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Institutionalisation of Transdisciplinarity in Research Organisations – A Review of Key Dimensions

DIT Working Paper 2, 2024

Rachel Williams, Julia M. Wittmayer, Niko Schäpke, Mark Lawrence, Derk Loorbach

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Suggested citation

Williams, R., Wittmayer, J.M., Schäpke, N., Lawrence, M., Loorbach, D. (2024) Institutionalisation of Transdisciplinarity in Research Organisations – A Review of Key Dimensions. DIT Working Paper #2. Rotterdam, Design Impact Transition Platform, Erasmus University Rotterdam.

Contact

Rachel Williams williams@eur.nl
Julia Wittmayer wittmayer@drift.eur.nl

Institutionalisation of Transdisciplinarity in Research Organisations – A Review of Key Dimensions

Authors: Rachel Williams [1], Julia M. Wittmayer [1,2,3], Niko Schäpke [4,5], Mark Lawrence [5], Derk Loorbach [1,2]

[1] Design Impact Transition Platform, Erasmus University Rotterdam, The Netherlands
[2] DRIFT, Erasmus University Rotterdam, The Netherlands
[3] Erasmus School of Social and Behavioural Sciences, Erasmus University Rotterdam, The Netherlands
[4] Institute of Environmental Social Sciences and Geography, University of Freiburg, Germany
[5] Research Institute for Sustainability, Helmholtz Centre Potsdam, Germany

Abstract

Transdisciplinary academic work, which involves co-developing knowledge with practice to tackle pressing societal and ecological issues, is increasingly advocated by policymakers, academics, funders, and research organisations. This approach not only enhances the understanding of these problems but also aids in devising practical solutions. However, implementing transdisciplinary work within research organisations including universities, traditionally organised around disciplines and academic outputs, poses significant challenges. This paper addresses the enabling and hindering factors for transdisciplinary work within such organisations. Through a comprehensive literature review, we identify nine key dimensions that influence the institutionalization of transdisciplinary work. Dimensions included are: Organisational values, Organisational structure, Inter-organisational collaboration, Leadership, Training, Teaching & Curriculum, Financing, Reward structures and Institutional culture. These dimensions serve as a starting point for thinking more strategically about such institutionalisation. The concluding discussion evaluates the current state of the field, the limitations of the literature review, and suggests future research directions. It also underscores the collective challenge of fostering changes to support transdisciplinary work before it closes with highlighting six emerging institutional changes necessary for progress.

Keywords

Transdisciplinary work, institutionalisation, organisational structures, organisational values, leadership, funding, reward structures, training, teaching and curriculum, research organisations, transdisciplinary research, sustainability transformation, transformation research, transformative research

1. Challenges to the institutionalised ways of producing knowledge

There is a widespread consensus that urgent and concerted action is needed to address the pressing societal and ecological problems that societies around the world are facing (Folke et al., 2021; UNDP 2023; Richardson et al., 2023). Many of these problems are inherent to the structure of modern society and a fossil-based, linear and extractive economic model. Continuing to produce (increasingly specialised) knowledge about this model and how to improve it is inadequate for addressing the problems faced. In some cases, it even contributes to stagnation by supporting the status quo. Transdisciplinary work, the act of co-developing knowledge in and with practice, is said to not only increase our understanding of the persistent problems but also to support the development of workable solutions (Norström et al., 2020; Lang et al., 2012).

There are increasing calls for transdisciplinary work, and research organisations such as universities are not standing still: they have adapted their missions and formulated multi-year strategies putting themselves to work on societal impact (Kump et al., 2023; Reed and Fazey, 2021), or on co-creating for sustainability (Trencher et al., 2014). We also see new academic associations and networks (e.g. Global Alliance for inter- and transdisciplinarity[1] or GPTF - German society for participative and transdisciplinary research[2], as well as university centres (e.g. Kassel Institute for Sustainability[3], Sustainability Innovation Campus Freiburg and Karlsruhe[4], the University of Aukland[5]) dedicated to addressing societal problems through transdisciplinary collaboration being founded. However, in an academic environment in which academic outputs and publications or high scores on university rankings are being prioritised (Freese et al., 2022), transdisciplinary ways of working are to a large degree niche practices (Jahn et al., 2012, Koier & Horlings, 2015; Gluckman and Kaiser, 2023).

In transdisciplinary work, researchers team up with professionals or citizens from a specific context (a neighbourhood or area, or perhaps a bigger organisation or a societal sector) to engage in a social learning process. By bringing together academic knowledge, historical sources and lived experience, they collectively try to understand the problems they face in this context in a systemic way to then hypothesise about potential transition pathways or transformative solutions. By collectively going through this process, professionals or citizens are supported to reinterpret their strategic challenges and positionality and are enabled to identify new courses of (strategic) action. Academics involved play multiple roles (from facilitator and researcher to mediator or knowledge broker and designer) and bring in knowledge, co-produce new knowledge, get access to deep empirical insights and might be able to test (methodological) hypotheses. Yet what will come out, and how, is uncertain upfront and organising such a process requires time, skills, and dedication.

Especially within organisations in which the individual pursuit of grants and publications in a competitive way is prioritised within largely disciplinary contexts, developing transdisciplinary work requires a deep change in cultures, structures and practices in academia. Working in a transdisciplinary way means to collaborate across disciplines (and therewith across faculties and chairs), with its associated challenges. This typically includes expanded timescales for concrete outputs like journal papers, but also close collaborations throughout projects with actors outside the university setting. That means building and maintaining relationships and trust with actors from different institutional contexts, different timeframes, priorities and working styles. Transdisciplinary work is also, by definition, explicit in its normative orientation, aiming to help address societal challenges and to contribute to sustainability transformations. It therefore needs to be reflexive about and deal with bias and the (often hidden) agendas of various stakeholder groups (Lawrence et al., 2022). Because transdisciplinary work adds aims of societal relevance and impact to the expectations on what research should contribute to and it asks for different skillsets, and different ways of producing and sharing knowledge.

[1] https://itd-alliance.org/
[2] https://www.gtpf.science/
[3] https://www.uni-kassel.de/uni/en/nachhaltigkeit/nachhaltigkeitsforschung/kassel-institute-for-sustainability/researching-sustainability
[4] https://uni-freiburg.de/university/topics-in-focus/sustainability/sustainability-innovation-campus/
[5] https://www.auckland.ac.nz/en/research/research-institutes-and-centres/university-centres-and-institutes.html

In this working paper, we thus understand transdisciplinary work as a process in which researchers from different disciplines work together with actors from outside academia to create relevant knowledge and action to better understand, analyse and address relevant societal problems (cf. Lang et al., 2012; Lawrence et al., 2022; Klein, 2004). By adding an explicit aim to both explore and support transformative change, transdisciplinary work is critical and emancipatory and addresses existing hegemonic power relations and unsustainable structures and practices that are at the root of many of the problems faced by current societies (Chambers et al., 2021; Blythe et al., 2018; Wittmayer et al., 2021). Practically, it means that transdisciplinary researchers that aim to help guide and support transformative change in society, partly work in completely different ways than (inter-) disciplinary researchers that are primarily incentivised to be productive as an individual within a specific academic niche. As transdisciplinary work asks from researchers to work and relate differently, the organisations those researchers are embedded in, are called to support them in different ways (Loorbach and Wittmayer, 2024).

The question that emerges is what enables or hinders transdisciplinary work when it develops within an existing academic institution that has historically developed around disciplines and academic output. This can be looked at on various levels, with a variety of studies covering diverse aspects located at the micro level of the individual researcher (e.g. skillset, profile, career path) (e.g., Jahn et al., 2012; Nyang'au et al., 2018; Hahn et al., 2023), the meso level of research organisations (e.g. reward structures, promotion criteria, leadership of research organisations) (Martens, 2021; Guimarães et al., 2019) and the macro level of formalised knowledge systems (e.g. the institutions, functions and contexts of the collective of universities, research institutes, non-government and government organisations determining how knowledge is produced and used) (e.g. Fazey et al., 2020; Cornell et al., 2013). In many cases, transdisciplinarity is thereby studied as one aspect amongst others of, for instance, more transformative knowledge systems (Fazey et al., 2020), or developing action-oriented or socially robust knowledge (Nowotny, 2003; Caniglia et al., 2020). Other studies zoom in on specific aspects of transdisciplinarity, such as leadership, funding, and teaching (Boone et al., 2020; Otero et al., 2020; Boyd et al., 2015), backgrounding the complexity of factors impacting transdisciplinary practice.

Textbox 1: Overview of our methodology.

We address the research question through a topical literature review of academic publications addressing the topics of institutionalization and transdisciplinarity from SCOPUS using a search strategy that includes searching for specific keywords in the titles of articles, their abstracts and keywords. This approach aims to ensure that the search results are more comprehensive and relevant by considering multiple aspects of the articles' metadata. The search strings used included "university AND structure AND "transdisciplinary research" and secondly (research) AND (institution* AND (structure OR design)) AND "transdisciplinary research". While both search strings share the aspect of "transdisciplinary research" and "structure," the first string encompasses a wider range of organisations beyond universities, including research institutions, which might yield broader results. The second string specifically targets universities and their involvement in transdisciplinary research with a focus on structure.

The documents were assessed for duplicates, we further complemented the results with sources known to us to be of relevance and we also used snowballing to identify additional publications. Identified publications were screened for relevance based on their abstracts. Sources identified to be relevant were read in depth by the first author, developing an initial clustering and characterization of key dimensions, their influence on institutionalization of transdisciplinarity and identifying related examples and recommendations. Subsequently, we further refined the initial clustering of key dimensions and discussed these outlines amongst the team of authors to refine them into a coherent set. This process led to a broadly comprehensive collection of factors mentioned in the literature. We acknowledge limits regarding the full comprehensiveness of the results, for instance due to relevant dimensions escaping our search string due to varying terminology. Furthermore, given the complex nature of institutionalising transdisciplinarity, understanding both relevant dimensions and their interactions within different contexts is essential. Thus, while key dimensions generally apply to research organisations more broadly, details may be relevant to specific organisations such as universities or think tanks only. In the below, we seek to do justice to and be transparent about the focus of the underlying references in this regard.

In this working paper, we focus on research organisations, such as universities, research institutes and think tanks, and explore the question of what the factors are that enable or hinder transdisciplinary academic work. By providing an overview and identifying favourable conditions, we seek to provide orientation for those who aim to strengthen the role of transdisciplinary work at the level of the research organisation. Acknowledging external influences, we also assume that organisations have significant agency to innovate and shape academic practice, thereby enabling or hindering transdisciplinary work of researchers, projects, institutes, or faculties. Based on a literature review of academic publications (see Textbox 1), this DIT working paper is structured as follows: First, we provide an overview on key dimensions influencing the institutionalisation of transdisciplinary work in research organisations. Second, we outline the key dimensions in more detail. Each section closes by presenting recommendations and concrete examples on how to shape mentioned key dimensions to enable transdisciplinarity. Third, we conclude drawing out core insights on the state of play regarding institutionalization of transdisciplinarity, and implications for future research and policy making.

2. Key dimensions influencing the institutionalization of transdisciplinarity in research organisations

Transdisciplinary education and research have developed in various academic contexts over the past decades, alongside its conceptualisation as a specific form of knowledge development with its own values, methodologies and epistemological basis. From the existing literature, we can distil several dimensions through which we can understand the institutionalisation of transdisciplinary work and the dilemmas and tensions that might arise. We identified nine dimensions as critical, encompassing organisational values, organisational structure, inter-organisational collaboration, leadership, training, teaching and curriculum, funding and reward structures. Institutional culture as ninth dimension is crosscutting and discussed as relevant in all the other dimensions. Below we provide clarifications of the nine dimensions and discuss their influence on transdisciplinarity within research organisations.

2.1 Organisational Values

We understand organisational values as the principles that guide an organisation by providing meaning and purpose. Such values find their expression by shaping strategies, policies, rules and norms - all of which can either catalyse or impede the institutionalisation of transdisciplinary research within research organisations. Values can translate into incentive structures, and resource allocation decisions, influencing the institutional environment and determining the criteria and metrics used to evaluate research performance and impact. Values have been found to be fundamental in addressing institutional design obstacles like compartmentalization, lack of student involvement, and limited societal relevance (Hugé et al., 2016). Furthermore, the literature outlines how values shape collaboration dynamics, and the lived experience of employees. On a basic level, what an organisation values as its role and relationship with other stakeholders' impacts (positively or negatively) the potential role and influence an institution can have in developing transdisciplinary research and education.

Organisational values that promote flexibility seem paramount, including flexibility of structures which is a critical factor to enable successful transdisciplinary work. It is recommended that structures are adaptable to new knowledge, circumstances, and priorities (Campbell et al., 2015). Inflexibility could as well hinder meaningful consultation with end users, such as indigenous groups. Yet, variation in institutional missions and goals make a "one size fits all (Budwig and Alexander, 2020: p.8)" approach to transdisciplinarity inadequate (Budwig and Alexander, 2020). Thus, every organisation needs to develop a fitting set-up, transferring organisational values into concrete structures. For instance, Ghent University's strategic objectives focus on socio-ecological challenges and societal relevance, embedding transdisciplinary approaches into the institution's core mission. This commitment is reflected in the establishment of specialised research centres and interdisciplinary platforms, providing researchers with the necessary infrastructure and collaborative opportunities to pursue transdisciplinary initiatives effectively.

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Table 1: Dimensions of Institutional Design for Transdisciplinarity (TD)

The nine dimensions of institutional design of transdisciplinary research and education. Each dimension is defined and its importance to transdisciplinary work is summarised.

Dimension	How and in which ways does this dimension influence TD?	References
Organisational values refer to the principles that guide an organisation by providing meaning and purpose. Such values find their expression by shaping strategies, policies, rules and norms and daily practice.	By focusing on organisational values for TD, the organisation alters the emphasis of its agendas and outputs towards new modalities of knowledge production and innovation. Organisational values that prioritise collaboration, inclusivity, adaptability, and systemic change facilitate TD by fostering interdisciplinary collaborations, integrating diverse perspectives, and enabling teams to adapt to changing contexts. These organisational values can drive the institutionalisation of TD through innovation, knowledge integration, and systemic reforms, creating an enabling environment for transdisciplinary teams to address complex challenges and generate impactful solutions.	Campbell et al. 2015; Dilling and Lemos, 2009; Maas et al. 2022; Boyd et al. 2015; Pascoe et al. 2020; Swan et al. 2021; Felt et al. 2016; Budwig and Alexander, 2020
Organisational structure refers to the institutional home of transdisciplinary work within a research organisation. This includes how TD is embedded within the different organisational entities that make up the research organisation.	Organisational structures can enable TD by providing dedicated units, centres, platforms or academic positions and by supporting boundary-spanning roles. The overall organisations or selected parts of it can be structured towards transdisciplinary work. Dedicated places and roles can facilitate collaboration, resource allocation, and institutional support. Structural support for TD can provide orientation via targeted guidelines and evaluation tools. Structures for TD necessarily do involve both academics and societal actors in substantial ways. Organisational structures oriented towards TD need to avoid rigid or siloed set-ups which may hinder TD by impeding communication, cross-disciplinary collaboration and resources access.	Muhar et al., 2013; Bammer et al. 2020; Fazey et al., 2020; Care et al., 2021
Inter-organisational collaboration refers to the arrangements and relationships established between different organisations to leverage resources, competencies, and expertise for shared activities towards shared goals.	Inter-organisational collaboration can enable TD by fostering collaboration, flexibility, and co-productive practices, aligning with stakeholder needs and enhancing continuity. These relationships enable leveraging diversity in expertise, resources, and competencies going beyond what single organisations are capable of. They enhance trust, new integrative thinking and facilitating knowledge integration, translation and outputs. Collaboration benefits from structured environments such research centres, networks and platforms. Barriers such as institutional silos, cultural resistance, and inflexibility can hinder collaboration and adaptation across diverse contexts, impeding success of TD.	Archibald et al. 2023; Kassab 2018; Arpin et al. 2023; Otero et al. 2020; Gray 2008
Leadership refers to the role of leaders in shaping the structures, processes, and culture within an organisation to achieve its goals effectively.	Leadership supports TD through strategic decisions, visionary thinking, encouragement and practical resources to foster a collaborative and innovative academic environment. Strong organisational leadership is core to institutionalize TD. It can take place at various levels, from chairs, to faculties, heads of organisations and ministries. Effective leadership for TD rests on appropriate qualities and skills, including visionary, creative and collaborative leadership. It cultivates norms, habits and an overall culture of collaboration through effective communication, networking and appropriate monitoring and evaluation frameworks. Leadership resistant to change or unaware of the benefits of TD may hinder institutionalization of TD failing to cater for mentioned aspects.	Houser et al., 2021; Budwig & Alexander, 2020; Hugé et al., 2016; Muhar et al., 2013; Lang et al., 2012; Tumer et al., 2024; Boone et al., 2020; Lauto & Sengoku, 2015; Pickett et al., 2017; Care et al., 2021
Training in transdisciplinary work refers to practices and processes through which academics and practitioners can get acquainted with the necessary skills, knowledges and capacities. This includes implementing respective educational programs.	Training can enable transdisciplinary research by equipping individuals with the necessary skills, such as to collaboration, creativity, and interdisciplinary thinking. Such skills are essential for effective engagement across disciplines. They are provided via formal education programs, mentorship, and opportunities for hands-on research experiences. Well-designed training programs can facilitate communication and collaboration among researchers from diverse backgrounds, ultimately enhancing the quality and impact of transdisciplinary research. The lack of skills and capacities for TD strongly limits organisations to expand their transdisciplinary engagement.	O'Donovan et al., 2022; Yeung et al., 2021; Wilson et al., 2021; Mokiy, 2019; Felt et al., 2016; Luthe, 2017; Wittmayer & Schäpke, 2014; Campbell et al., 2015; Boyd et al., 2015; Hugé et al., 2016; Muhar et al., 2013; Swan et al., 2010

Teaching and curriculum refer to educational activities in developing and supporting competencies of students for future TD research. It further includes engaging students in practical TD research.	TD can effectively be institutionalized at research organisations by reframing the educational philosophy and curriculum to include sustainability and transdisciplinary approaches, either institution-wide or in specific programmes and hosted by specific centres. Enabling and expanding TD benefits from a strategic focus on developing TD-specific competencies and key topical areas in higher education. Developing competencies aligned with the principles of transdisciplinary research enables students to address complex societal challenges and to engage with various stakeholders to co-create solutions. This reinforces the need for the organisations to foster an overall environment supportive of transdisciplinary methodologies, and for a targeted professional development for educators.	Shephard et al., 2019; Di Giulio and Defila, 2017; Lozano, 2006
Funding refers to the practices, processes and conditions of funding transdisciplinary work.	Funding is a key dimension to enable or hinder TD. Funding oriented to support TD does provides resources for collaborations, supports innovative projects, allows for longer-term viability and enables flexibility and adaption. Funding is needed to provide the necessary space, time and support to iterative and collaborative processes of knowledge co-production. It can enable researchers to collaborate across disciplines, build capacity, and mobilise knowledge for societal benefit. Flexible and continuous funding allows to establish longer term relations, adapt to the needs of stakeholders and build trust needed for successful TD. Funding structures characterised by single funding paths and high rigidity can hinder TD by overly limiting projects, reducing innovation and make it difficult to attract and retain talent.	Gluckman & Kaiser, 2023; Fazey et al., 2020; Muhar et al., 2013; Otero et al., 2020; Campbell et al., 2015; Luthe, 2017; Trencher et al., 2013; Felt et al., 2013
Reward structures refer to the formal and informal guidelines, mechanisms and practices which describe what academics ought to do and/or through which academics and their work are evaluated and rewarded in monetary and non-monetary terms.	Reward structures in universities significantly influence the engagement in TD, affecting support, incentives, and evaluation metrics in various ways. Reward structures can enable transdisciplinary research when recognise the unique contributions of transdisciplinary work. This can be done through strategies like activity-based measures and additional incentives that recognise and encourage engagement, valuing impacts beyond academia. They can hinder TD due to tensions with traditional disciplinary reward systems, time constraints, and perceived career risks, particularly for early-career researchers engaged in TD.	Sellberg et al. 2021; Gluckman & Kaiser 2023; Fazey et al. 2020; Muhar et al. 2013;Otero et al. 2020; Campbell et al. 2015; Luthe 2017; Boyd et al. 2015; Trencher et al 2013; Arnott et al. 2020; Felt et al. (2013)
Institutional culture refers to the patters of behaviours, values and norms, as well as believes collectively shaped and reshaped by the members of the organisation	Institutional culture has a variety of influences on TD and can be seen as crosscutting and interacting with the other dimensions. It impacts on how organisation members do value and interpret their experiences, including attempts of institutionalizing TD. Cultural resistance including often unconscious interpretative frames can strongly hinder mainstreaming TD, and pre-existing institutional culture needs to be built on. There is a reciprocal influence between organisational structures and culture, as structures provide a framework within which (e.g. TD-supporting) values, norms, and practices are established and perpetuated throughout research organisations. Relatedly, cultural patterns impact how structures are interpreted and lived in daily practice. Similarly, collaboration, leadership and funding can establish and underpin certain cultural patterns and are reciprocally always framed through the shared cultural lenses. A culture of care and responsibility, collaboration, reflexivity and learning supports TD	Swan et al. (2010); Felt et al. (2016); Pascoe et al. (2020); Trencher et al. (2013); Care et al. (2021); Levina & Vaast, (2005); Gulati et al., 2012); Boone et al. (2020).

Organisational values that promote collaboration and boundary-spanning across disciplines, additionally foster an environment where transdisciplinary research (teams) can thrive. This includes allowing to make a diversity of perspectives visible by amplifying the expertise of others or by encouraging iterative work processes (Maas et al., 2022). What seems missing for a concrete shift to co-productive models of interaction is a vision and related organisational values of what an effective science-policy practice might look like if not [considered to be] linear (Maas et al., 2022). Risk taking and enhancing adaptivity of research agendas would be required to create more usable science and further to better match the changing nature of problems and needs in practical settings. However, Dilling and Lemos (2011) found current knowledge producing systems to reward predetermined methods or incremental efforts rather than risky, unproven innovative strategies. Boyd et al. (2015) underline that accommodating the varying needs of non-academic stakeholders into transdisciplinary research may represent a challenge. To overcome this, different geographic, cultural, political and institutional contexts should inform the adaptation of existing methods to the specific context (Boyd et al., 2015).

Organisational values and institutional culture are interrelated, both influencing the lived experience of employees. Existing institutional cultures influence the establishment and expression of new organisational values such as those in support of or in opposition to transdisciplinarity. Cultural resistance from within the university was identified as an important institutional barrier (Trencher et al., 2013). Specifically, a lack of support or rewards for those wishing to do transdisciplinary research, requires urgent attention to encourage further development of co-creation for sustainability (Trencher at al. 2013, building on Alperovitz et al., 2008; Crow, 2010; Wiek et al., 2012; Yarime et al., 2012). To enable changes towards organisational values in support of transdisciplinary work, various studies highlight the importance of building on the pre-existing institutional culture (Swan et al., 2010; Felt et al., 2016; Pascoe et al., 2020).

2.2 Organisational Structure

Organisational structure within a research organisation encompasses both the institutional framework where transdisciplinary work resides and the way it is integrated across diverse organisational entities within the larger organisation. The role of organisational structures in facilitating transdisciplinary work within research organisations is pivotal for establishing and nurturing robust systems that incentivise and sustain engagement in such collaborative endeavours. Importantly, these structures do involve actors from within the research organisations, such as researchers as well as actors from outside the organisation, including policymakers or community members. As stated by Felt at al. (2016), "high-quality sustainability research requires a broader set of actors who are involved in all of the steps (2016: p.732)." This requires including society and policy into the full research process, from defining problems to developing solutions. Questions arise regarding how the organisational structure can foster and

Textbox 2: Ways forward for organisational values to enhance transdisciplinary work.

- **Promote Flexibility in Structures and Research Agendas:** Organisational values that promote flexibility are crucial for enabling successful transdisciplinary work, making room for structures and research agendas to be adaptable to new knowledge, circumstances, and priorities (Campbell et al., 2015; Dilling and Lemos, 2009).
- **Encourage Risk-Taking**: Risk-taking, including unproven innovative strategies, are required to create more usable science and to better match the changing nature of problems and needs in practical settings (Maas et al., 2022; Dilling and Lemos, 2009).
- **Foster trust and a no-blame culture**: Emphasising trust-building and open communication minimises conflicts, promoting a cooperative mindset among stakeholders (OECD Report 2020).
- **Promote Collaboration and Boundary-Spanning**: Organisational values that promote collaboration and boundary-spanning across disciplines contribute to fostering an environment where transdisciplinary research teams can thrive.
- **Make Diverse Perspectives Visible:** Encourage making diverse perspectives visible by amplifying the expertise of others and promoting iterative work processes (Maas et al., 2022).
- **Develop a New Imaginary for Science-Policy Practice Recognizing Existing Contexts**: Work towards a visionary image of how research, policy and society can work together to address societal problems including the underlying organisational values (Maas et al., 2022), while building on pre-existing institutional cultures to maintain a degree of coherency (Swan et al., 2021) and recognize (potential) tensions (Felt et al., 2016).

sustain engagement in transdisciplinary work, involving both internal and external actors. This indicates "a need to rethink how society can relate to and be integrated into the production of scientific knowledge." (Felt et al., 2016: p.732).

Thus, structurally, transdisciplinary processes and projects create delimited and interactive spaces where new science–society relationships are probed (Felt et al., 2016; Wittmayer and Schäpke, 2014). Also, those arenas are influenced by deeply entrenched, pre-inscribed social and political knowledge orders around questions such as whose knowledge counts or is considered legitimate, who is involved in research and who not. Therefore, they are a focus point in shaping all aspects of transdisciplinary research (Felt et al., 2016). The structural set up of a research organisation shall bundle and provide institutional, interpersonal, and environmental supports [to] enhance the ease and rapidity of transdisciplinary collaboration (Stokols et al., 2003). This can include a physical ´headquarter´ (Trencher et al., 2013), or a broader understood physical infrastructure, which can take the form of a demarcated space for transdisciplinary research outside of the research organisation (Boone et al., 2020). This physical space can facilitate the "co-location of scholars (p. 1728)" to spark serendipity or with external stakeholders which may lead to easier access to policymakers to facilitate the production of knowledge (Boone et al., 2020). If co-location is not possible then technological engagement is key (Boone et al., 2020).

Research organisations can take different measures on the structural level to facilitate transdisciplinary work. It is recommended, that they seek to overcome the widespread compartmentalization and siloing, which can be an impediment to transdisciplinary research and education (Boyd et al., 2015). Measures include, but are not limited to the following:

Firstly, and most fundamentally, the organisation can be set up based on an overall structure dedicated to transdisciplinary work. Exemplary institutes founded on a transdisciplinary approach to tackle complex societal challenges include KWR Water Research Institute[6], Stockholm Environment Institute[7], NewClimate Institute[8], RIFS – Research Institute for Sustainability[9], and the Fondazione ENI Enrico Mattei[10]. These institutes seek to integrate knowledge from multiple disciplines and non-academic stakeholders, combining research with policy impact and practical solutions, in their overall modus operandi. Ghent University mainstreamed transdisciplinarity throughout the university as part of their stepwise transition path from 2013-2020. Specific objectives guided mainstreaming of transdisciplinarity, including to focus on socio-ecological challenges, use societal relevance as a key criterion for research, consider multi-, inter-, and transdisciplinary research as core practice, and performing research sustainably. Part of this activity were forming Transition UGent and Ghent City Academy, as a university-based think tank, and innovation and collaboration networks (Lambrechts et al., 2018, Ghent University 2022).

Secondly, one can think about establishing new organisational units dedicated to transdisciplinarity, on par with existing ones within a larger organisation. This can provide strong visibility within the institution's environment (Muhar et al., 2013) and can ensure access to resources and power in decision making, as well as provide resources and support for researchers from different disciplines to collaborate on projects (Fazey et al., 2020). According to Stokols et al. (2004) research centres "housed in a common facility" that are situated within a single administrative unit and are supported by university/institute leaders "evidenced the highest levels of readiness for collaboration". Establishing separate units however also carries the risks of separation and isolation from the overall organisation, which could be addressed through building a crosscutting horizontal structure which would "interweave existing units" (Muhar et al., 2013: p.128).

Thirdly, respective cross-cutting structures involving various units of the larger organisation are possible. Such university-based collaboration centres, research platforms and hubs allow the organisation of common interdisciplinary events, projects or even programmes around issues of shared concern (Hugé et al., 2016). These can be set up from a transdisciplinary mindset such as the

[6] https://www.kwrwater.nl/en (on KWR Water Research Institute)
[7] https://www.sei.org/
[8] https://newclimate.org (NewClimate Institute for Climate Policy and Global Sustainability)
[9] https://www.rifs-potsdam.de/en
[10] https://www.feem.it/en (Fondazione ENI Enrico Mattei)

Maastricht University's CAPHRI - Care and Public Health Research Institute[11], which involves researchers from different departments (Social Medicine, Medical Microbiology, and Health Ethics) to research viruses and borders as the specific topic of mutual interest. Existing programmes on issues such as sustainable development, climate change or biodiversity conservation seem to invite integrating co-production into their ways of working (Lemos et al., 2021). These cross-cutting structures, also including multi-actor consortia and long-term networks, would allow for connecting and aligning "across hierarchies and sectors within academia" (Care et al., 2021: p. 2). Further examples include Karlsruhe Transformation Centre for Sustainability and Cultural Change (KAT)[12], Design Impact Transition (DIT) Platform at Erasmus University Rotterdam[13] and Kassel Institute for Sustainability[14].

Fourthly, establishing new roles and positions such as sustainability chairs and research coordinators, along with establishing inter- or transdisciplinary hubs, provides essential infrastructure and support to facilitate sustained collaboration on an everyday, practical level. Hugé et al., (2016) recommend setting up a sustainability science chair/professorship, for example the chair for transdisciplinary sustainability research at Leuphana University Lüneburg[15]. Fazey et al., (2020) recommend appointing research coordinator(s) for drafting and managing inter- and transdisciplinary project work. Another type of roles includes positions that focus on boundary spanning between the research organisation and its stakeholders on a continuous, longer-term basis. Examples include community relations managers at Arizona State University[16], and the Cooperative Extension program at Washington State University[17].

Fifthly, research organisations can foster transdisciplinary research by providing guidance and frameworks to individual researchers and projects. Universities like Utrecht University[18] offer field guides and resources that define transdisciplinary research, explain its rationale, and provide guidance on conducting such research. These resources help researchers understand the paradigm shift towards transdisciplinary knowledge production and navigate the challenges and trade-

Textbox 3: Ways forward for organisational structure to enhance transdisciplinary work.

- **Establish Dedicated Structures for Transdisciplinary Work:** Consider setting up an organisation dedicated to transdisciplinary work or establishing new transdisciplinary units alongside existing ones (Felt et al., 2016; Boyd et al., 2015; Muhar et al., 2013).
- **Promote Cross-Cutting Structures and Platforms:** Implement cross-cutting structures like interdisciplinary research platforms or hubs, issue-based intra university collaboration centres, and long-term networks to facilitate collaboration across hierarchies and sectors within the organisation (Hugé et al., 2016; Lemos et al., 2021; Muhar et al., 2013).
- **Appoint Specialised Roles and Provide Infrastructure Support:** Establish new roles such as sustainability chairs and research coordinators, along with inter- or transdisciplinary hubs, to provide essential infrastructure and support for sustained collaboration daily (Hugé et al., 2016; Fazey et al., 2020).
- **Provide Guidance and Frameworks for Transdisciplinary Research**: Offer guidance and frameworks to individual researchers and projects, defining transdisciplinary research, explaining its rationale, and providing guidance on conducting such research (e.g. Utrecht University).
- **Implement Flexible Evaluation and Monitoring Frameworks:** Establish flexible evaluation and monitoring frameworks for transdisciplinary projects from their inception, to assess effectiveness, facilitate learning, and adapt to evolving circumstances and priorities (Boone et al., 2020).
- **Develop Context-Specific Structures:** Due to variations in institutional missions and goals, a "one size fits all (p.8)" approach to organisational set-up for transdisciplinarity is inadequate. Each organisation needs to develop a structural organisation that fits its specific context (Budwig and Alexander, 2020).

[11] https://www.maastrichtuniversity.nl/research/school-caphri-care-and-public-health-research-institute/our-research/health-inequities-3
[12] https://www.transformationszentrum.org/english/index.php
[13] https://www.eur.nl/en/about-eur/strategy-2024/strategy-practice/dit-platform; Wittmayer et al., 2021
[14] https://www.uni-kassel.de/uni/en/nachhaltigkeit/nachhaltigkeitsforschung/kassel-institute-for-sustainability/researching-sustainability
[15] https://www.leuphana.de/en/institutes/setri/transdisciplinary-sustainability-research.html
[16] https://governmentaffairs.asu.edu/community-relations
[17] https://extension.wsu.edu/about-extension/
[18] https://www.uu.nl/en/research/transdisciplinary-field-guide/get-started/why-transdisciplinary-research

offs involved (see also section 2.5 on training below).

Lastly, it is crucial to accommodate flexible and dynamic evaluation and monitoring measures into the structure of the organisation. This can support research for sustainability in general (Fazey et al., 2020), and an effective long-term management of transdisciplinary projects in particular. Boone et al., (2020) recommend that such frameworks be established from the project's inception. This approach ensures that projects can adapt to evolving circumstances and priorities, ultimately enhancing their impact and sustainability.

The interplay of organisational structures and institutional culture is paramount. Organisational structures provide a framework within which values, norms, and practices are established and perpetuated throughout research organisations. The institutionalisation of transdisciplinarity in organisational structures, as posited by Care et al., (2021), is poised to fundamentally change academia by dispelling the notion of the solitary scholar as the primary creator of knowledge. Instead, collaborative efforts, driven by research questions formulated collectively with a diverse array of societal actors, will take precedence and that fosters a culture characterised by a steadfast commitment to supporting scientific rigour alongside societal impact and engagement. It should foster a culture of care towards self and others within academic institutions (Care et al., 2021). Emphasising the quality of contribution over sheer quantity of output would underscore this mentality.

2.3 Inter-organisational collaboration

Inter-organisational collaboration refers to the arrangements and relationships established between different organisations to leverage resources, competencies, and expertise for shared activities towards shared goals. Inter-organisational collaboration plays a crucial role in influencing the effectiveness and institutionalization of transdisciplinary research in research organisations. Such collaboration creates a favourable context enhancing trust, new integrative thinking and facilitating knowledge integration, translation and outputs (Archibald et al., 2023). Furthermore, it provides an enabling environment for distributed and flexible leadership, helps to overcome disciplinary silos through unifying visions, align efforts around sustainability principles, and take on brokering roles connecting disparate groups across organisations. The literature exemplifies collaborations, ranging from formal research centres to networks and platforms. These provide structured environments for diverse expertise, resources, and competencies to converge, fostering cognitive leadership and boundary-spanning roles that are crucial for collaboration and knowledge integration across organisations.

Structures of inter-organisational collaboration can have different degrees of institutionalization. Institutionalised research centres like the Swiss Competence Centre Environment and Sustainability (CCES)[19], act as inter-organisational structures that provide an academic environment, often including resources and funding, to facilitate inter- and transdisciplinary research collaborations across multiple organisations. Another example is the Sustainability Innovation Campus (ICN)[20] created by Freiburg University, in collaboration with Karlsruhe Institute of Technology. ICN is a dedicated structure aimed at addressing sustainability challenges through transdisciplinary research and education, by catalysing and hosting cross-sectoral and cross-institutional projects. The collaboration of Erasmus University, Technical University Delft and Erasmus Medical Centre on pressing societal issues including digitalisation, resilience or disaster takes place in the Convergence[21]. This collaboration aims to provide ecosystems for research and teaching that address regional challenges and their connection to global developments.

Slightly less formalised are networks and platforms. Here, research organisations can jointly promote and engage in collaboration and knowledge exchange between disciplines as well as between science and society. Examples include td-net – network for transdisciplinary research[22], the Global Alliance for inter- and transdisciplinarity[23] or the GPTF - German society for participative and transdisciplinary research[24]. Furthermore, centres, networks and platforms often offer services for

[19] https://cces.ethz.ch/about.html
[20] https://uni-freiburg.de/university/topics-in-focus/sustainability/sustainability-innovation-campus/
[21] https://convergence.nl/
[22] https://transdisciplinarity.ch/en
[23] https://itd-alliance.org/
[24] https://www.gtpf.science/

capacity building, methods, tools, and resources to enable transdisciplinary work.

Transdisciplinary research addressing complex transdisciplinary problems requires leveraging diversity in expertise, resources and competencies which inter-organisational arrangements allow for (Archibald et al., 2023). When studying the reorganisation of research communities driven by calls for inter- and transdisciplinary work, Arpin et al., (2023) found that inter-organisational collaborations facilitate such reorganisation. It allowed to bring together the diverse resources and competencies required for transdisciplinary research goals that transcend what a single organisation can accomplish alone (Arpin et al., 2023). New integrative thinking and cross-institutional collaboration was catalysed by a focused organisational structure (Kassab 2018). Therein, trusted intermediaries and personnel continuity are paramount for the long-term success of transdisciplinary research development (Otero et al., 2020).

Leadership is central to inter-organisational collaborations enabling transdisciplinary research. Distributed leadership models within inter-organisational teams can empower researchers at different career stages to autonomously capitalizing on unforeseen transdisciplinary opportunities (Archibald et al., 2023). Complementarily, multiple leaders with diverse skills can act as brokers to connect disparate groups in large, geographically dispersed inter-organisational transdisciplinary projects Gray (2008). Additionally, cognitive leadership is needed to provide a unifying vision that motivates researchers to transcend disciplinary boundaries and assumptions towards inter-organisational, transdisciplinary collaborations (ibid.).

Moreover, inter-organisational collaboration plays a crucial role in establishing rules and governance mechanisms that are conducive to effective transdisciplinary collaboration (Gulati et al., 2012; Provan & Kenis, 2008; Williams, 2002). By defining the rules and processes that govern interactions between organisations, these collaborations create an environment of trust, cooperation, and shared goals, essential for the successful execution of transdisciplinary research projects. This includes mechanisms to enhance transparency and accountability. The promotion of boundary-spanning roles within these structures facilitates knowledge co-production across disciplinary and organisational boundaries, bridging gaps, and fostering shared understanding (Levina & Vaast, 2005; Williams, 2002).

Inter-organisational collaboration is foundational to foster an institutional culture necessary to enable transdisciplinary research initiatives. Through the facilitation of interaction and knowledge sharing across organisational boundaries, these collaborations engender an inter-organisational culture characterised by

Textbox 4: Ways forward for inter-organisational collaboration to enhance transdisciplinary work.

- **Establish appropriate inter-organisational** structures of various levels of formalization to host, facilitate and resource inter-organisational collaboration in form of research centres as well as platforms and networks. Thereby it is crucial to leverage diversity in expertise, resources and competencies beyond what individual organisations are capable of (Archibald et al., 2023; Arpin et al., 2023).
- **Provide dedicated leadership to facilitate collaboration** across different organisations, including distributed leadership empowering researcher autonomy, multiple complementary leaders as well as cognitive leadership providing orienting vision and mission for cross-organisational collaboration (Archibald et al., 2023; Gray, 2008).
- **Establish rules, processes and governance mechanisms,** to provide transparency and orientation as well as to enable trust building in knowledge co-production across boundaries (Gulati et al., 2012; Provan and Kenis, 2008, Williams, 2002).
- **Facilitate interaction and knowledge sharing across organisational boundaries:** Collaborative efforts promoting communication and shared meanings between organisations foster an inter-organisational culture (Otero et al., 2020).
- **Promote boundary-spanning roles and trusted intermediaries:** Inter-organisational collaboration can include dedicated boundary-spanning roles like knowledge brokers, translators, or facilitators. These roles help bridge gaps, create shared understanding, and facilitate knowledge co-production across disciplinary and organisational boundaries, which is essential for effective collaboration.
- **Align divergent structures and cultures: Integrating** divergent organisational cultures fosters a shared culture, further supporting collaboration (Reynolds, 2019).

communication, shared meanings, and the integration of diverse cultural perspectives, beliefs, and values from multiple organisations (Levina & Vaast, 2005). This inter-organisational culture is essential for transcending disciplinary silos and fostering the collaboration and knowledge integration vital to transdisciplinary research endeavours. Through their emphasis on trust-building, open communication, and a no-blame culture, inter-organisational collaboration can furthermore reduce conflicts and promote a cooperative mindset among stakeholders (Gulati et al., 2012). Finally, by aligning divergent organisational cultures, structures, and processes, these collaborations contribute to the development of a shared inter-organisational culture that transcends individual organisational boundaries, further facilitating transdisciplinary collaboration (Levina & Vaast, 2005).

2.4 Leadership

Leadership refers to the role of leaders in shaping the structures, processes, and culture within an organisation to achieve its goals effectively. Promoting transdisciplinary research at research organisations requires strategic support, visionary thinking, and practical resource management to foster a collaborative and innovative academic environment. When discussing strong organisational leadership for transdisciplinary research, key concerns arising from the literature include necessary leadership support at different levels, necessary leadership qualities, the establishment of effective monitoring and evaluation frameworks, and strategic decisions influencing institutional culture.

Strong organisational leadership plays a key role in institutionalising transdisciplinary research. Houser et al. (2021) emphasise the importance of such leadership, which can come from various levels, including disciplinary societies, national organisations, and individual research organisations like universities (Budwig & Alexander, 2020). While Hugé et al. (2016) suggest that universities can adopt a bottom-up approach to foster transdisciplinary research, the support from university governing bodies like ministries remains essential. Initially, leaders can show their support informally, but in the long term, this support needs to be visible in strategic documents (Muhar et al., 2013). Recognising transdisciplinary research as a strategic project can lead to broader institutional support, framing it as a significant contribution to the university's development strategy (Lang et al., 2012; Tumer et al., 2024[25]).

Effective leaders in transdisciplinary research organisations must cultivate appropriate leadership qualities and skills. Boone et al. (2020) highlight the need for leaders to be persuasive and to build teams with diverse abilities, acknowledging that no single individual is likely to possess all the skills required for transdisciplinary work. Visionary leadership is essential for seeing beyond the status quo and implementing innovative approaches. Care et al. (2021, p. 703) call for organisations to "allow space for future leaders to develop and enact radically reimagined visions of how to lead as a collective with care for people and the planet". It is recommended that leaders have the creativity and ability to envision what is possible and necessary for progress (Boone et al., 2020). Perseverance is another critical trait for transdisciplinary leaders, who must articulate a shared strategy and resist regressing to traditional disciplinary approaches.

Collaborative leadership and partnerships are also vital. Effective leaders develop clear processes for partnerships, articulating potential trade-offs between scientific ideas and participatory methods. They support factors associated with knowledge production and coordination among multi-disciplinary teams (Lauto and Sengoku, 2015). This includes promoting norms and habits of collaboration that affect problem selection, research approaches, and solutions (Pickett et al., 2010). An example is sharing data in clear, well-documented and easily accessible formats to inform ongoing transdisciplinary research (Boone et al., 2020). Effective communication with multiple audiences, both within and outside the organisation, is also necessary to build networks and align disciplines to substantiate partnerships.

Appropriate monitoring and evaluation frameworks are essential for managing transdisciplinary research. Leaders need to redefine assessment criteria, prioritizing stakeholder engagement and societal impact alongside traditional academic measures (Boone et al., 2020; Gluckman and Kaiser 2023). To account for the high dynamics of

[25] https://open.oregonstate.education/handbookhighereducationleadership/chapter/connecting-the-university/

transdisciplinary work, these frameworks should be flexible, dynamic, and established at the project's inception to aid long-term management. Boone et al. (2020) additionally suggest revisiting expectations set frequently with stakeholders. It is recommended that leaders inform team leaders about the potential impacts of transdisciplinary research on junior colleagues' employability (Lauto and Sengoku, 2015). Since early-career researchers generally lack the protection and autonomy of senior staff such as full professors, leaders are expected to nurture the interests of those early career researchers (Lauto and Sengoku, 2015). Boone et al. (2020) stress that communicating the values and roles of transdisciplinary research can help erode scepticism.

Strategic choices by leaders supporting transdisciplinarity can shape various aspects of institutional culture. University leadership can signal commitment in securing internal and external support and allocating resources to address key areas in developing, expanding or enabling transdisciplinarity (Felt et al., 2013; Muhar et al., 2013). This creates an overall supportive environment for transdisciplinary work. Leaders can engage in facilitating a cultural change towards knowledge integration and cooperation through advocating and practicing collaboration and stakeholder engagement (Boone et al., 2020). This entails valuing diverse perspectives and incorporating stakeholder interests into research endeavours that addresses real-world challenges and offers practical solutions (Boone et al., 2020). Reflexivity and ongoing learning are also vital aspects of transdisciplinary research (Boone et al., 2020). It is recommended that leaders promote a culture of self-reflection and continuous improvement, encouraging researchers to critically examine their roles, assumptions, and societal impacts. Additionally, providing training programs that equip researchers with the necessary skills for stakeholder engagement, team collaboration, and knowledge integration is crucial (SHAPE-ID Consortium).

Textbox 5: Ways forward for leadership to enhance transdisciplinary work.

- **Establish Strong Institutional Leadership for Transdisciplinary Research:** Recognise transdisciplinary research as a strategic project that significantly contributes to the university's development strategy, thereby garnering broader institutional support (Houser et al., 2021; Budwig & Alexander, 2020; Lang et al., 2012; Tumer et al., 2024).
- **Promote Collaborative Leadership and Partnerships:** Encourage collaborative leadership and partnerships to support knowledge production and coordination among multidisciplinary teams (Lauto & Sengoku, 2015; Care et al., 2021).
- **Cultivate Essential Leadership Qualities and Skills:** Effective leaders develop appropriate qualities and skills, such as creativity and visionary thinking, to implement innovative approaches in transdisciplinary research (Boone et al., 2020; Care et al., 2021).
- **Redefine Assessment Criteria and Implement Flexible Frameworks**: Redefine assessment criteria to prioritise stakeholder engagement and societal impact. Establish flexible and dynamic evaluation frameworks from a project's inception, allowing for continuous adaptation in exchange with stakeholders (Boon et al., 2020; Kaiser & Gluckman, 2023).
- **Shape Institutional Culture through Strategic Resource Allocation:** Leaders strategically allocate resources to key areas in developing, expanding, or enabling transdisciplinary research, fostering joint ownership and funding of research initiatives, and ensuring active engagement from diverse stakeholders (Felt et al., 2013; Muhar et al., 2013; Polk, 2015).
- **Support Development of Interdisciplinary Research Networks:** Facilitate the development of interdisciplinary research networks and provide mentoring opportunities for early career researchers. Supervisors and mentors can promote integrated writing, interdisciplinary networking, and help researchers find intellectual communities (Lyall & Meagher, 2012).
- **Facilitate Platforms for Mentoring and Professional Development:** Offer platforms for researchers to share experiences, plan career development, and receive training for competence and skill development, thus supporting the professional growth of early career researchers (Lyall & Meagher, 2012).

2.5 Training

Training refers to the practices and processes through which individuals (academics and practitioners) can get acquainted with the necessary skills, knowledges and capacities for transdisciplinary work. Training includes developing and implementing respective educational programs. Effective training for staff, both current researchers and leaders, is crucial in fostering transdisciplinary research (Houser et al., 2021, Wilson et al., 2021). Fostering capacity through collaborative networks, anticipating

challenges and tensions, and implementing structural changes in curricula are essential steps for enhancing the impact and sustainability of transdisciplinary efforts.

The lack of training and skills development for researchers, particularly in relation to capacities need for transdisciplinary work, is mentioned by many academics (Wittmayer and Schäpke, 2014; Yeung et al., 2021; O'Donovan et al., 2022). Often, they recommend supporting skill development both within and between research groups and institutes. Specific capacity-building initiatives that focus on training researchers in new methodologies and fostering an environment that supports collaborative research efforts are highlighted (Campbell et al., 2015). These initiatives can include formal education programs, mentorship, and opportunities for hands-on research experiences. In more detail, Mokiy (2019) suggests developing skills including collaborative tools and techniques, case studies, networking opportunities, integration of societal perspectives, and reflective practices to enhance researchers' competencies and promote impactful research. Along this line, Hugé et al. (2016) proposes that universities create forums of frontrunners that practice developing system analysis and future visions, alongside setting up transition paths with experiments.

It is important to recognise that specific skills are needed for inter- and transdisciplinary research and education (Boyd et al., 2015). Those go beyond what is broadly taught in research methods trainings. Additionally, it is relevant to recognise a certain lack of coherent practices and methodologies in transdisciplinary research, which may lead to tensions or contradictions in collaborative research practice (Swan et al., 2010; Felt et al., 2016). Anticipating potential tensions from the "heterogeneous assemblages" of ideologies, institutional beliefs, practices, and people is crucial as these elements often contend with each other, creating challenges as well as opportunities for dissolving barriers (Felt et al., 2016). To create an even playing field Muhar et al. (2013) recommend shared introductory courses.

Reflexivity is a related key competence supporting transdisciplinary work. However, in daily research practice, there's a risk that reflexivity becomes an afterthought, merely addressed through structural fixes like ethics committees, which manage it via forms (Wittmayer et al., 2024). Felt et al. (2016) highlight this issue, noting that while structural fixes are a common approach, they may be insufficient. Instead, they propose considering spaces of negotiation as a more effective alternative to practice reflexivity. They emphasise the importance of embedding reflexivity deeply into the research process.

The lack of capacities for transdisciplinary research has consequences, and strongly limits

Textbox 6: Ways forward for **training** to enhance transdisciplinary work.

- **Develop training programs and capacity building initiatives** to equip researchers and practitioners with the necessary skills, knowledge, and capacities for transdisciplinary work (Houser et al., 2021; Wilson et al., 2021). Targeted capacity-building initiatives can include formal education programs, mentorship, and opportunities for hands-on research experience (Campbell et al., 2015).
- **Create collaborative training networks** and partnerships among researchers, institutions, and stakeholders to share resources, knowledge, and expertise. Co-supervision between organisations can provide additional perspectives and enhance research capacity (Muhar et al., 2013; Stokols et al., 2008). Establish centres of excellence to bundle resources and facilitate learning.
- **Acknowledge the specific skills needed for transdisciplinary work** beyond regular methods courses. Skill development should include collaborative tools, case studies, system analysis and visioning, networking opportunities, integration of societal perspectives, and experimental and reflective practices (Mokiy, 2019). Foster an environment that supports collaborative research efforts.
- **Anticipate potential tensions and dissolve barriers** to contribute to the success of transdisciplinary endeavours (Swan et al., 2010; Felt et al., 2016).
- **Use workshops for knowledge sharing** as valuable means to foster transdisciplinary research and formal knowledge sharing among different organisations or organisational units. Provide platforms for skill development and sharing best practices, including among multiple universities (Mokiy, 2019).
- **Provide funding for structural support of capacity building** and recognise that funders play a core role in enabling or hindering the development of capacity building and skill development initiatives at research organisations and provide the necessary resources (Luthe, 2017).

organisations to expand their transdisciplinary engagement (Muhar et al, 2013; Campbell et al, 2015). Scholars emphasise the importance of creating collaborative networks and partnerships among researchers, institutions, and stakeholders to share resources, knowledge, and expertise (Stokols et al., 2008). One example is the Integration and Implementation Insights blog and repository that focuses on exchanging knowledge around researching complex societal issues26. These networks can help overcome capacity limitations by pooling together diverse resources and expertise (Stokols et al., 2008). Muhar et al. (2013) suggests that institutions with experience in transdisciplinarity establish co-supervision with institutions starting off with more limited capacities. Relatedly, Mokiy (2019) recommends to scale skill development workshops from within individual institutions to a broader level, sharing knowledge and best practices among multiple universities that are centres of excellence in transdisciplinarity.

To achieve the structural changes necessary for effective transdisciplinary research, Muhar et al. (2013) highlight four key areas within curricula and research practices. These involve acknowledging diverse disciplinary contributions, harmonizing methodologies, developing shared concepts to bridge disciplinary boundaries, and aligning research with societal contexts. Integrating these elements into curricula and research practices is essential for fostering the necessary research capabilities, attitudes, practices, and mindsets. As a word of caution, Luthe (2017: p. 18) notes, that capacity development relevant for transdisciplinarity "conflicts with the current science funding system, which is based on individual theoretical experience proven by peer-reviewed publications, neglecting other important skills". Accordingly, further structural changes are required building on the core role of funding bodies to support training that enables transdisciplinary research (Sellberg et al., 2021). Funders are called upon to provide resources to build the necessary skills for conducting high-quality transdisciplinary research. This includes funding for training programs, workshops, and other capacity-building activities that can help researchers develop the skills and knowledge needed to engage in transdisciplinary research effectively.

Training can bolster an institutional culture supportive of transdisciplinary research by creating an environment where the skills required for transdisciplinary research are fostered and invested in at all levels of the organisation. Training programmes thus can be an effective avenue to change the current culture of the organisation if they are valued by and meeting demands of researchers and stakeholders. Here, leadership can play a supportive role. If a university leader identifies skills for transdisciplinary research as relevant for their colleagues, those colleagues are more likely to feel supported, emotionally and financially, in investing in their personal training to develop as transdisciplinary researchers.

2.6 Teaching and Curriculum

Enabling and expanding transdisciplinary work benefits from a strategic focus on developing related competencies and key topical areas in higher education at universities. Teaching and curriculum refer to developing and supporting knowledge and skills of students for future transdisciplinary research. It further includes engaging students into ongoing transdisciplinary research processes. More broadly it concerns fostering an institutional culture that prioritises comprehensive education and competency development, based on targeted professional development for educators.

Lozano (2006) discusses the importance of opening and reframing the curriculum to incorporate sustainability and transdisciplinary approaches. He emphasises that traditional curricula often focus on single disciplines, which can limit students' ability to address complex, real-world problems that require knowledge integration across various fields. Positive examples like ETH Zurich are implementing such approaches by offering specific programs including the Environmental Science Bachelor's and Master's with a minor in Transdisciplinarity for Sustainable Development[26]. By reframing the curriculum, organisations can foster a more comprehensive and integrated approach to education, encouraging students to think critically and work collaboratively on sustainability issues. This process involves revising existing courses, introducing new cross- or non-disciplinary programs, and creating opportunities for experiential learning that engage

[26] https://tdlab.usys.ethz.ch/teaching/tdcs.html

students with real-world challenges and diverse perspectives. A comprehensive integration of transdisciplinary methodologies is seen as necessary to aligning teaching and curriculum with transdisciplinary aims.

A focus on developing competencies relevant for transdisciplinarity amongst students through an integrated curriculum approach was discussed in detail by Shephard et al. (2019) and Di Giulio and Defila (2017). This includes competencies aligned with the principles of transdisciplinary research, such as critical thinking, systems thinking, normative thinking and collaborative skills, enabling students to address complex societal challenges and to engage with various stakeholders to co-create solutions (Shephard et al., 2019). Examples such as the Challenge Lab[27] at Chalmers University of Technology, the transdisciplinarity lab at ETH Zurich[28], and the environmental and sustainability sciences careers at Leuphana University[29] enact collaborative learning environments through transdisciplinary projects where students and the wider community work towards addressing societal challenges. At the Erasmus University Rotterdam, the recently accredited Master programme Societal Transitions focuses on the core capacities of thinking, acting, relating and reflecting[30]. Another example is Tomorrow University of Applied Sciences[31], that integrates real-world applications and collaboration with industry experts into various challenge-based learning programs to prepare students for transdisciplinary research and engagement. These approaches help prepare students to tackle real-world problems in a holistic and collaborative manner, while reinforcing the need for educational organisations to foster an environment supportive of transdisciplinary methodologies.

Di Giulio and Defila's (2017) research supports and expands on the idea that embedding sustainability competencies within higher education curricula is essential for fostering inter- and transdisciplinary research. Additionally, they emphasise the importance of professional development for educators, ensuring they are equipped not only to

teach these competencies but also to model interdisciplinary collaboration in their own research practices (Di Giulio and Defila, 2017). It is recommended that universities provide educators with support to develop their own skills to facilitate transdisciplinary learning and research (Shephard et al., 2019).

The approach to teaching and curriculum does influence institutional culture, particularly in how it integrates and prioritises transdisciplinary research. Some organisations integrate transdisciplinary research across their entire teaching and learning approach, while others confine it to specific courses or centres. When embraced throughout the organisation, transdisciplinarity becomes a foundational focus, building on yet going beyond traditional disciplinary knowledge approaches.

Textbox 7: Ways forward for teaching and curriculum to enhance transdisciplinary work.

- **Foster transdisciplinary learning and research through curriculum design** through deliberate incorporation of sustainability and transdisciplinary approaches, ensuring alignment with transdisciplinary research principles (Shephard et al., 2019; ETH Zurich, 2024; Tomorrow University of Applied Sciences, 2024; Lozano, 2006).
- **Develop transdisciplinary competences in students** including critical, relational, futures, normative and systems thinking skills to address complex societal challenges in co-creation with stakeholders (Shephard et al., 2019; Di Giulio and Defila, 2017, e.g. Chalmers University of Technology, 2024; ETH Zurich, Leuphana University Faculty of Sustainability).
- **Provide educators with professional development** opportunities to support interdisciplinary teaching and collaboration (Di Giulio and Defila, 2017).
- **Integrate and prioritise transdisciplinary thinking** in student education – either through specific courses or along the entire teaching and learning approach. (e.g. Chalmers University of Technology, 2024; ETH Zurich, Leuphana University Faculty of Sustainability).
- **Integrate key areas into training** via structural changes within curricula and research practices to recognize and incorporate the value of diverse disciplinary contributions, balance methodologies, generate new concepts for shared understanding, and engage with societal contexts. Integrating these elements into training is essential for fostering the necessary research capabilities, attitudes, practices, and mindsets (Muhar et al., 2013).

[27] https://challengelab.chalmers.se/
[28] https://usys.ethz.ch/en/research/TdLab.html
[29] https://www.leuphana.de/en/college/bachelor/bsc-global-environmental-and-sustainability-studies/curriculum.html
[31] https://www.tomorrow.university/

2. 7 Funding

Funding is a key dimension to enable or hinder transdisciplinary work and refers to the practices, processes and conditions of financing transdisciplinarity. Funding can enable researchers to collaborate across disciplines, sustain long-term efforts, build capacity, and mobilise knowledge for societal benefit. When we think of funding, important issues emerging from the literature are questions around what is being funded, who provides the funding, how long is funding provided and what is the nature of the funding.

Sellberg et al. (2021) see a number of core functions to which funding bodies can contribute to enable transdisciplinary work and further its institutionalization. This includes support for building the necessary competencies amongst researchers and educators (see also section 2.5 on Training). Additionally, funding can enable longer-term projects and give the necessary space, time and support to iterative and collaborative processes of knowledge co-production. For example, Gluckman and Kaiser (2023) acknowledge that "consultation takes time and cannot be tokenistic. When projects involve many partners, the costs of running them can easily reach very large sums (2023: p.34)." Crucially, funding bodies need to have a genuine understanding of what transdisciplinary research requires in terms of time, resources, methodologies and evaluation. Their willingness is needed to support research that may not fit traditional disciplinary boundaries. Only if funders recognise the significant time, resource, partnership, and engagement requirements inherent to transdisciplinary process, they will offer the funding tailored to support the realities and expenses of such work. Funding programmes focusing specifically on transdisciplinary work include the Belmont Forum[32] as an international example, while the Dutch Climate Research Initiative[33] aimed to provide national funding that puts collaboration first and is mission driven. A regional example is ACCEZ[34], a research programme funded by the Province of South Holland, its universities and the employer organisation to accelerate the transition to a circular economy in the region driven by science-society-policy knowledge development.

Textbox 8: Ways forward for funding to enhance transdisciplinary work.

- **Create awareness among funding bodies** about what transdisciplinary research requires in terms of time, resources, methodologies and evaluation (Gluckman and Kaiser 2023)
- **Ensure funding schemes are flexible to accommodate** for flexible and iterative research protocols in response to initial findings, for different and changing needs throughout the research process (Otero et al., 2023; Campbell et al., 2015).
- **Ensure continuity and longevity of funding** since transdisciplinary research has longer timeframes and also might continue along different cycles (Muhar et al., 2013; Campbell et al., 2015)
- **Prioritise societal impact and participatory engagement** in transdisciplinary research projects to demonstrate clear pathways to societal impact and long-term sustainability (Sellberg et al., 2021).
- **Support the development of structures and mechanisms that can sustain the outcomes and collaborations** generated through transdisciplinary research initiatives (OECD Report, 2020).
- **Create tailored funding mechanisms** that institutions can utilize for different funding requirements, including seed funds, financial backing for event organisation, and governance structures (Otero et al., 2020).

A related question is who provides funding opportunities and incentives for transdisciplinary work. This not only concerns external funding agencies but should include also institutes or universities (Fazey et al., 2020). Here the commitment from university leadership has been shown to be vital, both to support striving for external funding as well as for securing internal funding sources (Muhar et al., 2013). Otero et al. (2020)'s data showed that transdisciplinary research was developed by the organisations supporting various funding paths: seed funds including for pilot projects, financial support for event organisation, as well as for the governance structure running transdisciplinary projects or research centres. Pilot projects provide space for innovative ideas given their flexibility, allowing for adaptations and possible failure, which decreased pressure and allows for continuous adaptation based on participant contributions.

[32] https://www.belmontforum.org/, Vermeer et al., 2020
[33] https://www.nwo.nl/en/kin
[34] https://accez.nl/, Design Impact Transition Platform 2023.

Another question arises around the longevity and continuity of the funding provided. While seed funding might be available to start off research programs, a longer-term funding perspective is needed for continuing research and secure employments (Muhar et al., 2013). The continuity of funding is particularly crucial to the success of transdisciplinary research as they have a longer time horizon. Campbell et al. (2015) stress the importance to have minimal gaps between funding periods, arguing that this enables funders to take long term view, and maintains the staff, relationships, knowledge that have been developed in one funding period. Luthe (2017) argues for main project funding to be "smoothly available and based on success of initiation funding" (p.13), allowing effective bridging from pre-project phases to the project itself. The author also notes that many successful projects emerge as follow-ups from previous projects in which relationships have already been developed. To have transition funding quickly available could better support these follow-up projects. In sum, Gluckman and Kaiser (2023) advocate for innovative funding models that better accommodate the collaborative and long-term nature of transdisciplinary research, calling for flexibility and responsiveness from funding agencies. They recommend a "cascading life cycle" funding model to account for the lengthy, iterative co-design phases and evolving nature of transdisciplinary projects.

Funding needs to flexible. This includes to accept possible changes within transdisciplinary research organisations and their research projects over the course of the funding period (Otero et al., 2020). Research funding programs could likewise incorporate measures to favour serendipity, for example, allowing project leaders to redefine goals and methods based on interactions with societal stakeholders during a project. Otero et al. (2020) suggest increasing the capacity of funding programs to enhance transdisciplinarity by allocating resources for the 'unknown' parts of transdisciplinary research. This flexibility also extends to the possibility of integrating different funding sources. Trencher et al. (2013) confirms that various "green stimulus funds" have worked to create several large partnerships, meaning that the formulation of such funds could, in the future, encourage further partnerships. It is recommended that funding also covers specific expertise relevant to transdisciplinary work. Campbell et al (2015) for instance suggest that 10% of budgets is allocated to knowledge brokerage (which they understand as professional intermediaries, organisations or individuals) and note that this is especially useful if undertaken before research is initiated.

What is proposed is not only a new role for funders where they have shared goals with stakeholders and researcher (Campbell et al., 2015) but a full reassessment of current knowledge systems as a radical but necessary step. Arnott et al. (2020) underscore the importance of recognizing and valuing diverse knowledge systems, advocating for funding mechanisms that support meaningful collaboration and engagement across different knowledge holders. They suggest restructuring funding models to enable the integration of diverse knowledge sources through the co-production process. This emphasises the need for funders and institutions to reassess their approaches to better support transdisciplinary knowledge co-production for sustainability solutions. It is recommended that funding is focused on "developing wisdom not just knowledge", regarding how to act in the world to solve sustainability challenges (Fazey et al., 2020).

Allocating funding to address key areas can significantly shape the institutional culture and foster a more supportive environment for transdisciplinary research. This includes shaping project scopes and stakeholder engagement to promote collaborative and inclusive approaches, as well as addressing institutional and disciplinary barriers posed by traditional academic structures and disciplinary silos. Funding that encourages collaborative adaptive management and flexible research protocols can further cultivate an institutional culture that is responsive and adaptable to the needs of transdisciplinary research. Moreover, prioritising societal impact and sustainability through funding requirements for clear pathways to real-world problem-solving can shift institutional emphasis towards practical application of research. However, establishing funding for transdisciplinary institutes or projects alone may be insufficient to cultivate transdisciplinary research (Felt et al., 2013). Further commitment from university leadership is vital to drive change, as well as dedicated organisational values and respective training and curriculum measures. This underscores the importance of an institutional culture to incorporate a broadly shared idea of transdisciplinary research and education.

2.8 Reward Structures

Reward structures refer to the formal and informal guidelines, mechanisms and practices which describe what academics ought to do and/or through which academics and their work are evaluated and rewarded in monetary and non-monetary terms. This includes the university and the broader academic system. These reward structures in universities significantly influence the engagement in transdisciplinary research, affecting support, incentives, and evaluation metrics in various ways. Key questions include what forms of support are available, who administers this support, how long it is sustained, and what criteria are used to evaluate and reward researchers' efforts.

Transdisciplinary research often lacks the support and rewards needed for researchers wanting to engage in transdisciplinary research and solve real-world sustainability issues (Trencher et al., 2013; Kump et al., 2023). The scientific reward system is traditionally based on a disciplinary logic, emphasizing individual achievements in specialised disciplines. Outputs like peer-reviewed articles are valued over other forms of contributions such as collaborative efforts, practical applications, and public engagement. This discourages transdisciplinary or engaged research (Lauto and Sengoku, 2015). Kump et al. (2023) emphasise that traditional academic reward structures often fail to recognise the unique contributions of transdisciplinary work. A specific challenge relates to balancing the demands of traditional academic publishing with the need to communicate their findings to broader, non-scientific audiences. This includes identifying appropriate channels for communication and valuing place-based sustainability collaborations (Muhar et al., 2013).

The current academic and tenure systems do not adequately reward these efforts, making it difficult for researchers to justify the time spent on transdisciplinary activities (Trencher et al., 2013). In response to the evolving landscape of academic research, there is a growing consensus among scholars calling for new evaluation standards that recognise and value transdisciplinary research endeavours (Otero et al., 2020; Care et al., 2021). Such standards would allow to "overcome the paradox of the disciplinary assessment of interdisciplinary work" (Sengoku 2015). To compensate for the risk taken by researchers to pursue transdisciplinary research, it is recommended that research organisations develop new career evaluation standards that value such work (Otero et al., 2020; Care et al., 2021). This includes developing porous boundaries within academia to enable real-world experiences, and creating accessible, diverse, and transparent career progression paths (Otero et al., 2020).

Lemos et al. (2018) suggest "carefully designing outcome-oriented evaluations that focus not only on the process but also on understanding what drives the desired impact." Care et al. (2021) call for changes within the existing evaluation systems to encourage "doing less better," meaning encouraging slow and careful research and publication. Therefore, evaluation systems are needed "evaluating academic contributions based on quality, not quantity." Paasche and Osterblom (2019) call for alternative metrics to "capture the actual value of scientific work beyond publications." They propose solutions such as tracking how and when people interact with a scientific article via social media, or with policy or other public documents. This approach broadens the scope towards value and impact outside academia, allowing scientists to focus on collaborative identifying the right questions and optimal

Textbox 9: Ways forward for **reward structures** to enhance transdisciplinary work.

- **Develop new career evaluation standards** that specifically acknowledge and compensate for the risks inherent in transdisciplinary research engagement (Otero et al., 2020; Care et al., 2021; Lauto & Sengoku, 2015; Mansilla, 2006).
- **Design both process and outcome-oriented evaluations processes and metrics** Those can prioritise quality over quantity and focus on understanding and achieving desired impacts (Lemos et al., 2018; Care et al., 2021) such as those broader values of scientific contributions beyond traditional publications and citations (Paasche and Osterblom, 2019).
- **Implement institutional policies and organisational arrangements to safeguard transdisciplinary researchers** from direct competition with those focused on monodisciplinary research, and which incentivise transdisciplinary work across career stages (Lauto and Sengoku, 2015).
- **Utilise evaluation processes with long-term perspectives and involve diverse stakeholders**, inclusive of non-academic entities, to capture comprehensive impacts, such as contributions to real-world problems and policy changes (Sellberg et al., 2021)

solutions, and to work across disciplinary and institutional boundaries.

The current, discipline-oriented reward system is especially challenging for those researchers on a fixed term contract or on a tenure track but wanting to engage in transdisciplinary research (Kump et al., 2023). However, empowering all researchers seems vital for the success of transdisciplinary research: Pascoe et al. (2020) touches upon the casualization of labour, gendered and racial inequalities, and exploitative research practices. They call on organisations to reflect on the precarity faced by their own researchers and workers. Career stage in general is impacting researcher's overall willingness to work in transdisciplinary projects (Felt et al., 2016; Lauto & Sengoku, 2015). Perceptions of the advantages of transdisciplinary research for career advancement grow with academic ranking (Lauto and Sengoku 2015). Junior scholars in a Japanese case study were often disadvantaged in achieving tenure if they pursue interdisciplinary doctoral dissertations (Lauto & Sengoku, 2015; Millar, 2013). Supportive environments and policies for junior scholars to engage in transdisciplinary research without compromising their career progression are needed (Sabharwal & Hu, 2013; Bunton & Mallon, 2007). To protect academics pursuing transdisciplinary research from direct competition with colleagues focusing on monodisciplinary research, policies and organisational arrangements including the award of permanent positions need to be adapted (Lauto and Sengoku, 2015). Such arrangements might also help reduce possible conflicts between junior and senior scholars working on the same team.

To enable the academic system to better value transdisciplinary science on equal terms with monodisciplinary research, reward systems must codify the intentions to recognise and incentivise transdisciplinary research (Care et al., 2021). It is recommended that evaluation metrics are reformed to reflect the importance of co-production processes, stakeholder relationships, and societal outcomes, rather than solely relying on traditional metrics like peer-reviewed publications and citations (Felt et al., 2016; Dilling and Lemos, 2009, Sellberg et al., 2021). Methods to evaluate the impact of transdisciplinary research can include engaging with stakeholders. This allows to understand the relevance and usefulness of the research, assessing the extent to which the research has contributed to addressing real-world problems, and evaluating the extent to which the research has led to changes in policies, practices, and behaviours. Evaluating the impact of transdisciplinary research requires taking a long-term perspective, as the impacts of transdisciplinary research may take time to materialise (Sellberg et al., 2021).

Reward structures that support transdisciplinary research can significantly shape institutional culture by fostering collaboration and interdisciplinarity, prioritising societal impact and engagement, enabling flexible and adaptive research approaches. They support capacity building and career development and promoting the integration of diverse academic and non-academic participants. These structures can help overcome traditional academic barriers, recognise contributions beyond conventional metrics, and equip researchers with the necessary skills for successful transdisciplinary work. Ultimately reward structures signal the institution's commitment to collaboration, knowledge co-production, and real-world problem-solving.

3. Concluding discussion

Undoubtedly there is an increasing interest in and support for transdisciplinary work. Funders are moving in this direction; society increasingly demands universities to be socially relevant and the persistent ecological and social challenges require transdisciplinary and transformative approaches. This growing interest is reflected in the bourgeoning literature on the topic. However, there are only very limited examples of research organisations that take transdisciplinarity as their central approach, which makes it still a relatively new and developing area of academic practice. It is often pursued by engaged academics and has been developed within a sometimes hostile or at least disadvantageous context. Yet, as the demand for transdisciplinary work is growing, its practices are professionalising and the pressures on existing institutional structures to adapt are increasing, a window of opportunity for more fundamental institutional change to accommodate transdisciplinarity is opening. Despite the persistent 'cultural resistance from within', it is inevitable that more and more space and support will emerge.

Within this context, we endeavoured to shed light on the multifaceted dynamics of transdisciplinary

research and aimed to contribute to a deeper understanding of its complexities and potentials within contemporary scholarship and practice. Recognizing the expansive and dynamic nature of this domain, the nine dimensions influencing the institutionalisation of transdisciplinary work suggested by us are to provide a robust basis and starting point for thinking more strategically about such institutionalisation. Assessing the current landscape across those dimensions revealed both advancements and areas necessitating further investigation. What is particularly evident, is that research often addresses a specific dimension of an issue or object but remains fragmented. This also applies to research into organisational structures, which has witnessed burgeoning interest, yet lacks comparative discussions across different types of structures and contextual settings, such as comparisons across different national contexts, inter-organisational collaboration or internal department structures. Similarly, there is much attention for leaderships, training and teaching, underlining the need for more support and capacity building to enable academics to take on different roles and be able to work productively in a transdisciplinary context. Yet the literature lacks more systemic attention for topics such as addressing power dynamics in practice, creating space within educational funding and programs for transdisciplinarity, or how to effectively deal with mediating between different disciplines and types of knowledge. It is also clear from the literature that new recognition and reward systems are needed, and it signals the challenges posed by traditional academic performance metrics and the imperative for innovative approaches, whereby there is still extensive work to be done to achieve the desired new metrics or evaluation criteria.

We also acknowledge several limitations to the present discussion paper, such as potential gaps regarding being comprehensive of all relevant factors influencing transdisciplinary work in research organisations. Such limitations can not only originate from biases of the literature search process we employed, including variations in terminology, but as well originate from the focus on academic sources in English. Further limitations arise regarding the possibility of understanding and presenting the complexity of institutionalizing transdisciplinarity, both internally in specific organisations, as well as regarding variations across contexts. Accordingly, we seek to provide a collection of dimensions that have been attributed specific relevance for transdisciplinary work within research organisations. Yet, we must abstain from presenting an integrated synthesis outlining how different factors interact in general and in various contexts specifically. Thus, while the study offers insights into key dimensions influencing institutionalization, we acknowledge the need for and invite further discussion, critique, and refinement.

Possible avenues for future research in enabling transdisciplinary work involve further addressing the gaps identified in recent academic literature. One avenue is investigating how organisational values influence the success of transdisciplinary research projects, necessitating qualitative studies and quantitative analyses to understand alignment and its impact. Additionally, research could focus on the political dimensions of transdisciplinary research, integrating insights from political science and sociology to manage power dynamics and value conflicts effectively. Another avenue involves capturing practitioners' perspectives on transdisciplinary research to identify common barriers and strategies for success. Understanding the dynamics of inter-organisational collaboration in transdisciplinary research contexts is crucial, requiring studies on facilitators, governance models, and collaborative capacity-building strategies. Finally, examining leadership behaviours and collaboration patterns in transdisciplinary research projects can inform effective leadership approaches and training programmes. These research avenues offer opportunities to advance our understanding of how to overcome barriers and foster successful transdisciplinary research, contributing to more effective strategies for interdisciplinary collaboration and societal problem-solving.

Yet, in the spirit of transdisciplinarity, we argue that it is perhaps most of all about actually carrying out (or ‘doing’) institutional transformation. Our overview in essence summarises the work of academics that, by doing, transform the way we collectively understand, appreciate, and embed transdisciplinarity. By building a scientific and methodological foundation, by creating new practices, by lobbying university boards, by convincing funders and by creating positive societal impact, transdisciplinarity is gradually developing out of its niche towards mainstream. Our collective challenge is thus to anticipate and build the growing momentum to work on institutional

changes that will enable and support others to also engage more. This will require institutional support and leadership: the cultural resistance against mainstreaming transdisciplinarity is often still strong and the transdisciplinary academics within existing institutions are often relatively small in numbers and scattered across schools, faculties, and departments. Only if they can connect across existing institutional barriers, evidence the academic quality and societal impact of their work, attract funding and students, and find a supportive institutional leadership, a more systemic change might be possible.

While this seems daunting or even impossible, certainly from the perspective of individual academics, our overview provides comfort in showing the possibilities as well as the increasing momentum for transdisciplinarity. There is still a long way to go, but there are at least six concrete institutional changes emerging that could be pushed further. Firstly, these are the funding mandates that increasingly support transdisciplinarity but should more explicitly include support for inclusion of other types of knowledge and the time needed for organisation and facilitation. Second, assessment criteria should be developed to assess and appreciate indirect impacts and process capacities. This also means, thirdly, that selection and recruitment should also focus on attracting different profiles and capacities and should think along the lines of creating teams. Fourth, institutional settings need to be designed for supporting team science, engagement, and co-creation, for example through creating fellowships, new engagement methods and investing in network building and communication. Fifthly, organisations need to start emphasizing collaboration over competition to create a ´critical mass´ guided by a sense of collective impact towards contributing collectively to sustainable development goals while encouraging knowledge sharing. Lastly, if research organisations, funders and research ministries are serious about leveraging transdisciplinarity for transformative change, they need to take a much more proactive and coordinated approach to create the needed institutional context that is conducive to transdisciplinary research.

To conclude, our analysis of the literature, even though limited given the breadth and depth of papers and books on the topic, shows a myriad of possible strategies, actions and steps that could be taken. As such, it provides, in a way, a guide for institutional change: how to design an institutional environment within academia that supports transdisciplinarity? This would imply a very fundamental shift in the understanding of the role of academic, what and how quality is determined, how funding and reward systems work and how it operates in society. It is happening across the globe, but in fragmented and uncoordinated ways, our overview is intended to add to convergence and our collective ability to accelerate the institutional shift to empower academics to support societal transformations by working on these in and with practice.

References

Adomssent, M., Godemann, J., & Michelsen, G. (2007). Transferability of approaches to sustainable development at universities as a challenge. International Journal of Sustainability in Higher Education, 8(4), 385–402. https://doi.org/10.1108/14676370710823564

Archibald, M. M., Lawless, M. T., de Plaza, M. A. P., & Kitson, A. L. (2023). How transdisciplinary research teams learn to do knowledge translation (KT), and how KT in turn impacts transdisciplinary research: a realist evaluation and longitudinal case study. Health Research Policy and Systems, 21(1), 20. https://doi.org/10.1186/s12961-023-00967-x

Arnott, J. C., Mach, K. J., & Wong-Parodi, G. (2020). Editorial overview: The science of actionable knowledge. Current Opinion in Environmental Sustainability, 42, A1–A5. https://doi.org/10.1016/j.cosust.2020.03.007

Blythe, J., Silver, J., Evans, L., Armitage, D., Bennett, N. J., Moore, M., Morrison, T. H., & Brown, K. (2018). The Dark Side of Transformation: Latent Risks in Contemporary Sustainability Discourse. Antipode, 50(5), 1206–1223. https://doi.org/10.1111/anti.12405

Boone, C. G., Pickett, S. T. A., Bammer, G., Bawa, K., Dunne, J. A., Gordon, I. J., Hart, D., Hellmann, J., Miller, A., New, M., Ometto, J. P., Taylor, K., Wendorf, G., Agrawal, A., Bertsch, P., Campbell, C., Dodd, P., Janetos, A., & Mallee, H. (2020). Preparing interdisciplinary leadership for a sustainable future. Sustainability Science, 15(6), 1723–1733. https://doi.org/10.1007/s11625-020-00823-9

Boyd, D., Buizer, M., Schibeci, R., & Baudains, C. (2015). Prompting transdisciplinary research: Promising futures for using the performance metaphor in research. Futures, 65, 175–184. https://doi.org/10.1016/j.futures.2014.10.014

Budwig, N., & Alexander, A. J. (2020). A Transdisciplinary Approach to Student Learning and Development in University Settings. Frontiers in Psychology, 11. https://doi.org/10.3389/fpsyg.2020.576250

Bunton, S., & Mallon, W. (2007). The Continued Evolution of Tenure Policies for The Continued Evolution of Tenure Policies for Clinical Faculty at U.S. Medical Schools Clinical Faculty at U.S. Medical Schools. https://pdxscholar.library.pdx.edu/elp_fac

The future of research is transdisciplinary. Maastricht University. https://www.maastrichtuniversity.nl/research/school-caphri-care-and-public-health-research-institute/our-research/health-inequities-3

Campbell, C. A., Lefroy, E. C., Caddy-Retalic, S., Bax, N., Doherty, P. J., Douglas, M. M., Johnson, D., Possingham, H. P., Specht, A., Tarte, D., & West, J. (2015). Designing environmental research for impact. Science of The Total Environment, 534, 4–13. https://doi.org/10.1016/j.scitotenv.2014.11.089

Caniglia, G., Luederitz, C., von Wirth, T., Fazey, I., Martín-López, B., Hondrila, K., König, A., von Wehrden, H., Schäpke, N. A., Laubichler, M. D., & Lang, D. J. (2020). A pluralistic and integrated approach to action-oriented knowledge for sustainability. Nature Sustainability, 4(2), 93–100. https://doi.org/10.1038/s41893-020-00616-z

Care, O., Bernstein, M. J., Chapman, M., Diaz Reviriego, I., Dressler, G., Felipe-Lucia, M. R., Friis, C., Graham, S., Hänke, H., Haider, L. J., Hernández-Morcillo, M., Hoffmann, H., Kernecker, M., Nicol, P., Piñeiro, C., Pitt, H., Schill, C., Seufert, V., Shu, K., … Zaehringer, J. G. (2021). Creating leadership collectives for sustainability transformations. Sustainability Science, 16(2), 703–708. https://doi.org/10.1007/s11625-021-00909-y

Chambers, J. M., Wyborn, C., Ryan, M. E., Reid, R. S., Riechers, M., Serban, A., Bennett, N. J., Cvitanovic, C., Fernández-Giménez, M. E., Galvin, K. A., Goldstein, B. E., Klenk, N. L., Tengö, M., Brennan, R., Cockburn, J. J., Hill, R., Munera, C., Nel, J. L., Österblom, H., … Pickering, T. (2021). Six modes of co-production for sustainability. Nature Sustainability, 4(11), 983–996. https://doi.org/10.1038/s41893-021-00755-x

Cornell, S., Berkhout, F., Tuinstra, W., Tàbara, J. D., Jäger, J., Chabay, I., de Wit, B., Langlais, R., Mills, D., Moll, P., Otto, I. M., Petersen, A., Pohl, C., & van Kerkhoff, L. (2013). Opening up knowledge systems for better responses to global environmental change. Environmental Science & Policy, 28, 60–70. https://doi.org/https://doi.org/10.1016/j.envsci.2012.11.008

Cuesta-Claros, A., Malekpour, S., Raven, R., & Kestin, T. (2022). Understanding the roles of universities for sustainable development transformations: A framing analysis of university models. Sustainable Development, 30(4), 525–538. https://doi.org/10.1002/sd.2247

di Giulio, A., & Defila, R. (2017). Enabling university educators to equip students with inter- and transdisciplinary competencies. International Journal of Sustainability in Higher Education, 18(5), 630–647. https://doi.org/10.1108/IJSHE-02-2016-0030

Dilling, L., & Lemos, M. C. (2011). Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. Global Environmental Change, 21(2), 680–689. https://doi.org/10.1016/j.gloenvcha.2010.11.006

Dorland, J., Clausen, C., & Jørgensen, M. S. (2019). Space configurations for empowering university-community interactions. Science and Public Policy, 46(5), 689–701. https://doi.org/10.1093/scipol/scz022

Fazey, I., Schäpke, N., Caniglia, G., Hodgson, A., Kendrick, I., Lyon, C., Page, G., Patterson, J., Riedy, C., Strasser, T., Verveen, S., Adams, D., Goldstein, B., Klaes, M., Leicester, G., Linyard, A., McCurdy, A., Ryan, P., Sharpe, B., … Young, H. R. (2020). Transforming knowledge systems for life on Earth: Visions of future systems and how to get there. Energy Research & Social Science, 70, 101724. https://doi.org/10.1016/j.erss.2020.101724

Fazey, I., Schäpke, N., Caniglia, G., Patterson, J., Hultman, J., van Mierlo, B., Säwe, F., Wiek, A., Wittmayer, J., Aldunce,

P., al Waer, H., Battacharya, N., Bradbury, H., Carmen, E., Colvin, J., Cvitanovic, C., D'Souza, M., Gopel, M., Goldstein, B., … Wyborn, C. (2018). Ten essentials for action-oriented and second order energy transitions, transformations and climate change research. Energy Research & Social Science, 40, 54–70. https://doi.org/10.1016/j.erss.2017.11.026

Felt, U., Igelsböck, J., Schikowitz, A., & Völker, T. (2016). Transdisciplinary Sustainability Research in Practice: Between Imaginaries of Collective Experimentation and Entrenched Academic Value Orders. Science, Technology, & Human Values, 41(4), 732–761. http://www.jstor.org/stable/24778197

Folke, C., Polasky, S., Rockström, J., Galaz, V., Westley, F., Lamont, M., Scheffer, M., Österblom, H., Carpenter, S. R., Chapin, F. S., Seto, K. C., Weber, E. U., Crona, B. I., Daily, G. C., Dasgupta, P., Gaffney, O., Gordon, L. J., Hoff, H., Levin, S. A., … Walker, B. H. (2021). Our future in the Anthropocene biosphere. Ambio, 50(4), 834–869. https://doi.org/10.1007/s13280-021-01544-8

Freese, J., Rauf, T., & Voelkel, J. G. (2022). Advances in transparency and reproducibility in the social sciences. Social Science Research, 107, 102770. https://doi.org/10.1016/j.ssresearch.2022.102770

Funding & Governing Transdisciplinary Sustainability programmes: Lessons from 5 years of ACCEZ. (2023).

Ghent University (2022). Critical Reflection on Ghent University's Education Policy. https://www.ugent.be/en/ghentuniv/mission/educational-strategy/ghent-university-critical-reflection.pdf

Gluckman, P., & Kaiser, M. (2023). Looking at the Future of Transdisciplinary Research. https://doi.org/10.24948/2023.05

Gray, C. S. (2022). Overcoming Political Fragmentation: The Potential of Meso-Level Mechanisms Comment on "Integration or Fragmentation of Health Care? Examining Policies and Politics in a Belgian Case Study." International Journal of Health Policy and Management. https://doi.org/10.34172/ijhpm.2022.7075

Guimarães, M. H., Pohl, C., Bina, O., & Varanda, M. (2019). Who is doing inter- and transdisciplinary research, and why? An empirical study of motivations, attitudes, skills, and behaviours. Futures, 112, 102441. https://doi.org/10.1016/J.FUTURES.2019.102441

Hahn, A., Kirschke, S., Caucci, S., Müller, A., Benavides, L., & Avellán, T. (2023). Perceptions of transdisciplinary research – A comparative case study from Latin America. Current Research in Environmental Sustainability, 5, 100207. https://doi.org/10.1016/j.crsust.2022.100207

Houser, M., Sullivan, A., Smiley, T., Muthukrishnan, R., Browning, E. G., Fudickar, A., Title, P., Bertram, J., & Whiteman, M. (2021). What fosters the success of a transdisciplinary environmental research institute? Reflections from an interdisciplinary research cohort. Elementa: Science of the Anthropocene, 9(1). https://doi.org/10.1525/elementa.2020.00132

Hugé, J., Block, T., Waas, T., Wright, T., & Dahdouh-Guebas, F. (2016). How to walk the talk? Developing actions for sustainability in academic research. Journal of Cleaner Production, 137, 83–92. https://doi.org/10.1016/j.jclepro.2016.07.010

Human Development Report 2023-24. UNDP (United Nations Development Programme). http://report.hdr.undp.org

Jahn, T., Bergmann, M., & Keil, F. (2012). Transdisciplinarity: Between mainstreaming and marginalization. Ecological Economics, 79, 1–10. https://doi.org/10.1016/j.ecolecon.2012.04.017

Kessel, F., & Rosenfield, P. L. (2008). Toward Transdisciplinary Research. American Journal of Preventive Medicine, 35(2), S225–S234. https://doi.org/10.1016/j.amepre.2008.05.005

Klein, J. (2004). Prospects for transdisciplinarity. Futures, 36(4), 515–526. https://doi.org/10.1016/j.futures.2003.10.007

Koier, E., & Horlings, E. (2015). How accurately does output reflect the nature and design of transdisciplinary research programmes? Research Evaluation, 24(1), 37–50. https://doi.org/10.1093/reseval/rvu027

Kump, B., Wittmayer, J., Bogner, K., & Beekman, M. (2023). Navigating force conflicts: A case study on strategies of transformative research in the current academic system. Journal of Cleaner Production, 412, 137374. https://doi.org/10.1016/j.jclepro.2023.137374

Lambrechts, W., van Liedekerke, L., & van Petegem, P. (2018). Higher education for sustainable development in Flanders: balancing between normative and transformative approaches. Environmental Education Research, 24(9), 1284–1300. https://doi.org/10.1080/13504622.2017.1378622

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling, M., & Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainability Science, 7(S1), 25–43. https://doi.org/10.1007/s11625-011-0149-x

Lauto, G., & Sengoku, S. (2015). Perceived incentives to transdisciplinarity in a Japanese university research center. Futures, 65, 136–149. https://doi.org/10.1016/j.futures.2014.10.010

Lawrence, M. G., Williams, S., Nanz, P., & Renn, O. (2022). Characteristics, potentials, and challenges of transdisciplinary research. One Earth, 5(1), 44–61. https://doi.org/10.1016/j.oneear.2021.12.010

Lemos, M. C., Arnott, J. C., Ardoin, N. M., Baja, K., Bednarek, A. T., Dewulf, A., Fieseler, C., Goodrich, K. A., Jagannathan, K., Klenk, N., Mach, K. J., Meadow, A. M., Meyer, R., Moss, R., Nichols, L., Sjostrom, K. D., Stults, M., Turnhout, E., Vaughan, C., … Wyborn, C. (2018). To co-produce or not to

co-produce. Nature Sustainability, 1(12), 722–724. https://doi.org/10.1038/s41893-018-0191-0

Loorbach, D. A., & Wittmayer, J. (2024). Transforming universities. Sustainability Science, 19(1), 19–33. https://doi.org/10.1007/s11625-023-01335-y

Lozano, R. (2006). Incorporation and institutionalization of SD into universities: breaking through barriers to change. Journal of Cleaner Production, 14(9–11), 787–796. https://doi.org/10.1016/j.jclepro.2005.12.010

Luthe, T. (2017). Success in Transdisciplinary Sustainability Research. Sustainability, 9(1), 71. https://doi.org/10.3390/su9010071

Lyall, C., & Meagher, L. R. (2012). A Masterclass in interdisciplinarity: Research into practice in training the next generation of interdisciplinary researchers. Futures, 44(6), 608–617. https://doi.org/10.1016/j.futures.2012.03.011

Maas, T. Y., Pauwelussen, A., & Turnhout, E. (2022). Co-producing the science–policy interface: towards common but differentiated responsibilities. Humanities and Social Sciences Communications, 9(1), 93. https://doi.org/10.1057/s41599-022-01108-5

Martens, K. (2021, January). Transdisciplinary research: Pain or Gain?

Mokiy, V. (2019). International Standard of Transdisciplinary Education and Transdisciplinary Competence. Informing Science: The International Journal of an Emerging Transdiscipline, 22, 073–090. https://doi.org/10.28945/4480

Muhar, A., Visser, J., & van Breda, J. (2013). Experiences from establishing structured inter- and transdisciplinary doctoral programs in sustainability: a comparison of two cases in South Africa and Austria. Journal of Cleaner Production, 61, 122–129. https://doi.org/10.1016/j.jclepro.2013.07.031

Norström, A. v., Cvitanovic, C., Löf, M. F., West, S., Wyborn, C., Balvanera, P., Bednarek, A. T., Bennett, E. M., Biggs, R., de Bremond, A., Campbell, B. M., Canadell, J. G., Carpenter, S. R., Folke, C., Fulton, E. A., Gaffney, O., Gelcich, S., Jouffray, J.-B., Leach, M., … Österblom, H. (2020). Principles for knowledge co-production in sustainability research. Nature Sustainability, 3(3), 182–190. https://doi.org/10.1038/s41893-019-0448-2

Nowotny, H. (2003). Democratising expertise and socially robust knowledge. Science and Public Policy, 30(3).

Nyang'au, I., Kelboro, G., Hornidge, A.-K., Midega, C., & Borgemeister, C. (2018). Transdisciplinary Research: Collaborative Leadership and Empowerment Towards Sustainability of Push–Pull Technology. Sustainability, 10(7), 2378. https://doi.org/10.3390/su10072378

O'Donovan, C., Michalec, A. (Ola), & Moon, J. R. (2022). Capabilities for transdisciplinary research. Research Evaluation, 31(1), 145–158. https://doi.org/10.1093/reseval/rvab038

Olsson, A. K., Bernhard, I., Arvemo, T., & Lundh Snis, U. (2021). A conceptual model for university-society research collaboration facilitating societal impact for local innovation. European Journal of Innovation Management, 24(4), 1335–1353. https://doi.org/10.1108/EJIM-04-2020-0159

Otero, I., Darbellay, F., Reynard, E., Hetényi, G., Perga, M.-E., Rüegg, J., Prasicek, G., Cracco, M., Fontcuberta, A., de Vaan, M., García, J., Bussard, J., Clivaz, C., Moos, C., Guisan, A., Schaefli, B., Mapelli, N., & de Bellefroid, B. (2020). Designing Inter- and Transdisciplinary Research on Mountains: What Place for the Unexpected? Mountain Research and Development, 40(4). https://doi.org/10.1659/MRD-JOURNAL-D-20-00036.1

Paasche, Ø., & Österblom, H. (2019). Unsustainable Science. One Earth, 1(1), 39–42. https://doi.org/10.1016/j.oneear.2019.08.011

Pascoe, S., Sanders, A., Rawluk, A., Satizábal, P., & Toumbourou, T. (2020). Holding Space for Alternative Futures in Academia and Beyond. Https://Antipodeonline.Org/2020/04/22/Holding-Space-for-Alternative-Futures-in-Academia-and-Beyond/.

Pickett, S. T., Kolasa, J., & Jones, C. G. (2010). Ecological understanding: the nature of theory and the theory of nature. Elsevier.

Polk, M. (2015). Transdisciplinary co-production: Designing and testing a transdisciplinary research framework for societal problem solving. Futures, 65, 110–122. https://doi.org/10.1016/j.futures.2014.11.001

Human Development Report 2023-24. UNDP (United Nations Development Programme). http://report.hdr.undp.org

Reed, M. S., & Fazey, I. (2021). Impact Culture: Transforming How Universities Tackle Twenty First Century Challenges. Frontiers in Sustainability, 2. https://doi.org/10.3389/frsus.2021.662296

Richardson, K., Steffen, W., Lucht, W., Bendtsen, J., Cornell, S. E., Donges, J. F., Drüke, M., Fetzer, I., Bala, G., von Bloh, W., Feulner, G., Fiedler, S., Gerten, D., Gleeson, T., Hofmann, M., Huiskamp, W., Kummu, M., Mohan, C., Nogués-Bravo, D., … Rockström, J. (2023). Earth beyond six of nine planetary boundaries. Science Advances, 9(37). https://doi.org/10.1126/sciadv.adh2458

Sabharwal, M., & Hu, Q. (2013). Participation in university-based research centers: Is it helping or hurting researchers? Research Policy, 42(6–7), 1301–1311. https://doi.org/10.1016/j.respol.2013.03.005

Sellberg, M. M., Cockburn, J., Holden, P. B., & Lam, D. P. M. (2021). Towards a caring transdisciplinary research practice: navigating science, society and self. Ecosystems and People, 17(1), 292–305. https://doi.org/10.1080/26395916.2021.1931452

Staffa, R. K., Riechers, M., & Martín-López, B. (2022). A feminist ethos for caring knowledge production in transdisciplinary sustainability science. Sustainability

Science, 17(1), 45–63. https://doi.org/10.1007/s11625-021-01064-0

Stokols, D., Fuqua, J., Gress, J., Harvey, R., Phillips, K., Baezconde-Garbanati, L., Unger, J., Palmer, P., Clark, M., Colby, S., Morgan, G., & Trochim, W. (2003). Evaluating transdisciplinary science. Nicotine & Tobacco Research, 5(6), 21–39. https://doi.org/10.1080/1462220031000162555

Swan, J., Bresnen, M., Robertson, M., Newell, S., & Dopson, S. (2010). When policy meets practice: Colliding logics and the challenges of 'Mode 2'initiatives in the translation of academic knowledge. Organization Studies, 31(9-10), 1311–1340. https://doi.org/10.1177/0170840610374402

Tejedor, G., Segalàs, J., & Rosas-Casals, M. (2018). Transdisciplinarity in higher education for sustainability: How discourses are approached in engineering education. Journal of Cleaner Production, 175, 29–37. https://doi.org/10.1016/j.jclepro.2017.11.085

Transdisciplinary Field Guide. (2024). Https://Www.Uu.Nl/En/Research/Transdisciplinary-Field-Guide/Get-Started.

Trencher, G. P., Yarime, M., & Kharrazi, A. (2013). Co-creating sustainability: cross-sector university collaborations for driving sustainable urban transformations. Journal of Cleaner Production, 50, 40–55. https://doi.org/10.1016/j.jclepro.2012.11.047

Trencher, G., Yarime, M., McCormick, K. B., Doll, C. N. H., & Kraines, S. B. (2014). Beyond the third mission: Exploring the emerging university function of co-creation for sustainability. Science and Public Policy, 41(2), 151–179. https://doi.org/10.1093/scipol/sct044

Tumer, I., Risien, J., & Marinelli, R. (2024). Connecting the University to Societies and Economies through Transdisciplinary approaches.

van Wijk, J., Zietsma, C., Dorado, S., de Bakker, F. G. A., & Martí, I. (2019). Social Innovation: Integrating Micro, Meso, and Macro Level Insights from Institutional Theory. Business & Society, 58(5), 887–918. https://doi.org/10.1177/0007650318789104

Vermeer J, Pinheiro H, Petrosova L, & Eaton D. (2020). Evaluation of the Belmont Forum: Final report.

Wilson, M. N., Laufer, A. E., Howard, E. M., & Wong-Ala, J. A. T. K. (2021). Lessons From the Trenches: Students' Perspectives of Their Own Marine Transdisciplinary Education. Frontiers in Marine Science, 7. https://doi.org/10.3389/fmars.2020.592368

Wittmayer, J. M., Huang, Y.-S., Bogner, K., Boyle, E., Hölscher, K., von Wirth, T., Boumans, T., Garst, J., Hendlin, Y. H., Lavanga, M., Loorbach, D., Mungekar, N., Tshangela, M., Vandekerckhove, P., & Vasques, A. (2024). Neither right nor wrong? Ethics of collaboration in transformative research for sustainable futures. Humanities and Social Sciences Communications, 11(1), 677. https://doi.org/10.1057/s41599-024-03178-z

Wittmayer, J. M., Loorbach, D., Bogner, K., Hölscher, K., Hendlin, Y., Lavanga, M., Vasques, A., von Wirth, T., & de Wal, M. (2021). Transformative Research: knowledge and action for just sustainability transitions. DIT Working paper for positioning transformative research.

Wittmayer, J. M., & Schäpke, N. (2014). Action, research and participation: roles of researchers in sustainability transitions. Sustainability Science, 9(4), 483–496. https://doi.org/10.1007/s11625-014-0258-4

Yeung, E., Carlin, L., Sandassie, S., & Jaglal, S. (2021). Transdisciplinary training: what does it take to address today's "wicked problems"? Innovation and Education, 3(1), 4. https://doi.org/10.1186/s42862-021-00011-1

DESIGN IMPACT TRANSITION PLATFORM

Design Impact Transition (DIT) platform

Erasmus University Rotterdam

Burgemeester Oudlaan 50

3062PA Rotterdam

dit@eur.nl

Website