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A material-centric approach in non-anthropocentric design

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doi.org/10.21606/drs.2022.518

Abstract: With the non-anthropocentric view, the materials—the non-human actors, can be seen as active contributors to the design process itself. Materials become carriers of a wide variety of information and reshape the human and non-human relations as relational agencies. Many pioneer design activities that de-center humanity rethink the relationship among different material actors to reflect on the 'Anthropocene' issues. The approaches to designing for post-Anthropocene scenarios are usually provocative in various aspects. This paper proposes a speculative, material-centric design approach to engage discussions towards post-Anthropocene scenarios by rethinking the entanglement of human and non-human actors. This approach was used to conduct a workshop called 'Future matters'. By sharing its results, this paper aims to trigger more discussions on the enriching roles material plays in post-anthropocentric design.

Keywords: material design; material speculation; non-anthropocentric design; anthropocene; material future; post-human design

1. Introduction

Material is playing a critical role in design, especially in today's changing and evolving material world. At the early age when design was an emerging discipline, material was essential for designers to proceed the hands-on activities and train their intuitions on designing shapes and objects (Wick 2000). With increased engineering knowledge involved in design, material in design has received greater attention in terms of its technological dimensions. However, Enzio Manzini mentioned that the abundance of new materials has caused a shift in the relationship that people once had with materials (Manzini, 1986) and Ashby and Johnson reframe the approaches designers select materials, which emphasize their different dimensions: the engineering dimension (the technical attributes), the usability on ergonomics and interfaces, the environmental dimension, and the aesthetics values (Ashby & Johnson, 2013). These multidimensional attributes set up materials’ personalities, and designers started to care more about the relation between ‘people’ and ‘materials.’ Accordingly, the term of materials experience generated refers to the experience that people have with and through the materials (Karana et al., 2015). With more new design practices on materials
emerged, researches to transform materials’ roles in design are constantly emerging, such as Oxman’s Material Ecology (2015), Karana’s Material Driven Design (2015), Rognoli’s DIY Materials (2015), Holzbach’s Design with designed materials (2015), etc. These discussions show that we are having new approaches to understand, explore and design materials, with a material-centric design approach. Different from the human-centric approach, a material-centric approach considers materials as the principal “stakeholders”, ”users,” or ”customers” we design for. As Carter interpreted, it is a new collaborative relation with materials, as the mediator, which could enhance new dialogues with unexpected results (Carter, 2004).

Nowadays the design on materials and with materials are creating collaborative relations between human and materials, which consider material is dynamic and active. This kind of relationship can be seen in many terms coined by the transdisciplinary experts from design, art, architecture, and engineer, such as Transmaterials (Brownell, 2017), Growing materials (Camere & Karana, 2017), ICS materials (Rognoli & Ferraro, 2021), Morphing Materials (Yao, 2019), Designing materials combining digital and analogue technics (Holzbach & Kellner, 2014). Today’s design scope has exploited more nonhuman species and the materials we mine for and reduce to human use. Wakkary in his “designing-with” approach argues that things we designed are actually called “nonhumans made by designers”, and they are calling for a commitment to design with more than human participation (Wakkary, 2021).

With the non-anthropocentric ideas of connected actors, in respect to the Actor-Network Theory (Callon M. 1986, Latour, 1988), the material that used to be the resources we use as humans and designers also became active contributors to the design process. Materials become carriers of a wide variety of information and enter into a dialogue with their environment, their informative and intuitive attributes giving insights and inspirations for design (Holzbach, 2014). By tinkering with materials, designers can reach unexpected experiences (Parisi et al., 2017), forms, structures, and even hybrid systems (Holzbach, 2015). An example can be the design work from the Institute for Materialdesign IMD, which focuses on physically, chemically, or biologically inspired material systems in the context of new technologies and processes. In self-generating and self-stabilizing systems, design concepts are renegotiated to material itself. In this kind of design practices on materials innovations, materials are no longer passive but active components of the process. These new material systems trigger a rethinking and speculating on scenarios beyond the Anthropocene era.

Today, there are many pioneer design activities that de-center the human and rethink the relationship among different material actors, in response to a post-anthropocene time. The design for a post-Anthropocene scenario has provocative approaches in various aspects, and the discussion on human and non-human relationships is one of them. Inspired by the material-centric design approaches that emerged today, this paper presents a practical workshop activity, which explores the potentials of design for post-anthropocene putting material in the beginning of the design process.
2. Designing past the anthropocene

With emerging technologies and their implications for cities, infrastructures, products, communication systems, and even human bodies, human activities are affecting and altering the natural cycles and changing the composition of the world. Today, globalization brings many issues onto an unprecedented scale, such as climate change, species extinction, and the depletion of natural resources. From a geological perspective, we are living in 'the Anthropocene' epoch. Since Paul Crutzen and Eugene Stormer brought up the term "Anthropocene"(Crutzen & Stormer, 2000), which describes the human-made changes on the planet’s surface with all alleged benefits and negative aspects for our species and the negative changes to all ecosystems, the global and local climate and weather, as well as biodiversity, in the year 2000 they started an ongoing discussion about whether and how the current geological era should be renamed.

Even though it is debatable whether the "Anthropocene "is the term to describe the current geological era, the idea of an epoch massively influenced by one species is inspiring new theories and ideas across all scientific and creative fields. While Bruno Latour is using the idea of an Anthropocene to develop his ideas about "being terrestrial "and living in the "critical zone "(Latour 2018), Donna Harraway develops her own concept of a "chthulucene" focussed on an interspecies - entanglement (Harraway, 2016), while Jason Moore breaks down the idea of the human species as the name-giving factor to the capitalistic system, the "capitalocene" era (Moore, 2014). Nonetheless, how the term will be discussed, the common idea is the consideration of the actions and influence of the human species on their non-human surroundings and the connections with the non-human.

For understanding the world as systems, networks and relations between human and non-human actors, it is essential to get away from an anthropocentric view. Methods like the Actor-Network Theory (Callon M. 1986, Latour, 1988) help describe and analyze these complex networks' connections and correlations. Decentering the human in the constitution of the world and the systems they live in also enables a design approach that considers more than human actors as "active" in the process. This idea connects to Latours "Parliament of things "(Latour, 2002) and Jane Bennets' "Vibrant Matter "(Bennett, 2010), in which non-human entities are considered as "active "in their social, political, and co-constitutional relations amongst each other and humans. Focusing the design process on non-humans and including post-humanist and neo-materialistic theory into the design process to tackle the topic of the Anthropocene in speculative and experimental projects is a currently emerging phenomenon across disciplines.

Specifically, some designers and artists are working on inspiring, material-based, and non-human-centered projects, questioning the relation between the human and non-human actors as well as our responsibility, our potential role in the current global climate crisis and the Anthropocene. In design, one of the most convincing evidence is the DIY Materials (Rognoli et.al, 2021), where designers realize the material drafts and demonstrators can be
inspired, subsequently studied and further developed as critical reflection of the contemporary production. For this workshop there were some provocative material-centric projects chosen as examples, such as Xandra van der Eijk’s Contain, Corrode project which demonstrates the waterwork that can be one of the representatives of the power struggle between humans and nature over time (van der Eijk, 2017); The Unmaking studio’s soil communities which explore the nature-culture relationships by soil research (UnMaking Studio, 2018); and Kelly Jazvac’s engagement with specific ‘hybrid matters’ as Plastiglomerates and discussions on the post-anthropocentric scenarios (Jazvac, 2019).

These projects, starting with the inquiry on material and human, nowadays usually draw on design fiction, speculative fabulation, and speculative design (Dunne & Raby, 2013; Haraway, 2011; Bleecker, 2009). Since there is a global discourse aimed to engage with histories and futures of the Anthropocene epoch, it is interesting to develop new methodologies in design that allow for such experimentation by questioning how materials leave clues about designers’ envisioned social, political, economic and environmental futures. Designers are designing materials responsibly, considering the social impact material brings and a better future for the planet, landscapes, animals, resources, and humans. It is an emerging field in design scope. There still need more discussions as Forlano said, “as we adjust our fundamental understandings of human and non-human knowledge and ways of being in the world, it is likely that we will also develop corresponding design methods, frameworks, and practices that better address the challenges we face as a planet” (Forlano, 2019).

In this sense the post-humanist ideas of a de-centering human, designing-with the nonhuman seems like a way to think beyond the so-called anthropocene. As designers, especially when focusing on material based- and centered design approaches, the understanding of ourselves as an actor amongst actors is a way of thinking about the processes, the environment as the entangled sting figure Haraway describes, as a way to think and act beyond the human-centered boundaries.

3. A practical workshop to test a material-centric approach to design for the post-anthropocene

With the collection of evidence in the real world, materials in this context are seen as “actors” to define the relations and anticipate non-anthropocentric scenarios in near or far future. This led to an implementation of a practical workshop, as the main research activity, to experiment with the critical outcomes that might be produced by combining the material-centric design approach and the way of thinking and understanding the non-human actors indicated by Actor-Network Theory. The method to define the workshop’s approach includes two parts: 1) Using the Actor Network Theory to explain the idea of non-anthropocentric thinking in entangled networks as the knowledge input of the workshop; 2) Establishing the idea of a timeline as a tool to visualize and discuss the ideas of material, or non-human-actors in an evolutionary and time-based process rather than a static phenomenon.
3.1 Using the Actor-Network Theory as the workshop input

As Actor-Network Theory indicated, non-human things are actually "material actors" rather than passive "materials" that we used to consider and recognize by their physical properties. It is important to consider the world as a "Network of actors" with all biological and artificial matters to think and design in a material-centric approach. Thinking of matters as active and vibrant actants in a non-hierarchical network of various actors opens the possibility of new ways of futural design and speculation. Further material development as a (co)evolutionary process is emphasized, which enables the idea of the self-organized development of hybrid materials, based on an understanding of the material world and the investigation on the related passive or active relations among them. In this workshop, the material meanings and their positions and powers in the system should be studied more to demonstrate their impacts and entanglements.

Therefore, the workshop input started with storytelling on how we are stepping into the Anthropocene epoch, with some evidence showing the impact of human beings on the planet, whether positive or negative ones. To inspire the participants, also for a better understanding of this material-centric approach, the workshop organizers also collected many designers’ material innovative practices for the Anthropocene these days. Thanks to many material designers’ constant explorations, there are many speculative materials, which provide inspirations for dystopian glances of the future towards a new form of ethics and a possible aesthetics (Celi & Rognoli, 2018). These examples were being clustered into three categories, which are material mutations, symbiosis, and future resources/objects. This paper, hereby, presents one descriptive example for each strategy.

- Material mutations: How does the material change itself with external changes, and what kind of mutations will it have? Many designers explained this concern through their projects to connect design, art, ecology, and activism. The workshop used the idea of correlative interference of different actors to develop a narrative of evolutionary material development, co-evolutionary processes in the material world, and the rapid development of artificial matters, interfering in an eco- or geo-system fast mutations in the nonhuman world, living or non-living alike.

One example is the project Future Remnants, which is an installation inspired by the Anthropocene, created by Dutch designer Xandra van der Eijk. By pouring household chemicals onto widely available metal objects in an installation, this demonstration presents how chemical waste dumping could affect the earth. It reflects that the chemical waste should be properly disposed of rather than end up in the landscape (Figure 1);

- Symbiosis: In Dutch Design Week 2009, Austrian masters graduate Sonja Bäumel presents a body of work at Design Academy Eindhoven’s Graduation Galleries exhibition, exploring how bacteria on human skin could be harnessed to create clothing that reacts to the environment. (In)visible Membrane (Figure 2) is about life on the human
body and its design applications. It seeks to find a balance between individual identity and the surrounding local environment, exploring how the bacteria on human skin can be employed to make clothing that adapts to the environment. Bäumel wants to use the bacteria on the human skin to transform it into a visible, functional, and flexible membrane that could serve as a new type of clothing. This has the potential to change the way we adapt to the environment while also having potential health benefits. In her work, Bäumel confronts the viewer with the endo-and exosymbiotic relations of human and microbes.

- Future resources and objects: Design Academy Eindhoven graduate Shahar Livne has created a clay-like material using discarded plastic that could be mined by future civilizations (Figure 3). She aims to challenge the idea that petroleum-based plastics are damaging the planet by treating their waste as a valuable commodity for future generations. She speculates that plastic production will cease in the future. As a result, the discarded waste from the present era would be seen as a rare and natural resource, needing to be mined from deep underground.

The purpose of the introduction to Actor-Network Theory and strategic examples is to increase the workshop participants' thinking and understanding of the material actors they are interested in. To help participants better choose their individual material actors, a series of categories was generated. For this some general categories of global aspects were chosen, which are currently influencing the anthropocene era: Climate and weather, the biosphere - including all animals, plants and other lifeforms, the geosphere - bodies of water, mountains, cities; and the aspect of capitalism - including resource extraction, pollution and all other influences in an global and local scale driven by human monetary interests. These four “main categories” with their several smaller categories were chosen to lead the participants into general directions and speed up the individual decision. Breaking down the individually chosen global phenomenon down to their smaller parts was inspired by the “powers of ten” video by Charles and Ray Eames (Charles and Ray Eames, 1977), zooming in on the chosen actors. Every participant was allowed to stop the “zoom” at whatever step they wanted, starting their research from there while still being able to consider the other three big categories.
A material-centric approach in non-anthropocentric design

Figure 1. Future Remnants (van der Eijk, 2018).

Figure 2. (In)visible Membrane (Bäumel, 2009).

Figure 3. Metamorphism (Livne, 2018).
3.2. Historical contextualization and future speculations

The current discussion about the starting point of the Anthropocene was used for further discussions and inspiration for the workshop, to define a timeline for understanding the evolutionary processes of materials. As formerly mentioned, the idea of the Anthropocene as an official era is still not fully established, even though it is highly influential and inspiring for most scientific and artistic fields. Also, the starting point of it cannot precisely be pinpointed. There seem to be two major positions in that discussion, which Timothy Morton sums up quite briefly in "Hyperobjects" (Morton, 2013): 1). the Anthropocene starts with the beginning of traceable remains of the human species in the form of human artifacts and the remains of non-human species, which humans highly influenced; 2). the Anthropocene starts somewhere in the timeframe between the early beginnings of industrialization and the "Great Acceleration" (Steffen et al., 2015) in the 1950s where humankind started to change and pollute the environment on a global scale.

Every futuristic scenario, either utopian or dystopian, needs to be developed from the past and present state of the current situation (Voros, 2003). Leading that discussion in the context of the workshop could help to establish the interdependence of human and non-human and the idea of impactful historical events on the chosen actors. This requires defining a particle system and specifically the development of each material actor. Each actor has its own evolutionary paths, and they are effective with each other: like the example regarding the “Darwin Finches” collected by Charles Darwin on the Galapagos expedition 1905-06 (Grant & Grant, 2020). Each of the 18 Species of Finches on the isolated ecosystems in the different Islands developed different Beaks and morphology depending on the environmental influences and challenges (Figure 4).

Figure 4  Darwin’s finches, different evolution results (Gould, 1845).
Therefore, researching on the actors’ historical development and understanding the material evolutionary processes is the essential activity in the workshop, and the timeline is a feasible tool. With the timeline, some critical points which changed their actors' "material evolution" in the past could be highlighted and zoomed into details. To determine the most advanced scenario the participants can "mirror" their research on the timelines and research future studies, and develop speculative scenarios. Using the current year of the workshop as a middle axis, an event 50 years ago should have a counterpart 50 years in the future, and their earliest date could determine their final speculative scenario. It is a "reverse-archeological" process in which they need to fill in the gap between their "final" scenario and the current date to develop a plausible material narration in the form of texts, visualization, material samples, and other media of their choice.

To establish some directions how the scenarios could develop, three possible different futures were described, illustrated by the organizers (Figure 5), concerning possible post-human futures: In the first scenario, humankind’s cultural and technological advancements are limitless in a positivistic "star trek" like manner; a mediocre development, where humankind somehow stagnates in their current way with all consequences on the environment and resources; and a scenario where humankind sooner or later disappears. These human-centered scenarios were examples for the participants to develop their individual non-human scenarios and as orientation for what could happen to the human species in their scenarios, despite centering on different actors. This seemed to be necessary because the workshop was targeted to participants without any knowledge of actor network theory and a non-anthropocentric worldview “taking care” of possible “human” timelines helped some of the participants further on to construct their own timelines of non-human actors.
4. Results

The workshop lasted for three weeks, with one meeting per week for discussions and presentations of the participants' works. The participants are five design students from Offenbach University of Art and Design, with a background in Materialdesign. With its input, this workshop allowed participants to investigate and speculate the related issues of material actors and a way to construct connections among them. It focused on the evolutionary process of material systems to understand a current phenomenon, and furthermore, to anticipate a post-human future.

Following this three-week workshop syllabus, after the first lecture, the participants were asked to work on individual projects and define the material actors to be investigated. In the next few weeks, they need to improve their projects based on a clear description of the relationship among the material actors and their interactions. Some experiments were conducted during this process too.

The workshop had generated five projects from different future scenarios: the great acidification, the evolution of a piece of fallow land, how fungus co-exist in this world, a culture totally dependent on cyanobacteria, and an over-polluted future in which electronic waves are able to 'print' information. These projects presented the participants’ concern towards the post-human era. The relationships and connections between different actors were zoomed into details and presented a profound understanding of related stakeholders.

Project 49°59’37.6”N 8°17’37.6”E used a reverse archeology approach to demonstrate a future of the river sediments. The name is the coordinate of a piece of fallow land right where Main and Rhine merge. The coordinates indicate the position where a sample of soil will be extracted 250 years from now on (Figure 6). The sample shows sediments of the Anthropocene era, a period where humans have a huge impact on the earth’s ecosystem, such as rivers and water bodies. Generally speaking, rivers form valleys and mountains through erosion and transport all sediments to the sea. In the anthropocentric era, rivers collect not only natural sediments but also artificial particles. River systems collect things, transport them and feed them to species. Those systems are the basis of the existence of nearly every species on earth. This means everything and everyone is affected by strong artificial modifications which occur rapidly. Every organism depends on adaptability to cope with these changes.
A material-centric approach in non-anthropocentric design

The project the Great Acidification is based on a trend that the earth is gradually getting into an acidification era (Figure 7). In fact, we can find several hints from the past: In the 1950s, people already noticed that Anthropogenic acid deposition already began in Europe and North America due to the increased use of fossil fuels. Around the 1970s, with the problem getting serious, many ecosystems suffered: plants could not photosynthesize properly and many aquatic organisms reduced their growth. In the 21st century, thirty percent of carbon dioxide emissions has been absorbed by the oceans, slowly turning it more acidic. Based on this, the project considers that in the future 2100s the Ocean pH will drop from alkaline 8.1 to 7.6, and this will be fatal for most of the algae and crustaceans dependent on calcium to build shells today. To avoid this, they have to accelerate their evolution process for more capabilities of adoption. Different aspects have been discussed in this project, such as chemical erosion, species extinction, and sediment change. Also, the evolution of microbes could extend their protection to other ocean organisms.

The project Shrooms imagined a world exploited by human remains to the fungi: radioactively contaminated areas, industrial wastelands, heavy metals in the soil, plastic waste and soil sealing (Figure 8). Fungi are among the oldest and most diverse organisms. Heavy metals are also rendered harmless by being absorbed and stored by the fungal hyphae. They can decompose almost everything-- highly toxic pesticides, crude oil, diesel and other pollutants; even plastic products are de-graded with the help of various species of fungi. They are also masters of biosynthesis and can form a wide range of organic acids and enzymes. Therefore, they can transform almost everything biological material they find into something new. They are true survival artists that contain a billion years of experience.
Particular Matter presented an actor system with a small group of humans not directly interacting. It described an over-polluted future in which natural and artificial particles are mixed and shifted continuously by the completely unpredictable and extreme wind and weather conditions. The majority of the human population died due to the toxicity of the particle storms and resulting air pollution. The ones who found a way to survive are barely equipped and unable to reach out to fellow survivors. In 1887 the concept of electromagnetic waves was proven by Heinrich Hertz. Seven hundred years of progression brought precision and controllability to perfection. A lot of Steel Towers had been built all over the
world, to habitat AI servers and transmitting stations. Many of them lost their wired connections due to environmental destruction. But most are still able to send out signals, not knowing where to or what information, unfortunately. The prototype materialized the object may occur in this world (Figure 9). It can be a layer structure printed out by the particulars collected in the air. Its surface structure works similarly to a barcode. The captured information works like an IP address and gives the humans instructions on how to find the sending server station.

![Figure 9. Project [P]articular Matter by Lara Bohe, IMD.](image)

The project “CYANO” describes a world in which only two organisms, humans and cyanobacteria, co-exist (Figure 10). Set in the Year 900700, all natural resources have been used up by humankind. A kind of ozone layer has formed around the earth and causes an average temperature of 60°C on the earth’s surface. Fortunately, to protect themselves from this, future humans have built their own ecosystems. The shell stores and filters sunlight, which serves as a source of energy. Inside the capsules, there is a water cycle, filtered in a perpetual cycle, used for perfect environmental conditions for humans. Food consists of cyanobacteria and is administered intravenously and in the form of tablets, providing all the necessary ingredients. Inside, the environment consists entirely of cyanobacteria. The bacteria are printed, pressed, or cast as a building module and bricks. This form enables an easy way of building and serves to shape the world inside the capsule. The bricks produce the oxygen they need and reproduce by cell division. In this way, the building block experiences a transformation into an organic form. The entire world inside is designed by cyanobacteria and is constantly growing.
Figure 10. Project CYANO by Sophie Bernauer, IMD.

5. Discussion and conclusions

This workshop reflects on today’s social, political, and environmental emergencies that require specific efforts in terms of thinking and acting in design. Its results contained designers’ consciousness on different aspects we are facing, which verified that a material-centric design approach that starts from the investigation of material actors has its significance to switch our anthropocentric and conventional way of thinking to a non-anthropocentric one. Through the fact that it is one of the biggest driving factors behind global industrial production, the design discipline can tackle the negative aspects of the Anthropocene, such as global waste accumulation, climate change, and decreasing biodiversity. In such an era when designers are increasingly aware of their social and environmental responsibilities, designing materials can be a radical approach to decouple our economic activities from finite resources and avoid waste and pollution generation (Cleries et al., 2021).

In the workshop the participants were encouraged to execute a speculative, research and material driven Design process with no human actors in the center of attention. This gave the opportunity to think about the “non-human” part of the environment, even though the complete detachment from the human point of view is impossible, since we are humans after all. Implementing the ideas of and the co-constitutional entanglement between human and non-human actors emphasized by the Actor-Network Theory can help designers recognize their social and environmental responsibilities and reflect on humans’ actions from the non-human point of view. This non-anthropocentric, material-centered, and material-inspired design approach is a way to develop a conscious and cautious way of design in and with the system of actors we live in. This approach merges material design, speculative de-
design, and future research into this design approach to bring out more discussions and revolu-
tions. The workshop program can help educate designers to be aware of their responsibili-
ties to the Anthropocene and renegotiate the roles in the design and connected processes.

Besides, opening up to other fields of knowledge defines a new scientific claim and reframes
the design knowledge boundaries. According to this, the material is also understood as a cul-
tural task and takes on an active role in interdisciplinary exchange as an impulse and de-
signer of our environment. Thinking in terms of natural processes is more urgent than ever
in times of dwindling resources. In the future description of new material concepts lies an
important and central task for design — this also with the help of the described networks.
For material design and the workshop, it is also important to expand one's networks and to
enter into new "associations" in the sense of Latour (Latour, 1984).

Through the worldbuilding and storytelling of material-centered narratives combined with
active experimentation and scientific research it is possible to understand complex systems
and natural phenomena and understand the materials we use in design processes as active
components with individual historical “evolutions” that could be changed in future scenar-
ios.

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