Real-World Lab

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Definition

In the pursuit of accelerating and extending sustainability transformations, an experimental turn has occurred in sustainability research since the 2000s. Around the globe, more and more transdisciplinary laboratories and workshops like *living labs*, *transition labs*, etc. are established in real-world contexts, which foregrounds experimentation for more sustainability (McCrory et al. 2022; Turnheim et al. 2018). However, in Germany, a specific form of transdisciplinary experimental lab was developed during this time: real-world labs (German: *Reallabor*). These models are elaborate and impactful in terms of promoting change in everyday settings, with a focus on transdisciplinary and transformative sustainability research at the intersection of science and society at large. Against the background of increasingly pressing sustainability challenges and a necessary change in science (Schneidewind and Singer-Brodowski 2014; WBGU 2011), the concept of real-world labs found its way into academic research discourse and practice in the early 2010s (Parodi 2011; Schneidewind and Scheck 2013). Real-world labs are places and incubators to develop and research sustainability solutions, or, in a nutshell, to experiment and examine desirable societal futures by scientific means.

Real-world labs can be set to explore a wide range of issues. This can be, for example, regenerative energy supply, socially responsible environmental protection, sustainable consumption, climate protection, or even the sustainable development of a city district. Many examples can be found on the real-world lab network website (2023). The crucial common aspects in how real-world labs are realized is that researchers and problem-owners enter into dialogue, share goals, and collaborate in practice. Researchers and (other) societal actors proceed transdisciplinarily and cooperatively, learn from each other, reflexively minimize risks, and jointly initiate and shape contributions to sustainable development (Bergmann et al. 2021).

In terms of content and concept, the recent term *real-world lab* still remains open to interpretation. Its definition is the subject of scientific and political debate (Schäpke et al. 2018) and does not meet with consensus. However, a widely

shared sense of what real-world labs are has emerged in theoretical, conceptual, and practical discourse: a real-world lab describes a transdisciplinary research and development facility and setting that serves to conduct experiments in a spatially delimited societal context, initiate sustainable transformation processes, and support scientific and societal learning processes respectively (Parodi et al. 2017, 80). Although definitions may vary, these aspects are reflected in them (see de Flander et al. 2014). Based on this understanding of real-world labs, a set of nine constitutive core characteristics can be identified (Parodi et al. 2016):

1. *Research orientation*: Real-world labs are research undertakings aimed at generating knowledge, specifically transformative knowledge.
2. *Design and transformativity*: Real-world labs contribute directly to societal change and sustainability transformation. They provide concrete contributions to sustainable development in practice.
3. *Normativity and sustainability*: Real-world labs are normative undertakings; they follow the guiding principle of sustainable development and make their normative starting points transparent.
4. *Transdisciplinarity and participation*: The predominant scientific mode in real-world labs is transdisciplinarity. From a social perspective, participation and co-design are central elements of real-world lab work.
5. *Civil society orientation*: In addition to other non-academic actors (such as local government, companies, schools), civil society actors and inhabitants in particular are also involved.
6. *Model character*: Real-world labs are place-specific and context-bound, but strive for transferability of results and solutions to other contexts, spaces, or scales.
7. *Long-term*: Real-world labs should be set up for as long as possible (ideally a minimum of five years, but potentially several decades), in order to be able to accompany transformation processes both scientifically and in everyday practices and to evaluate them ex post.
8. *Laboratory character and experimental space*: Real-world labs are for experimenting and provide specific (social) spaces, possibilities, and opportunities for joint experimentation.
9. *Education*: Real-world labs are highly condensed reflexive and learning spaces and as such at least implicit educational institutions. If possible, they should integrate educational aspects into their activities.

Ideally, one would only speak of a *real-world lab* when all these characteristics are present. Beyond that, real-world labs are closely related to other kinds of co-creative labs – such as *living labs*, *transition labs*, or *green urban labs* (Aßmann et al. 2017; JPI Urban Europe 2023). The explanation of the term and the list of constitutive core characteristics can also be used to distinguish real-world labs from related concepts

and labs. For instance, living labs are similar to real-world labs regarding characteristics 1, 2, 4, 6 and 8 but not necessarily to the characteristics of 3, 5, 7, and 9.

Etymologically, the term also refers to the decades older term *real-world experiment* and the related notion of "society as laboratory" (German: *Gesellschaft als Labor*) (Krohn and Weyer 1989, own translation). It draws upon the critical discourse on the risks of technically advanced societies and the (inadequately perceived) role of science in the 1980s but turns it into a constructive approach.

Background

The development of real-world labs as hybrid entities at the intersection of research and society ties in with different, partly convergent schools, concepts, and currents in science and society (Parodi et al. 2017). It is the combination of these that bestows on real-world labs their novelty and originality. The central problem background is the increasingly destructive side effects of modern lifestyles and economies, endangering the continued existence of humanity. The concern for a good, humane life for all in the future and the corresponding efforts towards sustainable development (Dixson-Declève et al. 2022; Schultz et al. 2008) is the main motivational and innovation driver for real-world labs. Historically, the idea and first implementations of real-world labs originate from transformative sustainability research (Schneidewind and Singer-Brodowski 2014; Wiek and Lang 2016).

The urgency of societal crises, such as climate change and its effects on ecosystems, habitats, and societies, also makes clear the need for action in sustainability research and calls on the research community to move from knowledge to action. Thus, real-world labs can be seen as a contemporary practical and applied form of sustainability research. With the transformative approach of real-world labs, transdisciplinary research has been expanded to the effect that the goal is no longer only to gain knowledge – the production of *knowledge* for sustainable development – but also to develop practical impulses: contributions to sustainable development in the course of the research. These take place in the form of (transdisciplinary) experiments. Real-world labs are both a specific case of applying transdisciplinary research *and* its further development. With their direct design mission, real-world labs leave the sphere of conventional academic research and become a force to change and reshape societies. They are at the same time knowledge producers as well as practical actors outside the academic context and in this respect *trans-scientific*. This ambivalence does not imply that they are non-scientific. However, they do *not only* proceed scientifically – which in turn gives rise to specific potentials, but also to challenges.

Thus, real-world labs operate also in the tradition of those forces of inter- and transdisciplinarity that try to broaden, renew, and reform research and science

(Bergmann et al. 2021). In general, their aim is to bring the cognitive processes of research closer to the issue at hand in order to be able to grasp and describe them more accurately. In the case of real-world labs, the issue is the transformation of an unsustainable society into a sustainable way of life and economy. Real-world lab research – and also teaching – approaches these transformation processes from an inside perspective. Real-world lab researchers are part of the change and gain their knowledge from an active and participating perspective. Real-world labs and the idea of the "Great Transformation" (Polanyi 2001) introduced into scientific and political debates, develop in parallel and relate to each other (WBGU 2011, 2016). As "institutions of change" (Parodi 2019, 8, own translation), real-world labs are intended to support, research, and accelerate the transformation of settlements in particular (WBGU 2016).

Alongside sustainable development, transdisciplinarity, and transformative research, the democratization of science forms another ideal root of the real-world labs. Against the background of a democratic society, in real-world labs the knowledge-producing process of research is more closely linked to the legitimized subject of knowledge: the population, the citizens, and the diversity of social actors. Thus, participation, the involvement and co-determination of many actors – if possible from the beginning – is an essential part of real-world lab work (Parodi et al. 2018). As many levels of participation as possible, from information to consultation, cooperation, and empowerment are to be realized (Meyer-Soylu et al. 2016; Parodi et al. 2018). Science communication and bidirectional knowledge transfer play a central role in the work of the real-world labs: not only research should be communicated to different actors in popularized or non-technical jargon. Similarly, impulses from non-academic actors should be equally incorporated into the real-world lab activities in order to generate scientific and societal resonance and effectiveness (Steglich et al. 2020). Furthermore, a democratization of research takes place directly through an (equal) participation of non-academic actors in the entire transdisciplinary process: from agenda setting to co-design and co-production to the utilization of the results.

The orientation on civil society also expresses the democratization of science. Extensive and far-reaching cooperation between science and private sector actors, especially in technology and product development, is widespread. The inclusion of citizens, (local) government, and civil society groups (including nongovernmental organizations) in real-world lab work broadens the social base of people participating in science. In this process, civil society grows into a new role that is crucial for transformation: through the direct participation in knowledge production made possible by real-world labs, civil society is recognized as a full partner in research.

Historically, both the term and the first real-world labs launched originated in transformative sustainability research: Schneidewind and Scheck (2013) introduce the term in the context of a transformative science, which not only conducts

research on transformation processes but also actively supports them. Real-world labs have developed into a research format in their own right that methodically condenses and practically concretizes transformative sustainability research. From the very beginning, real world labs – directly linked to urban development, urban research, and urban transformation – were conceived as a framework for societal research, transformation, and learning processes (de Flander et al. 2014). Already at the beginning of the real-world lab discourse, the above characteristics 1, 2, 3, 4, 8 are programmatically linked to the real-world lab concept. Almost at the same time, first proto-real-world labs emerged apart from the conceptual debate, such as the *District Future – Urban Lab* (2023; and see Parodi 2011), whose objective is the sustainable transformation of an existing urban district in Karlsruhe by means of a long-running transdisciplinary and participatory process (Parodi et al. 2018). To date, the establishment and spread of the term and concept have been accompanied by a semantic diversification and partial reinterpretation of the term.

Debate and criticism

Are real-world labs really new? The concept, discourse, and practice of real-world labs are undoubtedly new, especially in the context of academic research. However, real-world labs build upon many strands of discourse and practice, some of them decades old, combine them, and develop them further (JPI Urban Europe 2023). Since real-world labs are essentially about the concretization, operationalization, and ideally institutionalization of transdisciplinary sustainability research, the debates about real-world labs focus predominantly on aspects of transdisciplinarity and transformative research. Some of the real-world lab characteristics are controversial, such as the question of whether and how real-world labs are to be aligned with the guiding principle of sustainable development (for a critical appraisal, see Defila and Di Giulio 2018).

The term combines and merges *reality* and *laboratory* and thus points to a immanent epistemic tension between, on the one hand, the highly controlled environment of a laboratory, with which the attempt is made to create a stringent framework for the production of knowledge out of delimited experiments, and, on the other hand, the non-academic everyday practices full of complexity and contingency. In order to achieve impact, real-world labs must be based in everyday life settings and are therefore context-bound. This in turn makes it difficult for them to generate transferable knowledge. In this respect, real-world labs often run the risk of merely producing case studies while comparative analysis between them still needs to be done, bar a few rare occasions.

The role of the participating researchers in real-world labs is sharpened by the dual objective and strong proximity of research and design. Thus, in addition to

being the "honest broker" and "issue advocate" (Grunwald 2019, 170–76), the academic researcher is potentially also present in the role of designer, mediator, and process organizer. Hence, in addition to (individual) conflicts between roles and interests, the researcher involved may be overtaxed. However, some of these role conflicts are due to the hitherto unbalanced sponsorship of real-world labs.

Ideally, the flow of funds and sponsorship corresponds to the types of real-world lab activities. Hence, real-world labs should be supported and financed by research funding *and* other areas of society, but in reality, they have so far mainly been financed by the research funding system (in contrast to other labs internationally financed from a diverse range of funders; see Bylund et al. 2022). This distortion of funding and sponsorship hinders the development of transformative potential and discredits real-world labs as research ventures. Thus, it is not the task of academic research to shape society directly or to pursue societal transformation. A real-world lab financed exclusively by research funding misuses research resources for design purposes. On an individual level, the scientific sponsorship of real-world labs leads to conflicts and double burdens, as researchers have to manage research as well as design (processes). The necessary, often costly non-scientific activities such as the conception, initiation, and support of transformation processes, event organization, communication, etc. are rarely rewarded in the academic research system.

A major potential of real-world labs is to institutionalize them as actors of change (Karvonen 2018; WBGU 2016). Real-world labs, which – similar to engineering or natural science laboratories – would be established for 30, 50, or 100 years, would be a true innovation in the science system and would entail new framework conditions and unprecedented possibilities for transdisciplinary and transformative research. Transformation processes could be stimulated, accompanied, and researched over the long term, and evaluated ex post. So far, with few exceptions, real-world labs have been designed as research projects with durations and funding periods of about three years. However, far-reaching social and cultural transformation processes do not take place within a few years, but take decades. In addition, setting up a real-world lab can take a great deal of time and money: exploring the social context, identifying relevant actors, building trust and networks, acquiring real-world lab skills and premises, synchronizing research, practice, and teaching. The multifaceted and intense set-up work in a project lasting only a few years becomes disproportionate to the actual experimental work and its evaluation.

Current research questions for the further development of real-world labs are "What impact do real-world labs really have?", "How can we scale them up?", and "How can real-world labs contribute to a to sustainable technology transformation in a reflexive and responsible manner?" (Parodi et al. 2022).

Current forms of implementation in higher education

Real-world labs aim to implement and perpetuate scientific and social learning (Singer-Brodowski et al. 2018), and are thus didactic undertakings per se. Through the coupling of research, teaching, and practice, as well as the involvement of many often very different kinds of actors (Parodi et al. 2018; Steglich et al. 2020), real-world labs form rich learning environments and are, at least implicitly, educational institutions (Beecroft 2018). Education can occur at all scales: from individuals to groups, organizations, and society at large. Dialogue, resonance, and reflexivity are central aspects of learning. As a framework for transdisciplinary and transformative research, they enable precisely those didactic aspects of transdisciplinary and transformative research.

The forms of didactic implementation in the real-world lab are as diverse as the constellations of topics and actors within the lab or its social and spatial contexts. They range from self- and group experiments, conventional or transformative seminars incorporating student projects, service learning, lecture series, training courses, practical or scenario workshops, to self-experience of personal sustainability (Parodi and Tamm 2018) or serious gaming forms such as planning or learning games in which the actors involved swap roles (Beecroft 2018). In addition to the obvious and often established connection with university teaching (see Beecroft 2018; Steglich et al. 2020), real-world lab educational activities are also finding their way into primary, secondary, and vocational schools. An established link between real-world lab research and university teaching can be found for example at Leuphana University Lüneburg, ETH Zurich, TU Berlin, and the Karlsruhe Institute of Technology, where lab activities are integrated in the accompanying studies in sustainable development as transdisciplinary student projects. Related labs are also being directly integrated into higher education outside Europe, such as Cité-ID in Montreal, Canada. As real-world labs are showing signs of transformative potential and impact, other universities are currently expanding their offerings related to this approach.

Overall, real-world labs, in their pursuit of sustainability and with their core characteristics, offer a universal and flexible framework that can be applied around the world. However, they only work if they are adapted to and integrated in the local social and cultural context.

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