in the case of a thermometer). An alterity relation occurs when human beings interact with a technology as a quasi-other such as a coffee dispenser; and without awareness or relevance of the rest of the world. A Background relation denotes an indirect relation without interaction with a technology such as a central heating system that is part of the surrounding world.

2.4 WHERE IS THE EARTH?

The Product Impact Tool reflects several notions from Don Ihde's phenomenology of human-technology relations, and thereby the history of phenomenological analysis of technology that Ihde synthesizes. However, note that the four quadrants are not equalling Ihde's four relation types. As we have seen in the previous chapter the Product Impact Tool model incorporates also other sources resulting in a somewhat different and broader scope. The absence of

Earth/nature in the product Impact Tool was noted already. It appears that the same holds for the theoretical sources concerning the four quadrants with modes of interaction in the Product Impact Tool. Ihde's phenomenology of technics program is the most relevant source as it is explicitly on exploring human-technology-world relations. In that part of Ihde's work there is not an explicit mention of Earth.

3 EARTH AND WORLD ARE NOT THE SAME

The Product Impact Tool reflects several notions from Don Ihde's phenomenology of human-technology relations, and thereby the history of phenomenological analysis of technology that Ihde synthesizes. However, note that the four quadrants are not equalling Ihde's four relation types. As we have seen in the previous chapter the Product Impact Tool model incorporates also other sources resulting in a somewhat different and broader scope. The absence of Eearth/nature in the product Impact Tool was noted already. It appears that the same holds for the theoretical sources concerning the four quadrants with modes of interaction in the Product Impact Tool. Ihde's phenomenology of technics program is the most relevant source as it is explicitly on exploring human-technology-world relations. In that part of Ihde's work there is not an explicit mention of Earth.

3.1 TERRESTRIAL TURN

As with Ihde, also for Latour issues about the value and politics of nature always were interrelated with his research on humans and technology. The last decennium of Latour's work was all about a turn to Earth (Latour, 2017). Our human self-understanding and way of living need to land again, need to be brought 'down to Earth' (Latour, 2018). While modernity can be characterized by a technological flight lifting us up from our natural condition, we have gotten too far away, and it is now time for a reappraisal of our bounds to the Earth and to nature.

Recently ever more philosophers of technology emphasize the importance for such a reconsideration of our earthbound condition. Lemmens et al. (2017) make the case for a "terrestrial turn". This turn in the philosophy of technology was prompted by the growing urgence of environmental issues and climate change already acknowledged in philosophy of technology. However, it was research in "Earth systems science" and the invocation of a new geological epoch, the Anthropocene, which gave impetus to the turn to *Earth* in philosophy of technology.

3.2 EARTH SYSTEM SCIENCE

In the human-technology relations referred to so far the approach was mostly phenomenological, starting from the subjective position of us human beings in the world and from there exploring what is experienced and what can be known about the world, and Earth, around us. To the contrary, the upcoming discipline of Earth System Science (Steffen et al., 2020), takes an objective outside perspective on the structure and changes of Earth as a complex adaptive system. The aim is objective scientific knowledge (although because of the grandioso scope of planet Earth and its history the knowledge may remain more hypothetical and speculative than in other sciences).

3.3 ANTHROPOCENE

An important moment in the study of Earth as a system was the proposal in 2000 by Crutzen and Stoermer of acknowledging the arrival of a new geological epoch, the Anthropocene, because the Earth has geologically become marked by humans and human activity in a drastic and irreversible way (Crutzen & Stoermer, 2021). This provoked much scientific research to support, elaborate or falsify the claims, but also much philosophical and ethical thought about

the footprint and responsibility of humans on Earth. The Anthropocene meant a new awareness of the Earth system as a condition for human life, but it also meant a shock, because this Earth system appeared vulnerable.

Pieter Lemmens (2022) summarizes four narratives about the challenges of Anthropocene: from the "eco-modernist" belief by enhanced modernization and geo-engineering, to the "eco-catastrophist" fearful conviction that economic de-growth and de-industrialization are needed, to the "eco-Marxist" emphasis on capitalism as the cause that should be overturned, and a more moderate "naturalist" narrative that sees the Anthropocene as unfortunate but repairable. Lemmens then proceeds to discuss how some relevant currents in philosophy of technology compare to these narratives.

Our research in this paper proceeds in this line as it faces the challenge of Anthropocene and asks about the place of Earth in the Product Impact Tool and Human-Technology Relations.

3.4 TECHNOSPHERE

A second element of Earth system science is the study of spheres of the Earth. To begin, there is the "geosphere" with different sub-spheres: "lithosphere", "hydrosphere", and "atmosphere". Later, the "biosphere" became recognized as a layer of the Earth system embedded in the geosphere (as all that lives, humans included, on the Earth). Later again a sphere was distinguished that is an offshoot of humans in the biosphere, but is itself lifeless, which was called "technosphere" (Girardet, 2022).

This Earth system of technosphere as an intermediate between biosphere and geosphere resembles human-technology-world relation, but from a quite different perspective: Earth system science aims for an outside and objective perspective while the phenomenological method intends to remain close to the starting point of the human subject's experience. In more holistic approaches in Earth system science there are concepts which do allow for a subjective element, namely the "noosphere" (a sphere of spirit, thinking, human culture), and the concept of "Gaia" (the whole of Earth system as a kind of organism).

In other than phenomenological currents of philosophy of technology the systemic perspective and the notion of technosphere are explicitly referred to. This for example the case in the work on the so called Technium by journalist and thinker about technology Kevin Kelly (2011). And, as mentioned before and most notably for our research, Koert van Mensvoort (2020) also refers to natural sphere and technosphere.

3.5 NEXT NATURE IS NO NATURE

Following Van Mensvoort humans produce technological artifacts which form a technosphere on top of the natural sphere. In the course of time these artifacts become vital, invisible, and naturalized, part of human nature. This development is in itself interesting and may be true. However, our question is if this notion of "technology as next nature" does not obscure an awareness of what originally meant nature, which was something other than human produced technology. A nature that is developing by itself according to the principles of evolution; a nature that is given and evolving by itself.

A comparable critique applies to the notion of Anthropocene. It raises awareness for Earth/nature at a time when this Earth/nature appears endangered by human activity and technology. However, most narratives about the challenge of the Anthropocene (Lemmens, 2022, see above) see it as a human task to preserve the Earth; we humans must solve the problems that we created. This is all about human intervention in nature, first for worse, and now hopefully for the good. However, as soon as human intervention in nature begins, this actually means a trespassing from the sphere of nature to the sphere of technology.

PARADOXICAL NATURE OF NATURE

This leads to paradoxes in philosophical thinking about this situation. Respecting and preserving Earth and nature in itself would mean not to intervene with it, not even look at it, not even to be aware of it. Only Earth/nature out of sight and out of reach for us, would be real Earth/nature as it would be in itself. However, such overlooking of Earth/nature, and assuming the technosphere as the ultimate sphere in which we live, seems the cause of destroying Earth/nature. Note that this paradoxical nature of nature is also visible in the "Local is Delicious" design proposal from the case study; in order to re-establish a connection between the consumer and the sources of their food, actually a completely constructed 'natural' microcosmos is envisioned. As a consequence, from a more pragmatical stance, we opt for seeking a compromise. How can we take notice and care of Earth/nature, while at the same time remaining conscious of the philosophical paradoxes and practical dangers? Therefore our question: How to account for Earth/nature in technical mediation approaches, such as human-technology relations and the Product Impact Tool?

A distinctive aspect of Earth systems science that may be helpful for our reconsideration of human-technology relations in regard to Earth is how the different spheres (geosphere, technosphere, and life sphere) are nested. This is missing in the post-phenomenological analysis of the experiences of technology as part of human being-in-the-world. However, there are definitely relevant insights about the spheres of Earth and world and humans in classical phenomenology, including an awareness of the paradoxical nature of nature.

3.7 EARTH AND WORLD IN PHENOMENOLOGY

For our turn to Earth/nature, there is a very relevant tradition in phenomenology, with Martin Heidegger and Hannah Arendt, that should be noted and can be useful. As mentioned above, Heidegger's analysis in *Being and Time* of human being-in-the-world and tools which can be ready-to-hand or present-to-hand is an important source for the phenomenology of human-technology relations. In later work, Heidegger introduces "earth" as a counter-notion to "world" (Komel, 2002). The perspective of being-in-the-world becomes embedded in a broader "topology of being", which locates the being of humans and things "in the world, on the Earth, and under the heaven" (p. 67). We will leave heaven aside here, and focus on "in the world and on the Earth". Heidegger's thought directly engages with the paradox of nature. For him "Earth" has the meaning of the non-world, the non-place, of concealment and undifferentiation. In *The origin of the work of art* (Heidegger, 2011), first published in 1950, Heidegger presents the way of being of things as a struggle between world and Earth. Things make up a "world" which comes to appearance for humans, is brought to appearance by human work. The struggle means that this world of things is gained from and may be lost from the "Earth". Connected to this analysis is Heidegger's worry that human technical activity and thinking do not properly take care of the world and unconsciously destroy the Earth. In a poetic-philosophical way, Heidegger affirms an attitude of "Gelassenheit zu den Dingen und zur Offenheit für das Geheimnis" (Heidegger, in Komel, 2002, p. 63).

These considerations are taken up and elaborated in a more pragmatic way and maybe less esoteric terminology by Hannah Arendt in her analysis of the activities of human living, the *Vita Activa* (Arendt, 1958). In Arendt's perspective on how humans live their lives, Earth and world are linked to two different categories of human activities. "World" is related to the activity of "work", it is the resulting work (enduring product) of the work activity, the human-made world of humans as *homo faber*. "Earth" is the given, natural environment, the soil on which humans as *animal laborans* exercise all kinds of "labour" activities associated with staying alive as biological being. In the framework of Arendt human living is necessarily rooted in the natural environment, but is also dependent of a human-made world.

Arendt's work, like Heidegger's is relevant for philosophy of technology and the present challenge of the Anthropocene. The activity of world-making is always necessarily Earth-violating. However, Arendt's pragmatic approach invites for seeking balance in practice, instead of emphasizing paradox in principle (Achterhuis, 2022). Anne Chapman (2007) applies Arendt's categories for environmental philosophy, for example analysing controversies about the environmental pros and cons of wind mills. She explicates that in practice nature figures in human activities in the labour category as well in the work category. Nature matters as Earth that needs to be left to its own, and nature matters as world that needs to be cared for and sustained.

Heidegger and Arendt explore the environment of human existence from a perspective that starts from and remains with the human perspective. Still, it is not only about the world as it appears for us humans. Aware of the associated paradox, the exploration brings up the Earth as a foundation below human existence in the world.

3.8 ON THE EARTH, IN THE WORLD

Finally, the consideration on Earth and world from the distinctive perspectives of nested spheres in Earth system science can be combined with the perspective of phenomenological exploration from the human perspective by the simple formulation that human life takes place "on the Earth, and in the world" (cf. Botin, 2023).

4 HUMAN-TECHNOLOGY RELATIONS DOWN TO EARTH

We will now explore how this addition of Earth to the notion of world can be elaborated in the philosophy of human-technology relations.

4.1 HUMAN-TECHNOLOGY-EARTH

We are searching where Earth/nature in human-technology relations is or should be in the post-phenomenological analysis after Don Ihde's (1990) phenomenology of technics. Ihde's research addresses the relationship between:

human – technology – world

The scope of our investigation is to explicitly include Earth:

human – technology – Earth

How does this compare? Part of this is the relation between "technology – world" as distinct terms; and "Earth" is missing. What does Ihde mean by world? Does he include Earth in world, or is Earth outside the scope of his analysis? If we look at Ihde's examples and the four variants of this relationship, as well as to the application in the student's case the meaning of "world" is actually "the technological world". This makes good sense, as world and technology belong together in the phenomenological tradition, and world is distinct from Earth. We therefore can specify that Ihde's investigation concerns the relation:

human – (a specific) technology – (the world of) technology

If we simplify that, we have:

Human-technology-technology

The insight we gain is thus that Ihde's phenomenology of technics is all about the relation of humans to technics, whereas awareness of nature/Earth is out of scope. It also means that for our purposes Earth should be added to the relationship. Entering Earth in the equation,

following the conception that “we humans live (with technology) in the world on the Earth”, could then lead to:

human-technology-world-Earth

However it makes sense to consider “technology” as part of, or coinciding with “world”: “technology/world”. Moreover, this in turn coincides with “culture”, if we also take into consideration here the alternative terms and concepts of nature and culture. Thus these three concepts largely coincide: “technology/culture/world”. Comparably, “Earth” coincides with “nature”, which makes in schematic notation: “Earth/nature”. Our revised scope for a phenomenology of technics then is about relations between:

human – technology/culture/world – Earth/nature

This is an extended form with multiple related terms of the relationship in concise single-term format “human-technology-Earth” that we started with. The comparison with related terms makes it easier to see what is the peculiarity of the scope of Ihde’s human-technology relation. The common talk of “human-technology relations” is not just an abbreviation of “human-technology-word relations”. If we recognize that world and technology indeed coincide more than they differ, and are distinct from Earth, then the scope was indeed always “human-technology relations”. See the highlighted terms in the full scope, multi-term relationship:

human – **technology**/culture/**world** – Earth/nature

To come to a single-term abbreviation of our extended scope we highlight in a different way:

human – **technology**/culture/world – **Earth**/nature

Thus we arrive back at:

human-technology-Earth

Whereas in Ihde’s phenomenology of technics program “earth” was out of reach of conscious experience, we have broadened the scope. “Earth” now becomes recognized in its own right, distinct from “technology” and from “human”.

As said, Ihde complements his phenomenology of technics program with other programs, where the stakes are ultimately on Earth conservation. If we take this into account, then “Earth” is present around the human-technology relations. Chances are, however that Earth is easily overlooked. It seems important to explicitly consider the place of Earth also directly in a phenomenology of technics program.

4.2 (EARTH (TECHNOLOGY (HUMAN)))

So far we have adopted from Ihde the representation with hyphens between the terms of “human-technology-Earth” for denoting the research domain and the scope of it. Post-phenomenological research affirms a profound idea of technical mediation as entanglement and co-constitution of humans and technology, and aims to explore variations in the relations of this entanglement. However with this representation with hyphens there is the risk of a superficial understanding, in which technology becomes understood as “a thing in the middle” between on the one hand “humans” and on the other hand “Earth”. We than see an unintended reification of humans versus technology (and versus Earth), while the intended deeper sense of technical mediation is missed.

This is what we have often seen in the application of the human-technology relations framework in design projects by students. It is a good that the framework helps students to explore different types of relations in a way they would otherwise not have considered. At the

same time it is unfortunate that they often do not grasp the deeper meaning of technical mediation. The focus on technology as "thing in the middle between" can even lead to an exaggerated focus on technology as a means for solving any problem, a means that can save the world, can save the Earth. We think that the framework of human-technology relations, even in superficial form, can definitely enrich and improve design approaches. But a deeper understanding of technical mediation is necessary to avoid the "designer fallacy" (Ihde, 2008), the assumption that everything about technology and its effects can be designed and controlled.

A deepened understanding of technical mediation includes that there is entanglement between the different parts, or rather that the different parts are not given apart from each other, but co-constitute each other. Technical mediation than signifies that we as humans exist (partly) by means of technology, via technology, and co-constituted by technology. Moreover, the Earth spheres approach (also van Mensvoort) assumes a development of technosphere nested in biosphere nested in geosphere.

This leads us to a developmental model of embedded spheres for our new 'equation', where the human is seen as embedded and emergent in technical and in natural conditions (Figure 5).

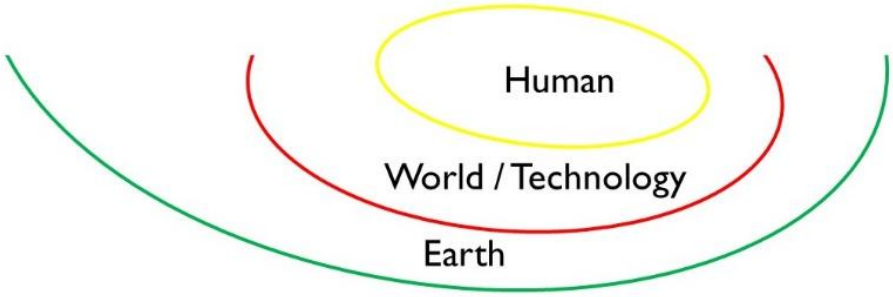


Figure 5: A provisional model of embedded spheres

We transcribe this to the characteristic notation system of Ihde's phenomenology of human-technology relations by use of round brackets:

(((human) in the world) on the Earth)

(((human) culture) nature)

(((human) technology) nature)

(((human) world=culture=technology) Earth=nature)

Then the schematization for the "human-technology relations" brought "down to Earth" becomes:

(((human) technology) Earth)

Or the other way around:

(Earth (technology (human)))

Note that this is only the basic scheme, denoting the scope of what is there as phenomena of experience. Ihde's phenomenology of technics concerns the mapping of variations of human-technology-world relations, or sometimes just human-technology relations. Our research sought to broaden the scope to include Earth/nature. Phenomenology of technics should be about variations of the relation:

(Earth (technology (human)))

This does not mean that Ihde's schemes have to be replaced, but it may at least be important to explicate how the relations he identified can be considered part of a broader context which more explicitly recognizes embeddedness in Earth/nature;

(((human - a specific technology) world of technology) Earth)

5 PRODUCT IMPACT TOOL DOWN TO EARTH

With the newly devised scheme of embedded relations in mind we revisited the design of the PIT-model graphic. The new design should emphasize the relation with nature not only in representing the embedded structure, but it should also represent nature associatively.

When we take the structure of embedded spheres of Figure 5 and compare it with the existing PIT model graphic of Figure 4, we see that the graphic only encompasses the yellow and red 'sphere'. Our human in the middle is surrounded by the 'world of technology'. Therefore, the redesigned graphic introduces another area around the original graphic as Earth/nature (Figure 6).

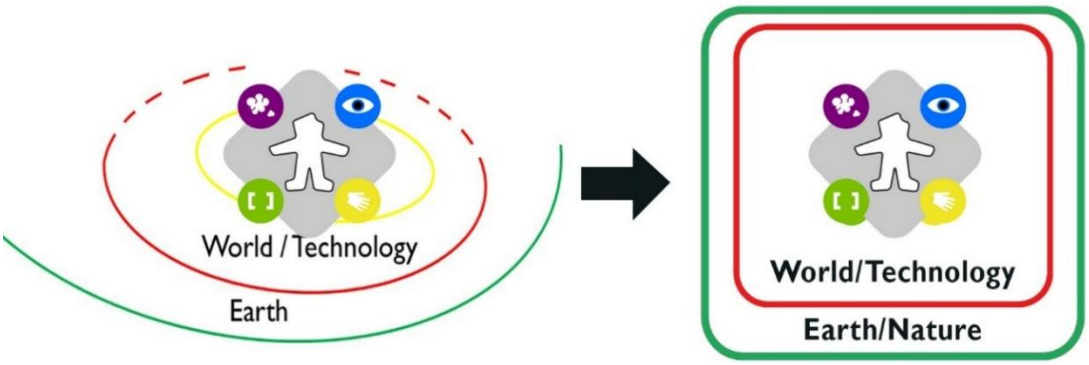


Figure 6: The transition of the embedded spheres graphic structure to the Product Impact Tool model layout.

5.1 REDESIGN INSPIRED BY NATURE

For the associative representation of nature, we were inspired by the artworks of Hans Arp, famous for his prints and installations with abstract forms as a representation of his natural surroundings. Hans Bolliger, curator of the Kunstmuseum Basel at the time of the artists later career, nicely phrased why Arp is intuitively a perfect match for our case at hand:

"Seine Holzschnitte, Lithographien und Radierungen sind Zeichen, Gleichnisse und Sinnbilder jener <<hypnotischen Sprache Arps>>, wie Max Ernst sie einmal definierte, <<die uns zurückführt in verlorene Paradiese, zu kosmischen Geheimnissen, und die uns lehrt, die Sprache des Universums zu verstehen>>." (Bolliger, 1959, p. 4)

["His woodcuts, lithographs and etchings are signs, parables and symbols of that <<hypnotic language of Arp>>, as Max Ernst once defined it, <<which leads us back to lost paradises, to cosmic secrets, and which teaches us to understand the language of the universe>>"]

We chose an artwork with embedded blob shapes as a starting point to show how technology, embedded in nature has no rigid boundaries (Figure 7).

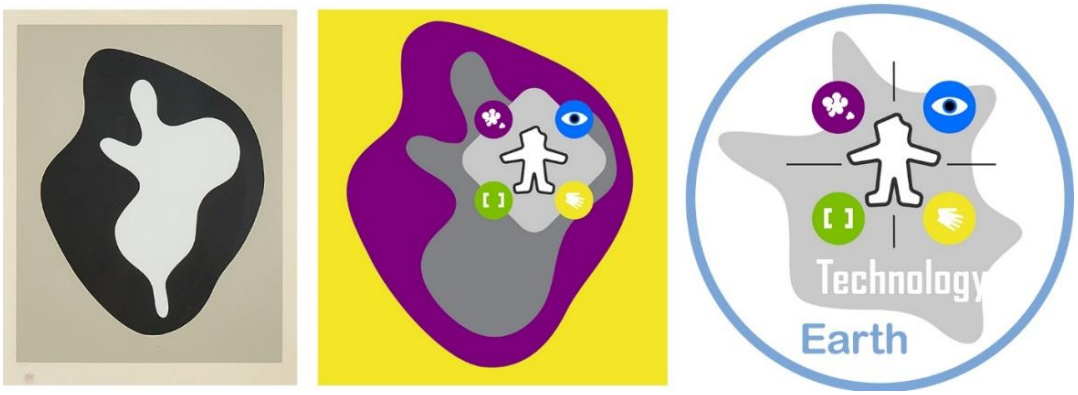


Figure 7: Left: "Torse-Feuille" (Torso-Leaf) 1959, serigraph in three colours by Hans Arp as inspiration source for the revised graphic (Buffalo AKG Art Museum, 2012). Mid: an early version incorporated the colours of the four quadrants. A later proposal represented the Earth as a sphere (right).

The initial colour scheme of the graphic was based on the four quadrants of the model. This however placed too much emphasis on the boundaries themselves. Therefore, we decided to make technology grey, as is already the metaphorical colour for technics for ages. The 'fingers' of the grey blob stretch out symbolically into the nature/Earth domain. Eventually we chose to depict Earth as a boundary instead of a surface, as to remind the user that our environment is limited. This is also a reference to the famous report of the Club of Rome "The Limits to Growth" (Meadows et al., 1972) and the environmental activists' slogan "there is no planet B". We then experimented with a circular edge, reminiscent of the Earth as a globe. However, in the end we found that Earth/nature was also best presented as a blob. In this way, the boundary is both hard -as in uncrossable- and at the same time flexible -as in still adaptive to change. We present the final version of the revised model in our next concluding section.

THE PRODUCT IMPACT TOOL – DOWN TO EARTH

Based on the model of embedded spheres we propose an amended representation for the Product Impact Tool, also brought down to Earth (Dorrestijn & Eggink, 2022; 2025). The expanded model expresses how the four modes or levels of interaction between humans and technology (and the types of impact of technology on humans on those four levels) are embedded in the sphere of the Earth (Figure 8). The amended representation thus illustrates how the four quadrants should be interpreted within the extended mediation theory 'equation' of (((human) technology) Earth).



Figure 8: The final version of the Product Impact Tool-down to Earth.

As with Ihde's human-technology relations, we will not abandon the Product Impact Tool model as such, however it is definitely important to at least consider how the model relates to Earth/nature and how it contributes to green design projects.

6 CONCLUSION

In this paper we have aimed to contribute to a turn to Earth/nature in design and philosophy of technology. We tried to break through the tendency of a technical bias in understanding nature, as we saw in the philosophical design of Van Mensvoort and also in design projects with the Product Impact Tool. We took on to investigate the place of Earth/nature in the "Product Impact Tool" as well as in the (post)phenomenological framework of "human-technology-world relations". We focused our research on ambiguity around the notions of Earth, world, and technology. We consider it important to consider the overlap instead of difference between world and technology, and make place for Earth explicitly in the analysis and schematic representation of relationships between human, technology, world, and Earth. We also propose that it is better to see these relationships as embeddedness than of connections. Therefore we proposed a model where these relations are in their turn embedded in Earth/nature; represented in the notation:

(((human – a specific technology) world of technology) Earth)

Based on this analysis we have redesigned an extended Product Impact Tool embedded in Earth. We hope that the expanded model will direct the use of the Product Impact Tool in the context of sustainability in new ways. And more generally, we hope to contribute to a turn to Earth/nature in design and in philosophy and cope with the ethical challenge for design to prevent the exploitation of natural resources.

Data Access Statement

No new data were generated or analysed during this study.

Contributor Statement

Wouter Eggink: Conceptualization, Investigation, Methodology, Project administration, Resources, Visualization, Writing – original draft, Writing – review & editing

Steven Dorrestijn: Conceptualization, Investigation, Methodology, Project administration, Writing – original draft

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