Shaping Shared Worlds:

Autonomous Systems and the Design of Future Environments

A conference of the research project „Embodied Agents and the Quest for a Sustainable Technological Future“

Prof. Klaus Bengler (TUM School of Engineering and Design) & Dr. Yvonne Förster (Institute for Advanced Study, TUM)

Institute for Advanced Study (IAS), Technical University of Munich, Lichtenbergstraße 2 a, 85748 Garching, Room: Faculty Club

Subway U6, Garching Forschungszentrum, Exit Lichtenbergstraße

9–10 September 2026

Topic

The conference is organized by the research project *“Embodied Agents and the Quest for a Sustainable Technological Future”,* a cooperation of Klaus Bengler (TUM School of Engineering and Design) and Yvonne Förster, Philosopher in Residence at the Institute for Advanced Study (IAS), TUM.

As autonomous vehicles, social robots, and smart systems increasingly shape the environments in which we live, work, and interact, they call for new ways of thinking about design, responsibility, and coexistence. No longer mere tools, these technologies act within complex socio-technical ecologies—reconfiguring urban spaces, domestic life, and ecological relations.

This conference asks: how can we meaningfully anticipate and shape future forms of living together across human, technological, and ecological domains? Do we need to move beyond human-centered design toward more relational, systemic, or more-than-human approaches? We are particularly interested in the question of functional openness: Are devices that enable a plurality of uses beyond their originally intended function more desirable for sustainable and adaptable future life-worlds? Can technological multistability and design flexibility foster engagement, inclusion, participation, and support sustainable human-machine relations?

PROGRAMME

Day 1 — Wednesday, 9 September 2026

Time	Programme — Day 1 · Wednesday, 9 September 2026
10:00–10:30	Opening & Welcome — Prof. Klaus Bengler (TUM School of Engineering and Design) & Dr. Yvonne Förster (Philosopher in Residence, TUM-IAS)
Cluster 1 · Philosophical Foundations	
10:30–10:50	Walther Zimmerli *TUM-IAS; Humboldt-Universität zu Berlin* Post-, Trans- or Inhuman? Present Prolegomena to a Future Anthropology
10:50–11:10	Klaus Kornwachs *Humboldt Center for Humanities, University of Ulm; Office for Culture and Technology, Argenbühl* Truth and Embodiment in the Age of Intelligent Robots
11:10–11:25	*Joint discussion*
11:25–11:40	*Coffee Break*
Cluster 2 · Practice Perspectives	
11:40–12:00	Manuel Mesters *TU Munich* Reopening the Device: Obsolescence, Multistability, and the Limits of User-Centered Design
12:00–12:20	Gabriel Müller & Barend Visser *Moving Parts, Munich* Designing for Different Expectations
12:20–12:35	*Joint discussion*
12:35–13:00	*Informal exchange (transition to lunch)*
13:00–14:00	*Lunch Break*
Cluster 3 · Shared worlds	
14:00–14:20	Yvonne Förster *IAS, TU Munich* Shared environments: Questioning human-centered Design Approaches
14:20–14:40	Hendrik Poschmann & Stefania Centrone *TU Munich* Empathic Machines, Shared Worlds: A Phenomenological Framework for Embodied AI Beyond User-Centered Design
14:40–14:55	*Joint discussion*
14:55–15:10	*Coffee Break*
Cluster 4 · Global Perspectives on Socio-technical Systems	
15:10–15:30	Sarah Silveira *PUCPR, Brazil* Closed Worlds: Algorithmic Environments and the Conditions of Coexistence
15:30–15:50	Joseph Bahati Nonozi *Anansoft Foundation, Democratic Republic of the Congo* Beyond Rigid Infrastructures: Functional Openness and Community-Led Plastic Waste Systems for Urban Resilience in Bukavu, DRC

Time	Programme — Day 1 · Wednesday, 9 September 2026
15:50–16:25	Alexander Stingl *University of Galway, Ireland* Can Personhood Generate Multi-Stabilities for Biodigital Systems Across Western and Indigenous Cosmologies? Towards an Attitude of Decolonial Playfulness in Worlds with Non-Human Agentic Systems
16:25–16:45	*Joint Discussion and Wrap-up*
19:00	*Conference Dinner at a Bavarian Restaurant (expenses need to be covered individually)*

PROGRAMME

Day 2 — Thursday, 10 September 2026

Time	Programme — Day 2 · Thursday, 10 September 2026
10:00–10:10	Welcome Back & Framing for Day 2 (Organizers)
Cluster 5 · Understanding and Inclusion	
10:10–10:30	Max Ryynänen *Aalto University, Finland* 'Weak' AI
10:30–10:50	Yee Mun Lee *University of Leeds, UK* Who Decides What Technology Can Become? Disability, Neurodiversity, and Cross-Cultural Perspectives Beyond User-Centered Design
10:50–11:05	*Joint discussion*
11:05–11:30	*Coffee Break*
Cluster 6 · Integrating autonomous systems in shared spaces	
11:30–11:50	Cristina Olaverri Monreal *Intelligent Transport Systems, Johannes Kepler University Linz; IEEE Board of Directors* Integration of Autonomous Systems in Public Spaces
11:50–12:10	Jens Krzywinski, Kirsten Wolfrath & Christian Wölfel *TU Dresden* Design Research as Formative Instrument: Twofold Resource Consciousness in the Governance of Autonomous Environments
12:10–12:25	*Joint discussion*
12:25–12:45	*Informal Exchange / Networking*
12:45–13:45	*Lunch Break*
Cluster 7 · Becoming with Technology	
13:45–14:05	Susan Gottlöber *Maynooth University, Ireland* Functional Openness as an Anthropological Requirement: The Case Study of Cognitive Offloading and the Design of Multistable Embodied AI
14:05–14:35	Annette Diefenthaler · *TUM Munich, Design Institute* The Quest for a Society-Centered Future at TUM: New Frameworks Beyond Human-Centered Design
14:35-14:55	Klaus Bengler *TU Munich* Multistability as Design Paradigm
14:55–15:10	*Joint discussion*
15:10–16:00	Synthesis and Perspectives for Future Collaboration and Joint Publication

ABSTRACTS

Abstracts: Day 1 — Wednesday, 9 September 2026

Cluster 1 · Philosophical Foundations

Walther Zimmerli · ***Alumnus Philosopher in Residence, Institute for Advanced Study (IAS), TUM; Honorary Professor „Mind and Technology“, Humboldt-Universität zu Berlin, Philosophy***

Post-, Trans- or Inhuman? Present Prolegomena to a Future Anthropology

Full abstract to follow.

Klaus Kornwachs · ***Honorary Professor Humboldt Center for Humanities, University of Ulm; Office for Culture and Technology, Argenbühl, Germany, Physics***

Truth and Embodiment in the Age of Intelligent Robots

Full abstract to follow.

Cluster 2 · Practice Perspectives

Manuel Mesters TU Munich, Systems Engineering

Reopening the Device: Obsolescence, Multistability, and the Limits of User-Centered Design

As autonomous vehicles, social robots, and smart systems reshape our environments, a quieter case deserves attention: the everyday computer. A technically sound laptop is increasingly declared obsolete not because it fails, but because automated decisions embedded in its software — over updates and eligible hardware — narrow what it is allowed to do. The same device that could serve as office tool, development platform, or research instrument is reduced to a single, expiring line of use.

We read this through the idea of multistability: a device sustains many possible uses, and design actively opens or closes that range. Planned obsolescence is closure; open, transparent configuration is reopening.

Crucially, a computer is not a bounded object but a node in a shared infrastructure; what it may become is decided largely beyond the individual user. User-centered design, indispensable at the level of interaction, does not reach this larger scale. Reopening depends instead on the surrounding relations — open standards, shared configuration, and users who become co-designers rather than consumers.

Drawing on one institutional initiative that returns obsolete machines to service as open research workstations, we argue that designed openness, more than user-centeredness, is what sustains adaptable, sustainable, and self-determined relations between people and their machines.

Gabriel Müller & Barend Visser · *Moving Parts, Munich*

Designing for Different Expectations

Why can the same autonomous system be perceived as a helpful assistant in one environment and as an obstacle, a toy, or even a source of uncertainty in another? Informed by the design of a large-scale infrastructure project and observations of autonomous systems in public spaces, this talk looks at how physical and social context shapes what people expect from a system, and what happens when a system's behavior fails to meet that expectation. It reflects on what this means in practice: how autonomous systems should be designed, prototyped, and evaluated before they become part of everyday human environments.

Cluster 3 · Shared worlds

Yvonne Förster · *IAS, TU Munich, School of Design and Engineering, Philosophy*

Shared environments: Questioning human-centered Design Approaches

One of the biggest learning points in our project is the extend to which current and future technologies shape environments in a fundamental sense. This represents a challenge and a chance at the same time. Imagine a care institution where humanoid robots take over a number of tasks that are tiresome for humas like lifting up patients or delivering objects. Especially the first task is very complicated to realize by humanoid robots. But the argument for humanoids instead of other forms of robots is that they fit better into the already established environment like a care institution than devices that for example cannot master stairs or whose outlook might scare patients. So the complicated form of humanoid robots is envisaged to fit in rather than actively require a redesign of the space. This presentations will draw together examples from our work and elaborate from case to case whether fitting vs. new requirements is the adequate question and where we might want to rephrase this altogether and broaden the horizon of design thinking and the scope of technology.

Hendrik Poschmann & Stefania Centrone · Hochschule Niederrhein, *TU Munich, Philosophy, Automation and Robotics*

Empathic Machines, Shared Worlds: A Phenomenological Framework for Embodied AI Beyond User-Centered Design

As autonomous systems increasingly participate in the constitution of shared environments, the question is no longer only how humans use technology, but how technologically embodied agents may become meaningful participants within socio-technical and ecological life-worlds. This contribution develops a phenomenological framework for embodied AI that moves beyond user-centered design by drawing on Edmund Husserl's concepts of intersubjectivity and lifeworld constitution. Building on the idea of a synthetic ontology of machines, I argue that sustainable and adaptable human-machine relations require systems that do not merely optimize predefined functions, but remain open to context-sensitive interpretation, relational situatedness, and multiple meaningful modes of use. In this sense, functional openness can be understood not simply as technical flexibility, but as a condition for participation in shared worlds. The contribution outlines how such a framework may inform the design of embodied autonomous systems and sketches a possible path toward technical operationalization in robotic demonstrators. By linking phenomenology, machine epistemology, and design theory, the contribution proposes a relational account of autonomous systems founded in solid robotics research.

Cluster 4 · Global Perspectives on Socio-technical Systems

Sarah Silveira · PUCPR - Pontifícia Universidade Católica do Paraná, *Brazil, Philosophy*

Closed Worlds: Algorithmic Environments and the Conditions of Coexistence

An observable tendency in the design of autonomous and algorithmic systems is to anticipate preferences, curate experience, and minimize friction — that is, to reduce functional openness. Against this backdrop, this contribution aims to examine the philosophical costs of this design tendency for the constitution of shared worlds. Guided by Bernard Stiegler's insight that technics is not external to the subject but constitutive of it, and informed by the phenomenological tradition, this work argues that algorithmically mediated environments — including generative AI systems, which tend to produce the statistically expected rather than the unfamiliar — do not merely reshape social arrangements: they reorganize the very conditions, reflexive and relational, through which subjects are constituted. When technical systems systematically narrow the encounter with alterity, with what is unexpected or simply other, they tend to produce something that might be described as a self-referential subjectivity: modes of experience in which repetition replaces encounter, and openness to difference gradually erodes.

If shared worlds — and the engagement, inclusion, and participation they require — depend on subjects capable of genuine encounter with otherness, then the design of autonomous systems raises a prior philosophical question: what conditions of subjectivity must be preserved for meaningful coexistence to remain possible? And what are the cognitive costs of environments designed to confirm rather than to challenge?

Joseph Bahati Nonozi · *Anansoft Foundation, Democratic Republic of the Congo, Sustainability*

Beyond Rigid Infrastructures: Functional Openness and Community-Led Plastic Waste Systems for Urban Resilience in Bukavu, DRC

In rapidly expanding urban centers under infrastructural constraints, rigid, centralized technological models often fail to capture complex local realities. This paper explores the concepts of "functional openness" and technological multistability through the innovative environmental initiatives led by the Anansoft Foundation in Bukavu, Democratic Republic of the Congo. Specifically, we analyze the community-driven socio-technical system established for plastic and organic waste management, highlighted by the "plastic bottles for food" incentive campaigns. Moving beyond Western-centric, automated smart-city designs, this study investigates how community networks reconfigure basic logistical and monitoring tools to build decentralized ecological resilience. By examining the integration of environmental data, public health challenges, and socio-economic co-benefits, we demonstrate how flexibility in design and practice prevents technological failure and fosters inclusive public participation. Ultimately, this contribution responds directly to the quest for sustainable technological futures by arguing that autonomous and technical systems must embrace a "more-than-human" relational framework — one that prioritizes open, adaptable, and community-embedded mechanisms to allow vulnerable urban ecologies to co-evolve and thrive.

Alexander Stingl · *University of Galway, Ireland, Sociology*

Can Personhood Generate Multi-Stabilities for Biodigital Systems Across Western and Indigenous Cosmologies? Towards an Attitude of Decolonial Playfulness in Worlds with Non-Human Agentic Systems

Where "bio-" meets "digital-", new technoscientific objects and, more importantly, agents or agentic systems emerge. How to address these in terms of ethics, governance, and jurisprudence — bioagents, digital agents, let alone biodigital agents (or agentic systems) — remains a disputed, ill-understood and, to a degree (i.e. with regard to complex AI agentic systems or to biodigital agentic systems), under-researched question.

Following a practical example from rare earth mining, in this address, I will aim to do three things: First, I will address and explicate what is actually at heart of the matter in the above paragraph, aka what does all this stuff

actually mean. Second, I will point to a "solution" frequently proposed for the ethical, regulatory, and legal dilemmas of how to deal with agents and agentic systems that are non-human, which is the bestowal of "personhood" to these agents, and I will do so by showing that the concept of personhood is introduced to fulfil a function of serving as multi- or meta-stability (as described in post-phenomenology and narrative phenomenology). Thirdly, I will discuss whether that function can be inherently upheld only with regard to Western cosmology, and if it breaks down once non-human agentic systems interact in environments with non-Western, indigenous cosmologies.

I will conclude with sketching that a more effective proposal would need to take delinking/decoloniality and playfulness seriously.

ABSTRACTS

Day 2 — Thursday, 10 September 2026

Cluster 5 · Understanding and Inclusion

Max Ryynänen · ***Aalto University, Finland, Visual Culture***

'Weak' AI

Grandmother sends a WhatsApp photo from Norway, with a fjord and snow-capped mountains. It is beautiful, and, for sure, granny, a bad photographer, is not capable of consciously sentimentalizing anything, but after thousands of cheesy representations of visually breathtaking sceneries with mountains, I cannot but help that an experience of kitsch creeps in.

"It's AI," my daughter says, and takes the issue further. A couple of times someone has already commented on a badly designed house or some other awkward scenery that it looks like AI.

It is not just that our real world gazing carries marks of the photos and films we have seen. It now carries also the mark of the possibility of an AI intervention. Robotics is, for sure, soon following, making us ask if we met an organic agent or not.

While paintings, photos and film have for long manipulated us — actors and illusionists too — our new companion tech brings with itself a constant urge to ask what is real, in a totally new way. While this creates for some a Cartesian desire to keep looking 'beyond the appearances,' many do not care. For some, images become just images — 'weak,' and thoroughly interpreted, interpretation now in the center, like Gianni Vattimo could have said if he still lived on.

While we end up 'reading' images more than in the past, aspiring to not become betrayed, the constant echo of this practice in the 'real world' becomes commonplace too — like in the example in the beginning. Could this new situation make us in the end focus on just visuals (without depicted 'content') — or could the allure of images fall totally, when they can always be just signifiers without a signified? Whatever, the game of interpretation we are forced to take up has a central role in these changing times. And it might be that only the acceptance of a greater role of visual hermeneutics can save us from despair. We all need to work out an aesthetically and existentially satisfying relationship to the situation, which has challenged us. How could visual hermeneutics help us?

Yee Mun Lee · ***University of Leeds, UK, Transport Studies***

Who Decides What Technology Can Become? Disability, Neurodiversity, and Cross-Cultural Perspectives Beyond User-Centred Design

Full abstract to follow.

Cluster 6 · Integrating autonomous systems in shared spaces

Cristina Olaverri Monreal · ***Intelligent Transport Systems, Johannes Kepler University Linz; IEEE Board of Directors, IEEE Division IX Director***

Integration of Autonomous Systems in Public Spaces

Full abstract to follow.

Jens Krzywinski, Kirsten Wolfrath & Christian Wölfel · ***TU Dresden, Industrial Design Engineering***

Design Research as Formative Instrument: Twofold Resource Consciousness in the Governance of Autonomous Environments

Autonomous systems are usually discussed as technical objects: how safe, how performant, how explainable. From a design research perspective, they are also relational configurations: they reorder who acts with whom, under what conditions, and in which places. They never land in the abstract, but in specific contexts, with specific constellations of academic, industrial, and civic partners. This contribution argues that design research enters the governance of systems not as translation of decisions already taken, but as translation toward decisions still in the making: an instrument of strategic-exploratory steering. Where ex-ante regulation reaches a structural limit under high technical and social complexity, design research opens place-bound spaces where consequences become foreseeable, negotiable, and provisionally testable. It does so under twofold resource consciousness: of the artefact through which negotiation takes place, and of the product-system being negotiated. Calibrating a prototype (its detail, interactivity, fidelity, what it foregrounds and what it withholds) is itself a steering decision; it conditions what can be negotiated, by whom, how soon. Calibrated this way, friction is resource consciousness made operational, not a defect. It bears directly on sufficiency, the sustainability dimension that depends on negotiation rather than specification. Grounded in work on Human-Robot Skill Transfer, TRL-bound demonstrators, and boundary object prototyping, the argument reframes design research as infrastructuring rather than the delivery of finished artefacts.

Cluster 7 · Becoming with technology

Susan Gottlöber · ***Maynooth University, Ireland, Philosophy***

Functional Openness as an Anthropological Requirement: The Case Study of Cognitive Offloading and the Design of Multistable Embodied AI

This paper develops the claim that functional openness, i.e., the capacity of a device or technology to sustain a plurality of uses beyond its originally intended function, should be seen not merely a pragmatic design preference but a philosophical-anthropological requirement for embodied AI which has ethical implications.

I will begin my argument from the basic anthropological commitment that persons are not self-enclosed subjects but are constituted through situated engagement with the real and ideal factors of their social, cultural, and material environments. What we are able to notice, value, know, and even think about is shaped, enabled, narrowed, and directed by the tools, institutions, and practices into which we are woven. Embodied AI is rapidly becoming one of the most pervasive of these real factors in contemporary life-worlds. Its design choices therefore carry anthropological weight as they help determine the very conditions under which human beings can not only shape their own personhood but also come to understand themselves, relate to others, and inhabit a shared world.

I will develop this argument through the case study of cognitive offloading in AI-mediated learning. Recent empirical and conceptual research distinguishes two modes of offloading. On the one hand, AI can serve as a scaffold, i.e., temporary, adaptable, strengthening internal human capacities. On the other hand, AI can act as a substitute, where the technology permanently assumes the very cognitive and evaluative acts through which persons form their intellect and the ability for abstract thinking. The substitution mode has been shown to generate an "illusion of competence", metacognitive laziness, and an erosion of introspection. What first appears as a question of pedagogical efficiency becomes, in fact, a question about the conditions of personhood, as closed, mono-stable designs risk foreclosing the learner's capacity to resist, re-purpose, and re-appropriate the tool. In this way, the technology can reorder what the learner notices, values, thinks, and trusts in. The effects are observable not only at the level of skill but at the level of the person's capacity to have the potential to develop future skills and for autonomous, critical, and empathetic engagement with the world.

From this case I draw three broader implications: (i) multistability can actively support the open-ended becoming of persons in relation to their lifeworlds; (ii) the anthropological and thus also ethical evaluation of embodied AI agents should turn on whether they keep attention, desire, and epistemic trust responsive to users' situated lives rather than captured by a single intended function; (iii) sustainable and inclusive human–machine–ecological relations depend on preserving exactly this kind of openness, not only in individual artefacts but in the socio-technical ecologies they compose.

Annette Diefenthaler · ***TUM Munich, Design Institute***

The Quest for a Society-Centered Future at TUM: New Frameworks Beyond Human-Centered Design

In technology design, common conversations revolve around designing for adoption and acceptance, as if humans had to be convinced to get used to the technological changes around them, rather than technology adapting in response to human or societal needs. The disconnect is a methodological problem: Designers and engineers struggle to understand the viable opportunities but also limitations of technology and often overestimate the prowess of artificial intelligence, leading to unrealistic ideas. In a world where technology is no longer only serving as a tool that can be programmed to fulfill predefined tasks but rather is emerging as a system that learns and develops its own intelligence alongside humans, methods that prescribe a rather linear process of developing solutions will no longer be enough.

Designers are meeting this moment by reinventing their own discipline with creativity and experimentation, and many promising methodological directions are underway. The Munich Design Institute will serve as a platform to test and evolve such approaches in direct collaboration with researchers and scientists. This will not only change design — it will also flip the script for technology development. The collaboration between designers and technology researchers will create space to work in an iterative and cyclical manner rather than linearly and allow room for uncertainty — because it is precisely at this intersection that creativity and society-centered innovations emerge. The conference contribution will illustrate this using the example of the development of care robots.

Klaus Bengler · ***TU Munich***

Multistability as design paradigm

Full abstract to follow.