



BTO 2016.081 | October 2016

## **BTO** report

Towards  
transdisciplinarity: a  
water research  
programme in transition



# BTO

## Towards transdisciplinarity: a water research programme in transition

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Mariëlle van der Zouwen

### Author(s)

Stijn Brouwer, Chris Büscher and Laurens K. Hessels

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### More information

Stijn Brouwer MA MSc PhD  
T (030) 606 9662  
E [Stijn.brouwer@kwrwater.nl](mailto:Stijn.brouwer@kwrwater.nl)

### Keywords

PO Box 1072  
3430 BB Nieuwegein  
The Netherlands

T +31 (0)30 60 69 511  
F +31 (0)30 60 61 165  
E [info@kwrwater.nl](mailto:info@kwrwater.nl)  
I [www.kwrwater.nl](http://www.kwrwater.nl)



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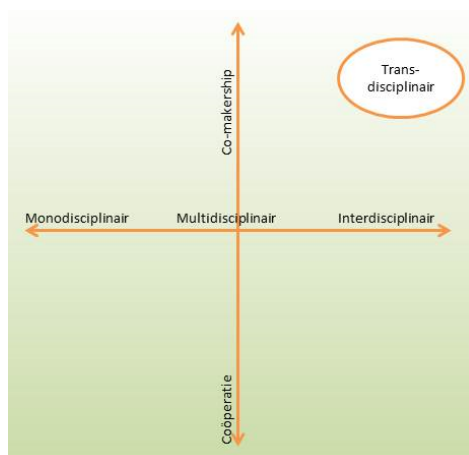
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# BTO Managementsamenvatting

## BTO-themagroepen ontwikkelen zich in co-makership en interdisciplinariteit

**Auteur(s)** Stijn Brouwer en Laurens Hessels

Empirisch onderzoek binnen het BTO heeft een duidelijker beeld opgeleverd van de verschillende soorten barrières en interventies die er zijn voor de realisatie van interdisciplinariteit en co-makership in het onderzoek. Het BTO streeft sinds 2013 naar meer interdisciplinariteit en co-makership omdat dit belangrijke hulpmiddelen zijn bij de aanpak van de grote maatschappelijke vraagstukken waar de drinkwatersector mee te maken heeft. Een van de mogelijke routes naar meer interdisciplinariteit en co-makership (samen aangeduid als transdisciplinariteit) ligt in de realisatie van themagroepen waarin de verschillende disciplines evenwichtig vertegenwoordigd zijn.



*Transdisciplinair onderzoek is een combinatie van interdisciplinariteit (integratie van verschillende discipline perspectieven) en co-makership (intensieve samenwerking tussen onderzoekers en professionals).*

### Belang: co-makership en interdisciplinariteit nodig bij aanpak grote vraagstukken

Sinds 2013 streeft het BTO naar zowel meer co-makership als meer interdisciplinariteit. Om effectief onderzoek te doen naar grote maatschappelijke vraagstukken zoals klimaatverandering is het immers nodig de perspectieven en methoden van verschillende disciplines te combineren (interdisciplinariteit) en om wetenschappers en professionals intensief te laten samenwerken (co-makership). Deze twee aspecten noemen we samen transdisciplinariteit. Het vormgeven van transdisciplinair onderzoek is een uitdaging op zichzelf. Tot nu toe bestond het

onderzoek naar transdisciplinariteit binnen 'Organiseren en Verbinden' voornamelijk uit literatuuronderzoek om te komen tot richtlijnen voor het organiseren van dit type onderzoek. Nu is voor het eerst empirisch onderzocht hoe transdisciplinair het BTO is en hoeveel interdisciplinariteit en co-makership de verschillende BTO themagroepen als wenselijk beschouwen. Daarbij is speciaal gelet op de barrières voor co-makership en interdisciplinariteit en de mogelijke manieren om deze barrières te slechten.

### Aanpak: literatuurstudie gecombineerd met 14 interviews binnen zes themagroepen

Eerst is door middel van literatuuronderzoek geïnventariseerd welke barrières voor transdisciplinair onderzoek er zijn en met wat voor interventies deze kunnen worden opgelost. Daarna is geanalyseerd hoe deze bekende barrières en daarbij horende interventies een rol spelen in de praktijk van zes geselecteerde themagroepen uit het BTO. Daarvoor zijn interviews gehouden met de voorzitters en de coördinatoren van deze themagroepen. Daarnaast is gesproken met de BTO programmamanager en de Chief Science Officer van KWR om meer inzicht te krijgen in de aanleiding voor en de omstandigheden rond het streven naar meer transdisciplinariteit.

### Resultaten: de meeste BTO-themagroepen werken steeds meer transdisciplinair

De transdisciplinaire insteek die het BTO sinds enkele jaren hanteert heeft de interactie tussen verschillende disciplines gestimuleerd. Hoewel de variatie op projectniveau aanzienlijk is, is het BTO als programma meer interdisciplinair geworden. In sommige gevallen heeft deze aanpak tegelijkertijd de integratie tussen wetenschappelijke kennis en praktijkkennis –co-makership– bevorderd. In andere gevallen blijkt de interactie tussen verschillende disciplines co-makership juist te hebben belemmerd: binnen de nieuwe opzet werden hoog-gespecialiseerde (disciplinaire) samenwerkingsstructuren tussen wetenschappers en professionals minder vanzelfsprekend. In vergelijking met literatuurbevindingen is het opvallend hoezeer de BTO onderzoekers praktijkkennis nadrukkelijk waarderen.

Het onderzoek heeft sociale, politieke, institutionele, methodologische en aan de kennistheorie gerelateerde barrières op een rij

gezet. Binnen de themagroepen worden de sociale en politieke barrières voor transdisciplinariteit het meest effectief uit de weg geruimd, zoals strijdige belangen met betrekking tot de onderzoeksagenda. De inhoudelijke barrières zijn het hardnekkigst. Zo vraagt het integreren van perspectieven uit verschillende disciplines extra tijd, waardoor conflicten kunnen ontstaan met gangbare prestatiecriteria. De meeste themagroepen willen in de nabije toekomst toe werken naar meer transdisciplinariteit, maar vinden het tegelijkertijd heel belangrijk dat er ook voldoende ruimte blijft voor het meer traditionele disciplinair ingerichte onderzoek.

### Implementatie: gerichte aanpak van barrières

Transdisciplinair werken biedt belangrijke kansen voor een effectieve aanpak van de grote maatschappelijke vraagstukken waar ook het BTO mee te maken heeft. In de praktijk is dit echter niet eenvoudig vorm te geven. Voor partijen die een transitie naar transdisciplinair onderzoek (willen) doormaken is het belangrijk oog te hebben voor de barrières en die gericht aan te pakken. Voor de aanpak van methodologische en aan de kennistheorie gerelateerde barrières zijn tijd en ruimte nodig. Bovendien is het verstandig na te gaan of de manier waarop de themagroepen worden samengesteld afdoende is, omdat de samenstelling van de themagroepen veel invloed blijkt te hebben op het realiseren van transdisciplinariteit.

### Rapport

Dit onderzoek is beschreven in het rapport *Towards transdisciplinarity: a water research programme in transition* (BTO-2016.081). Tevens zijn de onderzoeksresultaten ingediend bij het wetenschappelijk journal *Futures*.

# Summary

A transition towards a transdisciplinary approach in science is increasingly called for, yet our understanding of how such transitions actually occur in practice remains limited. This paper analyses a Dutch water research programme in transition from a mono- to a transdisciplinary structure. The main findings of the research are first, that efforts to embed a transdisciplinary approach stimulated interaction between different scientific disciplines (interdisciplinarity), but in some cases hampered the integration of non-academic knowledge and participation in research (co-creation). Second, the composition of transdisciplinary research groups matters deeply; in our research we found that practitioners had the biggest say, with consequences for research practice. Third, unlike the case of other studies on transdisciplinarity, most researchers in our case recognised the importance of integrating experiential knowledge in research.

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# 1 Introduction

The increasingly interrelated and complex water challenges the world is facing today, such as climate change, food and energy security, urbanization, and environmental degradation, cannot be exclusively addressed by research within disciplinary boundaries (Larsen et al., 2016; Pahl-Wostl et al., 2013). They require transdisciplinary (TD) research and knowledge production, in which different disciplinary approaches and contributions from both researchers and non-researchers are integrated (Lawrence, 2015; Pohl, 2011). The need for TD research, both in the water domain and beyond, is acknowledged by key players such as the European Commission, which has organised the current Framework Programme along grand challenges rather than disciplinary topics, and the Dutch national research council, NWO, which is currently transitioning from a disciplinary to a multidisciplinary organisational structure. In the same vein, research institutes and universities are organising an increasing share of their work in multidisciplinary centres, cooperative research entities or structures that coordinate research 'in the context of application' (Boardman et al., 2012; Rogers, 2012). It seems reasonable to assume that the need for transdisciplinary research will only continue to grow. However, a transition to TD research is easier said than done. Indeed, when setting up a new TD research programme, research organisations and individuals will face many constraints, including epistemological, social and institutional barriers (Kloet et al., 2013; Lauto and Sengoku, 2015; Rhoten, 2004).

In our reading, the (desired) shift towards a more transdisciplinary research system has attracted more conceptual than empirical attention in the literature. In particular, empirical evidence on the transition pathway from a disciplinary to a transdisciplinary research programme is scant and deals almost exclusively with academic research organisations. This paper addresses this lacuna by providing an analysis of an applied water research programme currently undergoing such a transition in practice. With the aim of improving the understanding of a transition from disciplinary to transdisciplinary research, this paper analyses the main institutional, methodological, social and political barriers researchers and practitioners experience in this transition and explores the interventions at their disposal to overcome these barriers and to facilitate TD research practices. The results of our analysis are intended to both enrich the theoretical understanding and to inform programme managers aspiring to make a similar transition.



## 2 Theoretical framework: barriers to and interventions for transdisciplinarity

In this paper, we refer to TD research as a mode of knowledge production which involves active contributions from different scientific disciplines and from practitioners. Our definition of transdisciplinarity therefore comprises two components: interdisciplinarity and knowledge co-creation. Interdisciplinarity is traditionally defined as the integration of theories or methods from different scientific disciplines (Klein, 1990). It can be contrasted to multidisciplinary (MD) research, which involves contributions from two or more disciplines, but in which each discipline operates independently, and the outcomes are ultimately combined (Huutoniemi et al., 2010). The second component of TD is knowledge co-creation, or the creative interaction between researchers and non-research actors. This implies that TD is a mode of research that takes into account different perspectives from both science and society (Benard and de Cock-Buning, 2014) or that includes collaboration between academic and non-academic actors (Pohl, 2011).

Over the past few decades the literature on transdisciplinary research has grown substantially. After its introduction in 1972 (Jantsch, 1972), the term gained momentum when it was designated as a key attribute of a new mode of knowledge production which contrasted with traditional academic research practice (Gibbons et al., 1994). There have been several publications on the barriers to and incentives for the participation of academic researchers in TD research, and on the mismatch between TD research and existing scientific institutions (Lauto and Sengoku, 2015; Lyall et al., 2015). Since an absence of appropriate procedures for quality control has been identified as one of the main obstacles to TD research, a lot of work has been done to develop approaches for the quality assurance and evaluation of this kind of research (Di Iacovo et al., 2016; Walter et al., 2007). Partly as a building block for quality control, numerous scholars have elaborated on the precise definition of the concept, and on indicators of transdisciplinarity (Huutoniemi et al., 2010; Pohl, 2011; Wickson et al., 2006). In terms of empirical analysis, the literature includes numerous case studies of transdisciplinary research programmes and learning processes on programme level (Benard and de Cock-Buning, 2014; Kloet et al., 2013). Others have focused on the project level, with quantitative analysis of the relationships between project characteristics and its results or satisfaction of the participants (Boon et al., 2014; de Jong et al., 2016). Although some of the above mentioned contributions deal with programmes including participation of non-academic research organisations (e.g. Boon et al., 2014 and Kloet et al. 2013), none of them focuses on a programme carried out exclusively by an applied research institute.

We have drawn on this growing body of literature to make an inventory of barriers to transdisciplinarity and possible interventions to cope with them. For this inventory we have also used publications that address either interdisciplinarity or knowledge co-creation, which we consider two key components of transdisciplinarity. The barriers we have identified can be divided into three categories: methodological and epistemological barriers (related to the content of the research), social and political barriers (related to communication and power

relationships between the participants), and institutional barriers (related to characteristics of the research system).

## 1. Methodological and epistemological barriers

- a. **Integrating disciplines is difficult and laborious.** The integration of knowledge from different disciplines requires overcoming fundamental epistemological differences, for example different conceptualisations of the same phenomenon (Klein, 1990) or different methodologies (Ramadier, 2004). This makes TD research activities more unpredictable and risky than disciplinary research, since it is uncertain whether they will yield a valued output (Kloet et al., 2013). Participants of TD research programmes at times have a limited ability or capacity to relate to other research fields with different approaches, framing and types of knowledge (Benard and de Cock-Buning, 2014). A quantitative analysis has also indicated that projects with a high level of partner diversity have more difficulties in combining or integrating research results (Boon et al., 2014).
- b. **Difficulties of integrating scientific with practical knowledge.** A related barrier concerns the challenge of transcending academic disciplines and recognising the relevance of experiential knowledge (Benard and de Cock-Buning, 2014). Given the novelty of the approach, TD methodologies and tools are less solid. Transfer of implicit knowledge requires more time than that of explicit knowledge (Roux et al., 2006). Many TD practices suffer from researchers' lack of openness to and interest in stakeholder preferences (Caron-Flinterman et al., 2007). Moreover, insufficient dialogue and consensus-building between researchers and practitioners will hinder the *implementation* of TD research outcomes (Darbellay, 2015). The involvement of practitioners can also threaten the objectivity or reliability of a research project. Researchers have to strike a balance between actively involving professionals/practitioners and protecting the independence and quality of the research (McNie, 2007; Van Buuren and Edelenbos, 2004).

## 2. Social and political barriers

- a. **Cultural differences.** In TD research, it can be difficult to overcome differences in the norms and values of various disciplines (Klein, 1990), and between those of research and practice (Mollinga, 2008, 2009). The general scientific norms of communalism, universalism, disinterestedness and organised scepticism (Merton, 1973) can clash with the organisational cultures of government or industry, which are more oriented towards power and profit, respectively. At the same time, scientific disciplines themselves also vary in terms of social stratification and communication cultures (Becher and Trowler, 2001; Whitley, 2000).
- b. **Conflicting interests.** Various conflicts can occur when collaborations involve different partners. These can for instance reflect the different priorities of the research partners and of the practitioners (Kloet et al., 2013), different expectations among the partners (Boon et al., 2014), or different problem definitions among actors (Hegger et al., 2012). For these reasons, the partners may pursue divergent strategic goals with a collaborative project.
- c. **Limited capacity.** The success of TD research depends crucially on an active and meaningful contribution from both practitioners and researchers. However, practitioners tend to play a more active role during the agenda-setting and a rather passive role during the execution of programmes or projects (Hessels et al., 2014). Their contribution can also be limited if they

lack the competences to articulate demands or formulate questions ([Caron-Flinterman et al., 2007](#)). Also, the motivation and skills of researchers to collaborate across disciplinary and organisational boundaries varies considerably ([Benard and de Cock-Buning, 2014](#); [van Rijnsoever et al., 2008](#)).

### 3. Institutional barriers

- a. **Reduced publication and career prospects.** In general, interdisciplinary research is more difficult to get published in high impact journals than disciplinary research ([Rafols et al., 2012](#)). This may be due to the tendency of scientific disciplines to defend their epistemological territory ([Klein, 1990](#)). A survey has also shown that disciplinary collaborations contribute more to career development than interdisciplinary collaborations ([van Rijnsoever and Hessels, 2011](#)).
- b. **Greater difficulty in accessing research funding.** Interdisciplinary research has a lower funding success rate than disciplinary research ([Bromham et al., 2016](#)). The established disciplinary structure strongly influences the allocation of research funding and is not always aligned with the practical questions requiring ([Caron-Flinterman et al., 2007](#)). Another obstacle to TD research funding may be its lack of a conceptual framework ([Lyll et al., 2015](#)). The available funding in the research system can even pressure TD programmes to take on a more disciplinary character ([Kloet et al., 2013](#)).
- c. **Lack of quality indicators.** The lack of generally accepted quality standards ([Jahn and Keil, 2015](#)), benchmarking tools or assessment criteria ([Kloet et al., 2013](#)), or of an officially accepted scoring system for societally relevant output ([Benard and de Cock-Buning, 2014](#)) are often mentioned as barriers to TD research. Suitable and appropriate quality indicators would facilitate learning across TD research projects and programmes, and make its achievements more rewarding in terms of visibility when compared to those of disciplinary research.

We have also identified a number of interventions from the literature that individuals or organisations can make in order to cope with the above barriers.

### Interventions

1. **Provide appropriate indicators and incentives.** Research organisations could change their evaluation systems and career paths to bolster the recognition of non-academic research output ([Lauto and Sengoku, 2015](#); [Rhoten, 2004](#)). The alignment of incentive systems of different participants ([Boon et al., 2014](#)) and the presence of innovations in reward structures ([Hegger et al., 2012](#)) have been shown to contribute to the success of individual TD research projects and programmes.
2. **Set a clear orientation.** Scholars recommend that programmes with an interdisciplinary and societal mission should work explicitly towards this mission from the start, since any reorientation at a later stage of the programme can be problematic ([Kloet et al., 2013](#)). In light of the temporary nature of most interdisciplinary or transdisciplinary research centres, ([Rhoten, 2004](#)) suggests that interdisciplinary centres should be established as permanent organisations with well-articulated organising principles (problems, products or projects).

3. **Facilitate leadership.** Strong leadership can reduce several barriers. A high-level commitment to the TD research goals (as opposed to more academic output) (Kloet et al., 2013), co-leadership with appropriate stakeholders (Goven et al., 2015), and continuity in leadership and management (Rhoten, 2004) have been mentioned as success factors. Some scholars advocate the appointment of an independent and professional facilitator for knowledge co-creation (Merkx, 2012).
4. **Develop personal competences.** Many studies point to individual qualities and competences as a success factor for TD research. Scholars recommend the involvement of people who are sensitive to different communication styles (Goven et al., 2015), who have an open attitude, conceptual skills, instrumental skills, behavioural and institutional design skills (Mollinga, 2009), and who are enthusiastic and have time available (Benard and de Cock-Buning, 2014). It may also help to appoint researchers on a flexible, intermittent basis to adjust to the uncertainty and unpredictability of TD research projects (Rhoten, 2004).
5. **Agree on a clear role division.** Several authors point to the importance of clarity about the role of different actors over the entire research process (Enengel et al., 2012). The role of researchers and their knowledge should be clear. Organised reflection on the division of tasks by participating actors has been shown to be beneficial (Hegger et al., 2012). Regarding the role of practitioners, it helps if they are made aware of their responsibility in building 'user readiness', that is, preparing the relevant actors within their organisation for the implementation of the knowledge (Roux et al., 2006).
6. **Stimulate intensive interactions.** Intensive interactions can help overcome methodological, epistemological and cultural barriers. Scholars have reported that high partner commitment (Boon et al., 2014), early involvement of stakeholders (Goven et al., 2015) and having partners spend significant time in the community (Goven et al., 2015) can contribute to the integration of knowledge. Proximity and regular contact between actors has been shown to help develop research programmes that match industrial needs (Hussler et al., 2010). Sharing intermediate results motivates partners to continue the research project and facilitates the implementation of the knowledge produced (Enengel et al., 2012). And creating a sense of 'ownership' of the research results contributes to the probability that the knowledge will be implemented (Roux et al., 2006).
7. **Choose the right team composition.** In terms of the actors involved in TD research, some recommend working with the broadest possible actor coalition given the selection available (Hegger et al., 2012). However, research has shown that finding the right balance between divergence and convergence of perspectives within a team can help make it both innovative and effective (Boon et al., 2014). In order to make it easier for researchers to divide their attention between their further development as scientists and their involvement in TD activities (second order learning), some recommend working with postdocs instead of PhD students (Benard and de Cock-Buning, 2014).
8. **Develop mutual understanding and trust.** Studies have found that joint reflection and recognition of stakeholder perspectives facilitate knowledge co-creation (van Veen et al., 2013; Hegger et al., 2012). Mutual trust also facilitates successful implementation of knowledge (Roux et al., 2006).

In section 5 we return to, and elaborate on, these barriers and interventions we found in the literature in relation to our empirical findings on an applied research programme making a transition to TD research. In the next section we first explain how we conducted our research.

### 3 Research Design

The environment informing our analysis of the transition towards a transdisciplinary research approach is the Joint Research Programme of the Dutch Water Sector (known as 'BTO', its Dutch abbreviation). This programme, with a current annual budget of roughly €8 million, is characterized by a close collaboration between the ten Dutch drinking water companies, Vewin, which is their branch association, and the applied research institute KWR<sup>1</sup>. The core of the BTO research programme, and also the focus of this paper, is its Thematic Research component, which involves collective research for all of the water companies and Vewin. In 2013, the decision was made to shift this research component from one based on research coordination groups, organised along disciplinary lines, to an arrangement of ten transdisciplinary research themes worked on by theme groups. Within each of these themes experts from water companies and KWR jointly carry out research projects, with KWR-researchers primarily responsible for designing and conducting the studies, and the company representatives for articulation research demands and implementation.

The BTO research programme represents a unique example of a large-scale research programme in transition from a disciplinary to a TD research practice. What makes this programme a particularly interesting environment is the historically close relationship and basis of trust between KWR researchers and drinking water practitioners, the shared mission of a future-proof drinking water sector, as well as the common effort to intensify co-creation processes (referred to as 'co-makship' in the BTO context).

Our analysis contains case studies of six of the ten BTO theme groups (see Table 1), which together represent BTO's diversity in terms of scientific disciplines and cultures. We conducted separate, semi-structured interviews with the chairperson and coordinator of each of the six theme groups. In addition, we interviewed two key informants within the BTO structure, namely, the chief science officer and the BTO programme manager, to get a better understanding of the rationale and the drivers underlying the transition. The interviews were conducted between June 2015 and July 2016, and lasted one hour on average. The interviews with the theme group coordinators and chairpersons focused on the introduction, (experiences leading up to) the current degree of TD research practices, future ambitions and the aspired degree of a TD research, as well as barriers and incentives that impacted or determined (the transition towards) TD research practices in the BTO, both before and after 2013.

TABLE 1: DISTRIBUTION OF 14 INTERVIEWEES BY THEME AND POSITION.

Theme	Position
Asset management (2)	Theme group coordinator (6)
Biological activity (2)	Theme group chairperson (6)
Climate-proof water sector (2)	Chief science officer (1)
Drinking water technology of the future (2)	Programme manager (1)
Hygiene and safety (2)	
Sustainable resources (2)	
BTO programme management (2)	

<sup>1</sup> In 2016, De Watergroep, the biggest drinking water company in Flanders, Belgium, joined BTO.

Documents constituted our second data source. We studied relevant general and strategic BTO policy documents, including an extensive 2013 BTO evaluation report based on a survey among all theme group members, which was conducted to elucidate the experiences to-date and identify room for improvement concerning the (at that time) novel TD BTO set-up; the survey recorded a response rate of 65% (60/92). We also closely examined the 2014 BTO evaluation, which had a similar format and response rate (59%).

## 4 Transition towards transdisciplinarity in practice

### 4.1 Background: the shift from disciplinary to TD research at KWR

BTO, which was set up over forty years ago, is a unique joint research programme centred on the goal of achieving a drinking water provision in the Netherlands that is healthy, sustainable, efficient and advanced. More than one hundred BTO projects are carried out every year, most of them within the ten theme groups. Each of these theme groups include representatives of several water companies that together decide about the theme's research agenda. They are managed by a chairperson, who is always a representative of a drinking water company, and a coordinator, who is a researcher from KWR. In this paper we refer to the chairperson and coordinator as the 'theme leaders'.

This transition towards a more TD BTO was officially adopted at the start of the current BTO programme in 2013. The decision to make the transition was preceded by, and based on, a process of critically evaluating the old disciplinary programme in light of various future challenges, or so-called 'wicked problems' that cannot be adequately addressed by disciplinary research only. In view of these problems, and of the drinking water companies' demand for closer involvement in the research programming, both KWR and the companies felt the need for a more transdisciplinary approach to research. This should provide a stronger focus on the integration and knowledge exchange of different disciplines and on implementation. The new set-up does not predetermine which disciplines contribute to what research theme, and hence offers opportunities for multi-, interdisciplinary or even TD research. In comparison to the previous programme, the current programme also includes a stronger emphasis on knowledge co-creation, enabling an even more active involvement of company representatives in both agenda-setting and implementation of research results. The water companies are involved in the programme governance at three levels: on the strategic level (in the director's assembly), the tactical level (in the so-called coordinating assembly) and the operational level (theme groups). Theme group coordinators were carefully selected; many of them are early and mid-career researchers with a broad view transcending their own discipline. Each theme group developed a five-year research plan, intended not only to provide a consistent long term research agenda focussed on the collective research priorities of the water companies but also to generate more MD research outcomes.

### 4.2 From theory to practice: theme group experiences

In the next section we turn our analysis to how this transition from a disciplinary to a transdisciplinary research approach has been taken on board and implemented in practice in the six selected theme groups.

#### 4.2.1 Asset management (AM)

Considering that within this theme group, which focuses on the development of knowledge, instruments and technology enabling water companies to make well-founded and objective decisions about their assets, the idea of a more multidisciplinary BTO was initially greeted with much scepticism, the group has made great strides towards a more TD research approach over the past five years. Theme leaders report that, at present, the theme group generally has a multidisciplinary mind-set and that its management level works quite



interdisciplinarily. However, the picture at the project level is mixed: some projects are multidisciplinary, others remain disciplinary, and very few have an interdisciplinary approach.

#### **4.2.2 Biological activity (BA)**

This theme group investigates the various aspects of microbial growth with regard to drinking water monitoring, production, treatment and distribution. As in the case of AM, the overall picture of the BA research approach is one of diversity. Nonetheless, under the supervision of a theme group of mixed composition, with experts ranging from technicians to water-quality specialists, most BA projects are indeed multidisciplinary, with some projects tending towards interdisciplinarity, and others being more disciplinary in nature. At present, the degree of co-creation in this theme is limited, with drinking water practitioners relying on the expertise and knowledge of KWR researchers.

#### **4.2.3 Climate-proof water sector (CWS)**

One could argue that a theme that focuses on (i) the mapping of the main climate change risks and opportunities for the drinking water sector, and (ii) the formulation of strategies to respond to these risks and opportunities is multidisciplinary by definition. And indeed, compared to the pre-transition period, the projects in this theme now have a broader scope, the involvement of researchers from other teams has grown, and the degree of co-creation is higher. On the other hand, notions that the research approach should be aligned to the specific knowledge question, and not the other way around, are especially deep-rooted in this theme. As a result, the actual degree of TD is mixed, with some projects being more disciplinary, others more MD.

#### **4.2.4 Drinking water technology of the future (DWT)**

DWT focuses on water treatment technologies to address the growing threats to the drinking water sector. This theme group hasn't undergone a major change under the new BTO set-up, since the type of research conducted in this group already had a strong multidisciplinary character before the transition. The theme group aspires to a more interdisciplinary research practice, but progress has been slow due to factors such as budget constraints and a considerably heterogeneous theme group composition. Significant improvements have been made in this respect through the establishment of project supervision groups. Still, at present the involvement of practitioners is not always at the desired level.

#### **4.2.5 Hygiene and safety (HS)**

In this theme, which focuses on investigating elements essential for safeguarding the hygiene and safety of drinking water – including source selection, soil passage and purification – the shift towards TD wasn't perceived as a significant transition. Indeed, in this theme the biggest change wasn't so much the new research approach, but the decision to divide microbiological safety research and microbiological activity research into two separate theme groups at the time of the transition; even if this reflected a division that was already present prior to the transition. The group's actual level of TD varies by project, similar to what we observed in other groups: most projects follow a rather multidisciplinary approach, others lean towards interdisciplinarity, and yet others remain discipline-focused. As regards co-creation, practitioners from water companies generally follow the projects from a distance rather than closely collaborating in the different phases of the research projects.

#### **4.2.6 Sustainable resources (SR)**

This theme group develops knowledge and skills to secure the long-term and sustainable utilization of drinking water resources. Perhaps more than the other theme groups, it has actively pursued a MD research agenda in a process of close co-creation. Many projects are multidisciplinary, some even lean towards an interdisciplinary approach. And even if some of

this theme's projects are, taken on their own, still rather disciplinary, they fit within the larger multidisciplinary agenda. Unlike various other themes, SR has always been oriented towards policy and decision-making, and thus has a longer experience with a MD research approach. Compared to the previous BTO programme, the theme group now pays more attention to area planning processes. Although the theme group's five-year plan could be considered a classic example of a successful process of co-creation, except for projects that involve pilot studies, the level of involvement at the project level could be intensified.

In sum, it appears that each theme group has handled the transition towards a TD research approach in its own way. The result is a variation in the degree and nature of the practical implementation of TD. Our analysis will now turn to acquiring a deeper understanding of the underlying causes for these variations and answering questions like: What are the barriers researchers and practitioners face in making the change from a disciplinary to a TD approach? And what are possible solutions to overcome these barriers?

## 5 Barriers and interventions

On the basis of the framework introduced in our theoretical discussion, we now analyse the barriers researchers and practitioners face in the transition towards TD research practices in the BTO programme.

### 5.1 Methodological and epistemological barriers

*Integrating disciplines is difficult and laborious.*

In our research we found the integration of knowledge from different disciplines (Kloet et al., 2013) to be a significant barrier in all the theme groups and, in many instances, a direct influence on TD research practices. One group leader, for instance, argued: ‘Disciplinary problems are rather straightforward. Cause and effect are closely related. As disciplinary problems are isolated, it is possible to develop specific knowledge . . . MD problems are less univocal, more context specific and therefore harder to translate into regular theories.’ In the CWS theme we found that, driven by efficiency concerns, MD research is restricted to those research questions where it is considered absolutely necessary. In other theme groups we observed that TD projects are limited in number because the extra time involved in developing and executing such projects often conflicts with perceived high productivity norms and heavy workloads. Moreover, preparing theme group meetings and transferring knowledge to peers/colleagues not involved in the theme group discussions consumes considerable additional time. Some respondents said that MD is often less well-defined in terms of scope, aims and responsibilities, and harder to plan. This leads some to conclude that TD research is more risky than disciplinary research.

We found several mechanisms to cope with these challenges. The so-called five-year plans, in which all theme groups lay out their mission and ambitions for the years ahead, proved important. They drove theme groups to seek a clear orientation and mission from the start, something that is considered indispensable for TD (Kloet et al., 2013). Indeed, one theme group paid insufficient attention to this start-up process, which led to fierce disputes amongst members about the path to follow. This false start was partly attributed to irreconcilable gaps in knowledge and research needs. The theme group then agreed to first draw up a preliminary and multidisciplinary overview of previous studies related to the theme in question. Only on this basis would they draw up a research agenda for the theme group. This worked well, as the study addressed the gaps and needs of the various members and provided a vehicle to continue the dialogue on the theme group’s path. The extra time invested at the start of MD projects may be ‘recovered’ in the implementation phase, respondents said. The time investment might slow down processes, yet it ‘. . . exposes issues that play a role on the shop-floor too . . . and, as a result, may improve the internal discussions in the drinking water companies.’ Another intervention involved the enlargement of research projects so as to avoid, in the eyes of one respondent, a ‘flimsy report with little substantial research’. With regards to co-creation, however, we found that some theme leaders plead for the programming of several small projects, so as to guarantee that there is always at least one project that closely meets the needs and expectations of each drinking water company.

### *Difficulties of integrating scientific with practical knowledge*

Our research suggests that KWR researchers have relatively little difficulty in recognising the relevance of experiential knowledge (cf. Benard and de Cock-Buning, 2014) and, related to that, in integrating scientific with practical knowledge. This suggests that the distance between practitioners in the Dutch drinking water companies, who are often highly-skilled knowledge workers, and KWR researchers, who are active applied researchers, isn't so great after all. In addition, the particular BTO structure is organised in such a manner that the needs and preferences of drinking water companies simply cannot be ignored. It is, however, worth noting that increased MD may be at odds with co-creation and a strong connection with practitioners. The chairperson of the AM group, for instance, observed: 'In my view, it is easier to realize co-makship within disciplinary research: . . . [here you deal with] a clearly defined problem which all involved parties [both researchers and practitioners] know a lot about, so it is easy to go in-depth. It's much harder to realize co-makship within interdisciplinary research.'

Indeed, in this connection the biggest challenge that theme groups faced in their transition towards TD is not the integration of practical knowledge, but the implementation of scientific knowledge in practice. To this end, theme leaders employ a whole range of interventions to promote co-creation, including:

- Early involvement of theme group members in developing/writing the five-year plans and the actual research proposals, so as to create 'ownership' of the research agenda and projects.
- Creation of so-called supervision groups for individual projects, enabling the theme group to focus on the process, while the supervision groups can provide in-depth supervision of the content.
- Secondment of researchers to water companies to improve mutual understanding and foster knowledge exchange encounters between researchers and drinking water company practitioners.

## **5.2 Social and political barriers**

### *Cultural differences*

The secondment of researchers to water companies also proved a very useful mechanism in dealing with cultural differences (Mollinga, 2009), as did field trips and site visits. They enhance the much needed mutual understanding between researchers and company representatives. Such cultural differences were experienced as barriers in three cases. In the case of BA, the multidisciplinary composition of the theme group complicated the decision-making about the research agenda due to diverging perspectives on the mission and societal position of the water companies. In two other cases, the main issue related to the degree of risk to be taken. As revealed in the literature, researchers were less risk averse than the practitioners. In the case of SR, the company representatives preferred not to let new initiatives interfere with existing trajectories as, according to one of the theme leaders, 'a pilot always creates expectations'. In the same case, researchers were also interested in collaborating with other firms and authorities besides the drinking water companies, but the latter hesitated because of their sensitive relationships in current area planning processes. In the case of DWT, researchers would have liked to publish certain intermediate results, but the companies, because of the sensitivity of the issue, preferred to wait until the final results.

### *Conflicting interests*

In five out of the six cases, we observed conflicts of interests arising from the TD approach. In some cases water companies disagreed about research agenda priorities, due to differing strategic interests in agreement with Boon et al. (2014) and/or problem definitions (disciplinary orientation) of their particular representative (in agreement with Hegger et al. (2012). In one other case two theme groups wanted to initiate a large project together, but the overall programme management objected for accountability reasons. While the literature mentions the opposing interests of researchers and practitioners (Kloet et al., 2013), we did not encounter them in the theme groups. The programme management of BTO, however, did indicate that the stronger influence of water companies on the research agenda strengthens the emphasis on applied research with a practical relevance on the short term, while for KWR it is of strategic importance to also conduct research with a longer term perspective. This kind of research is often regarded as an ‘insurance policy’ for the water companies and has, indeed, time and again proved to be of crucial importance to them in the event of calamities or radical system changes.

In order to solve or prevent possible conflicts within the theme groups, the programme management asked each group to produce a five-year plan. In the SR theme this proved beneficial: ‘We also took some more time than we were allowed to,’ said the SR coordinator. ‘But [we did so] on purpose, and in hindsight this was a good idea. We didn’t write [the five-year plan] in a hurry. It took us a couple of sessions: we gave it time to sink in for everyone. We all first had to get used to it. It was quite a transition process.’

### *Limited capacity*

In one way or another the capacity of partners limited the transition to TD in five out of the six themes. The 2013 evaluation indicated that many practitioners from water companies would like to be more involved in the research. Nonetheless, in the BA and DWT themes their current limited availability is perceived as hampering co-creation. ‘With regard to co-makship, I really see a barrier there; simply because people are already very busy at the water companies,’ said the DWT coordinator. ‘[At] companies where the BTO research is aligned with their priorities it works, but [at] others, where this is not the case, time would have to be specifically allocated for the practitioners to engage in co-makship.’ At the same time, one of the BA theme leaders indicated that the greater influence of practitioners tends to slow down the decision-making process and hence the research, because there is more discussion involved. In line with other analyses of TD research programmes (Boon et al., 2014), two themes experienced a problem due to the imbalanced composition of their theme groups. In these cases the dominance of one discipline over the others held back the development of an MD research agenda. More generally, the program management indicates that the tendency of the theme groups to ask for MD rather than TD research projects relates to the fact that the latter would require a different and more strategic demand articulation and supervision from its members. What is more, the 2014 BTO evaluation revealed that in such heterogeneous theme groups, members might not be able to effectively participate in group discussions, assess the value of all the research results, and translate them to their own company’s context. Appointing a chairperson, with a broader vision and an ability to transcend his or her own discipline, is key in this respect.

Regarding the availability of researchers, one chairperson reported that he sensed that the researchers had a preference for activities in their own discipline. This issue is amplified by the fact that the overall programme budget has not grown substantially with the new set-up. In several themes, researchers are concerned about the MD approach replacing the

disciplinary set-up, since they appreciated the level of technical knowledge exchanged in the traditional mono-disciplinary interactions. They pointed out that some highly specialized topics have already been marginalized in the TD set-up. To them, MD should not be a goal in itself, but only be applied when a research problem calls for it. In another theme group, the variety of research skills available was insufficient to truly address the theme in a TD approach. To address limited researcher competences, recruitment of researchers with additional skills and motivations can help [see also (Mollinga, 2009)]. Theme leaders reported that people with the capability to see linkages between research areas have more success in working across disciplinary and organisational boundaries. Various themes have invested in knowledge exchange (BA) and learning (CWS) within their groups, in order to reduce knowledge deficiencies and create an adequate knowledge base capable of addressing broader MD questions. The BA theme has deliberately appointed project leaders with a different disciplinary orientation than that of the discipline that 'owns' the project's subject.

### 5.3 Institutional barriers

Institutional barriers, such as reduced publication or career prospects, or difficulties in accessing research funding, played a minor role in the theme groups transitioning to TD. A lack of quality indicators (Jahn and Keil, 2015) is, however, experienced as an obstacle to TD research. More specifically, interviewees observed that the existing routine of quality assurance, with a final quality check often conducted by just one single disciplinary specialist, isn't accustomed yet to this new line of working. The absence of any issues concerning research funding is a direct consequence of our focus on a TD research programme whose funding happens to be secure for the programme's lifespan.

Table 2 below provides an overview of the barriers to the transition to TD research practices as revealed in the literature, an indication as to whether we encountered them in our research, and our empirical findings of the associated interventions.

TABLE 2: AN OVERVIEW OF BARRIERS AND INTERVENTIONS RELATED TO THE TRANSITION TO TD RESEARCH PRACTICES.

Type	Barrier	Encountered	Empirically observed interventions
Methodological and epistemological	Integrating disciplines is difficult and laborious	✓	Clear orientation (five-year plans) Larger project size*
	Difficulties of integrating scientific with practical knowledge	✓	Intensive interactions Mutual understanding and trust
Social and political	Cultural differences	✓	Intensive interactions Mutual understanding and trust
	Conflicting interests	✓	Clear orientation Leadership
	Limited capacity	✓	Personal competences Team composition Leadership Learning within the group*
Institutional	Reduced publication or career prospects	✓	Appropriate incentives
	Greater difficulty in accessing research funding		
	Lack of quality indicators	✓	

*An asterisk indicates interventions identified by our empirical data that have not been mentioned previously in the literature.*



## 6 Conclusion and discussion

In this paper we have analysed how an applied research institute is undergoing the transition from a disciplinary to a transdisciplinary research approach in practice, with a particular focus on the methodological, social and political, and institutional barriers and related interventions. Below we elaborate on four general observations.

A first finding of our study, not yet explicitly mentioned in the existing literature on transdisciplinarity, is the effect of the displacement of disciplinary research. Theme leaders experienced opposition from researchers concerned that the shift from a disciplinary to an MD set-up results in the marginalization of some highly specialized topics. This displacement can constitute an added obstacle in moving towards a productive TD research approach.

Second, it is interesting that we noticed an occasional tension or trade-off between the two components of transdisciplinary research, namely: interdisciplinarity and knowledge co-creation. The cases we examined suggest that a stronger focus on interdisciplinarity may unintentionally cause a decline in co-creation practices – in our specific case, a decline in the intensity of collaboration between KWR and the drinking water companies. This observation confirms the claim by (Hessels and van Lente, 2008) that collaboration between different organisations and integration of different disciplinary perspectives should be seen as separate characteristics of research practices, in contrast to the correlation suggested by the notion of Mode 2 knowledge production. The findings of this study show that interdisciplinarity and knowledge co-creation can even be at odds with each other. Further research will have to show the conditions and interventions under which this trade-off will or will not occur. Key factors that seem to this relationship are the type of questions guiding the research and the quality and intensity of the interactions between researchers and practitioners. A related issue that deserves further empirical study is the suggestion that the additional time invested at the start of MD projects may be ‘recovered’ in the implementation phase.

Third, the composition of theme groups turns out to be crucial in advancing the implementation of a TD research agenda. In the cases that a theme group was dominated by one particular discipline, this limited the development of an agenda involving various disciplinary perspectives. Theme leaders, in turn, for reasons related to the autonomy and capacity of drinking water companies, have little influence on this process. Regarding the availability of drinking water practitioners, we observed a discrepancy between aspiration and reality; many practitioners would like to be more involved in carrying out research, but their actual availability is limited.

Fourth, KWR researchers appear to have relatively little difficulty recognising the relevance of experiential knowledge. This can be attributed to the unique composition of the BTO programme and the historically strong bond between KWR and the Dutch drinking water companies. This observation gains significance when considered in relation to research conducted in other domains, where the integration of scientific and practical knowledge is often problematic – for instance in the use of the experiential knowledge of patients in biomedical research (Caron-Flinterman et al., 2005).

To what degree can the theme leaders cope with the various barriers to TD research? We found that the social and political barriers could most directly be influenced. Indeed, individual actors have a range of interventions at their disposal to overcome barriers related to limited capacity. Such interventions ranged from carefully designing and allowing time for the start-up and programming of research, to the secondment of researchers to water companies or, conversely, of practitioners to KWR. Institutional barriers, for their part, do not lend themselves to being tackled as directly as social and political ones, but require interventions that are more indirect and lobbying in nature. Theme leaders, for instance, called for attention to publication targets in relation to the complexities of TD research and to modifications of the existing quality assurance routines. Lastly, even though a couple of interventions were available and tried out, we found that the methodological and epistemological barriers, particularly the difficulty of integrating disciplines, were most persistent and tended to occasionally resurface during the research process.

Before concluding this paper with a couple of recommendations for research programme managers, we want to point to two limitations of our study. Although we attempted to minimize potential reporting bias resulting from individual conceptualisations, by using a graphic display to explain the key concepts of this study, including disciplinary, multidisciplinary, interdisciplinary and TD research, this study's reliance on self-reported information is a significant limitation. Another limitation is that we only interviewed theme group coordinators and chairpersons. Although these theme leaders are excellent informants, for greater validity, we would encourage future research to include individuals who are more actively involved as research performers.

All in all, our analysis only confirms the premise that TD research is a highly complex and difficult undertaking. Despite the efforts of theme leaders to intervene and come up with solutions, one has to acknowledge the challenge and complexity of both transitioning to and conducting TD research. The numerous interventions mitigate the barriers to a certain extent, but they certainly don't mitigate them all, and not at all times. For any research programme aspiring to shift to a more TD research practice, the existence of these barriers needs to be (i) acknowledged and taken into account, and (ii) viewed in close connection with the organisation's ability and/or limitations in addressing them. This ability also relates to the specific institutional infrastructure, including time flexibility, budgetary constraints and publication targets (Boon et al., 2014; Kloet et al., 2013). Ultimately, these considerations should be reflected in the level of TD practices to which the programme aspires.

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# Attachment I

## Interview questions (*in Dutch*)

### Transformatie

1. Hoewel de transformatie naar meer multi-, inter- of transdisciplinair onderzoek in de literatuur vaak wordt aangeprezen als dé manier om antwoorden te vinden op de huidige en toekomstige vraagstukken, weten we ook dat deze omschakeling *en* manier van werken in de praktijk niet altijd eenvoudig is.
  - a. Hoe werd het idee van deze transformatie binnen het BTO – we praten dan over het jaar 2012, initieel binnen uw themagroep ontvangen?
  - b. Wat waren indertijd binnen de themagroep de belangrijkste *bezwaren* tegen deze vorm van onderzoek?
  - c. Wat waren de belangrijkste kansen van deze manier van onderzoek die indertijd gezien/voorspeld werden?
  - d. In hoeverre hebben deze toen gevoelde kansen en nadelen zich wel/niet in de praktijk gemanifesteerd?
  - e. Zijn er opvallende of verrassende positieve of juist negatieve ervaringen opgedaan tijdens projecten waarin die multidisciplinaire/co-makership opzet is toegepast?
  - f. Op welke manier, als überhaupt, is de houding binnen de themagroep t.o.v. deze transitie en manier van werken wel/niet veranderd?

### Stand van zaken

2. Kijkend naar deze tabel [annex 1] met verschillende niveaus van multidisciplinair werken, op welk niveau plaats u uw themagroep in zijn geheel op dit moment en waar komen jullie vandaan?
  - a. En als we kijken op projectniveau, hoe groot is dan de variatie op deze ladder?
    - i. Wat is het project wat zich binnen jullie themagroep het hoogst scoort op de ladder? Wat is de verklaring dat juist dit project zo hoog scoort?
    - ii. Wat is het project wat het laagst scoort op de ladder? Wat is de verklaring hiervoor en hoezeer is deze score wel/niet wenselijk?



- b. Hoe verklaart u dit verschil in diversiteit, en ook de gemiddelde “score” van de themagroep als geheel?
  - i. In hoeverre kan deze score verklaart worden vanuit de inhoud? Lenen de vraagstukken waar uw themagroep zich mee bezighoudt zich niet tot meer multidisciplinariteit/co-makship? Waarom?
  - ii. In hoeverre kan deze score procesmatig verklaart worden? In hoeverre spelen bijvoorbeeld bedenkingen/bezwaren tegen of juist steun voor deze manier van werken van leden van de themagroep een rol?
  - iii. In hoeverre kan deze score institutioneel verklaard worden? Is er bijvoorbeeld wel of niet genoeg ondersteuning vanuit het BTO en/of vanuit KWR om deze transitie of manier van onderzoek mogelijk te maken?
  - iv. Zijn er nog andere niet besproken zaken die de huidige score van uw themagroep verklaren?
- 3. In hoeverre bent u tevreden met het huidige niveau van co-makship/multidisciplinair werken binnen uw themagroep?

#### **Vooruitblik**

- 4. Als we wederom kijken naar deze tabel, waar wil je heen bewegen, als überhaupt?
  - a. Waarom?

[Als ambitie hoger is dan nu]

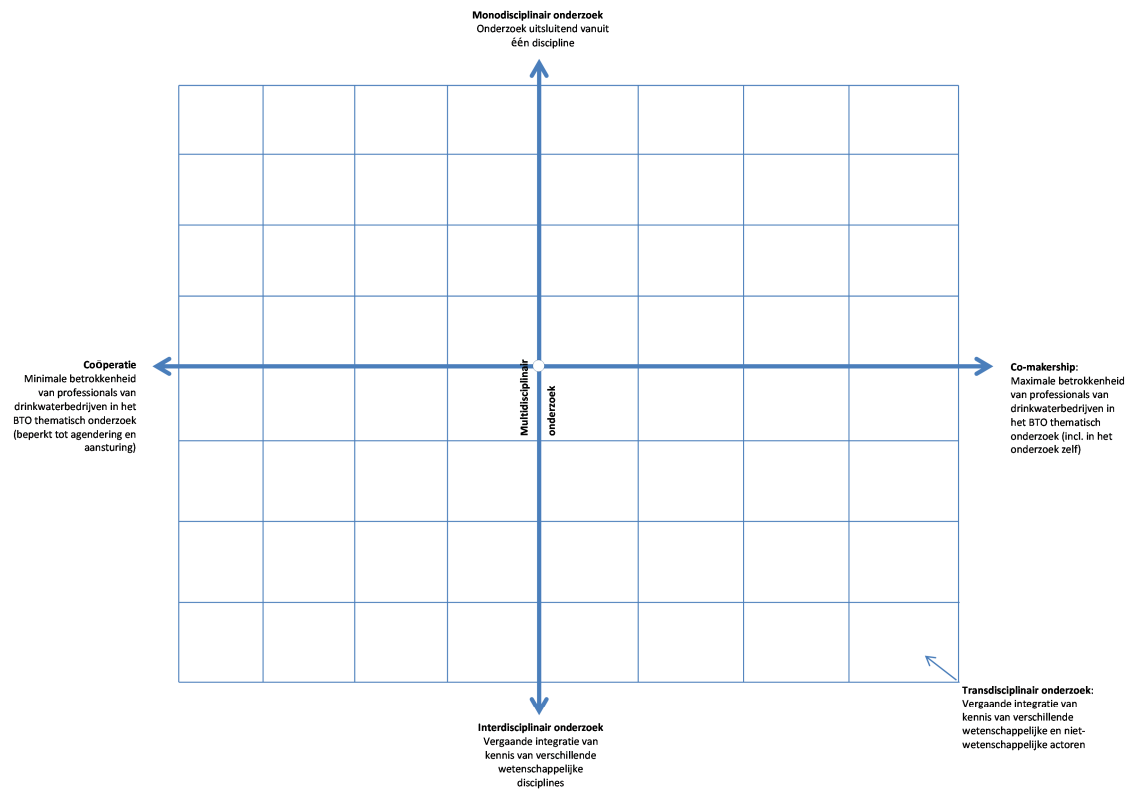
- a. Is dit een algemeen gedragen idee binnen de themagroep?
- b. Hoe haalbaar schat u de realisatie van die ambitie?
- c. Wat is er voor nodig dat uw themagroep die ambitie kan halen?
- d. Welke initiatieven/acties, als dat überhaupt aan de orde is, lopen er op dit moment binnen uw themagroep om toe te werken naar (meer) projecten aangestuurd vanuit een meer multidisciplinaire/co-makship benadering?

[Als ambitie niet hoger is dan nu]

- e. Is dit een algemeen gedragen idee binnen de themagroep?
- f. In hoeverre voelt u ruimte binnen het huidige BTO om deze manier van werken voort te blijven zetten?
- 5. In hoeverre wijkt volgens u de score van uw themagroep af van de ontwikkeling binnen het gehele BTO?
  - i. Waarom? Hoe kunnen we dat/die (verschillen) volgens u verklaren?

## Attachment II

### Graphic display key concepts



# Attachment III

## Presentation

Organiseren en Verbinden - september 2016 1

### Multidisciplinariteit & co-makship in het collectieve BTO onderzoek

**BTO** Organiseren en Verbinden

Stijn Brouwer, Chris Buscher & Laurens K. Hesseb

**KWR** Watercycle Research Institute

2

### Introductie & doel

- (Literatuur)onderzoek gedaan naar:
  - Multi-/interdisciplinair onderzoek
  - Co-makship
- Wat zijn de ervaringen met deze concepten in de praktijk van het collectief BTO onderzoek?
- Empirisch onderzoek in zes themagroepen



**KWR** Watercycle Research Institute

Organiseren en Verbinden - september 2016 3

### Twee verschuivingen in het BTO onderzoek

VAN MONO- NAAR MULTIDISCIPLINAIR ONDERZOEK



VAN COÖPERATIE NAAR CO-MAKSHIP



**KWR** Watercycle Research Institute

Organiseren en Verbinden - september 2016 4

## Waarom deze verschuivingen?

Veranderingen in de maatschappij t.o.v. ontwikkeling wetenschap

WICKED PROBLEMS



VERGAANDE SPECIALISATIE WETENSCHAP



# Mismatch?

Maatschappelijke vraagstukken zijn:

- Onzeker
- Complex
- Ambigu

Wetenschap:

- Veel (sub)disciplines in beide
- Academi in ivoren toren

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## Waarom deze verschuivingen?

Veronderstelde & gewenste veranderingen in het wetenschapssysteem

MODE 2 SCIENCE



Wetenschap gericht op:

- Toepasbaarheid
- Inter- & transdisciplinariteit
- Meerwaarde maatschappij
- Andere kwaliteitscontrole kennis

TRIPLE HELIX



Kwesties gezamenlijk tackelen met:

- Wetenschap
- Overheid
- Industrie / bedrijfsleven

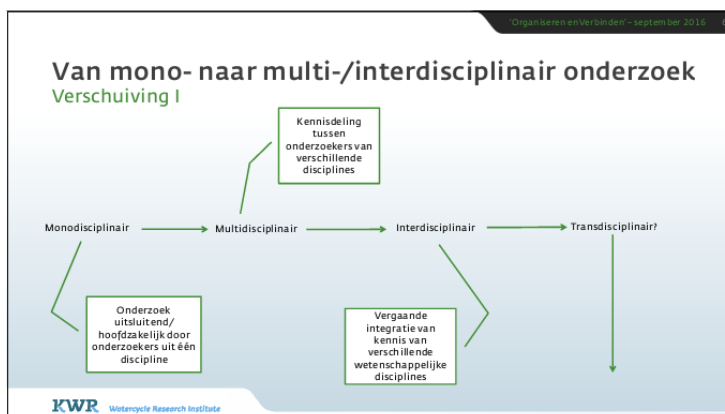
POST-NORMAL SCIENCE



Wicked problems vragen om interactieve vorm van:

- Onderzoek
- Besluitvorming
- Kennisevaluatie

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## Conceptueel raamwerk

Voor empirisch onderzoek in het BTO

Gebruikt voor onderzoek over transitie naar en ervaringen met:

- Multidisciplinair onderzoek in en tussen BTO themagroepen
- Co-makership tussen onderzoekers in BTO themagroepen en drinkwaterprofessionals

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## Methodologie

14 interviews in 6 BTO themagroepen

<b>1. Duurzame Bronnen &amp; watersystemen</b> <ul style="list-style-type: none"> <li>• Klaasjan Raat (coördinator)</li> <li>• Henk Hunneman (voorzitter)</li> </ul>	<b>4. Assetmanagement</b> <ul style="list-style-type: none"> <li>• Ralph Beuken (coördinator)</li> <li>• Rob de Bont (voorzitter)</li> </ul>	<b>KWR/BTO programma</b> <ul style="list-style-type: none"> <li>• Anne Mathilde Hummelen (programmamanager)</li> <li>• Gertjan Medema (chief science officer)</li> </ul>
<b>2. Klimaatbestendige watersector</b> <ul style="list-style-type: none"> <li>• Gertjan Zwolsman (coördinator)</li> <li>• Sef Philips (voorzitter)</li> </ul>	<b>5. Drinkwatertechnologie van de toekomst</b> <ul style="list-style-type: none"> <li>• Bas Hof's (coördinator)</li> <li>• Ron Jong (voorzitter)</li> </ul>	
<b>3. Hygiëne &amp; veiligheid</b> <ul style="list-style-type: none"> <li>• Patrick Smeets (coördinator)</li> <li>• Ruud Kolpa (voorzitter)</li> </ul>	<b>6. Biologische activiteit</b> <ul style="list-style-type: none"> <li>• Wim Hijnen (coördinator)</li> <li>• Ed van der Mark (voorzitter)</li> </ul>	

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## Multidisciplinair onderzoek & co-makership

Transitie naar het nieuwe BTO

- **Kansen**
  - Opschudden bed, weg navelstaren
  - Kruisbestuiving
- **Bezwaren/onzekerheden**
  - Verslapping aandacht voor specifieke topics
  - Verdeling van gelden (over meerdere groepen binnen het BTO)
  - Lastig multidisciplinaire projecten op te zetten
  - Weinig budget en tijd voor de gestelde ambities (co-makership & interdisciplinariteit) te realiseren

Illustratie:

- **TG Klimaatbestendige watersector:**  
Aanvankelijk verkeerde aanpak om te komen tot projecten: voorstellen vanuit KWR vielen slecht > na moeilijke start thans grote betrokkenheid

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## Multidisciplinair onderzoek & co-makership

Huidige stand van zaken

- Alle themagroepen zijn opgeschoven richting meer multidisciplinair ingericht onderzoek, maar de verschillen tussen de groepen en de projecten binnen de groepen zijn groot.
- Co-makership is binnen alle thema's een belangrijk thema maar heeft nog altijd aandacht
- Multidisciplinariteit en co-makership kunnen elkaar hinderen: soms kan de samenwerking met professionals sneller bereikt worden met eensgezinde betrokkenen, monodisciplinariteit

Illustratie:

- **TG Duurzame bronnen en watersystemen:**  
thema als geheel is multidisciplinair, variatie per project is groot: monodisciplinaire projecten passen binnen multidisciplinaire raamwerk van 5-jarenplan

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## Multidisciplinair onderzoek & co-makship

### Ambitie

- Grotere mate van interdisciplinair oz
  - met behoud van ruimte voor ook mono-/multidisciplinair oz
- Grotere mate van co-makship
  - Bedrijven meer betrekken bij uitvoering oz/ genereren data
  - Kennis toepassen in praktijk
  - Meer fysiek bij elkaar over de vloer

Illustratie:

- TC Assetmanagement:** Multidisciplinariteit vooral opzoeken in de relatie techniek – sociale aspecten, zoals organisatie, klant en stedelijke planning

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## Barrières en interventies

### Methodologisch epistemologisch

Barrière uit de literatuur	Geobserveerd binnen het BTO	Geobserveerde interventies
Integrating disciplines is difficult and laborious	✓	- Duidelijke oriëntatie (vijfjarenplannen)
Difficulties of integrating scientific with practical knowledge	✓	- Relatief grote projecten - Intensieve interactie - Wederzijds begrip en vertrouwen

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## Barrières en interventies

### Sociaal en politiek

Barrière uit de literatuur	Geobserveerd binnen het BTO	Geobserveerde interventies
Cultural differences	✓	- Intensieve interactie - Wederzijds begrip en vertrouwen
Conflicting interests	✓	- Duidelijke oriëntatie
Limited capacity	✓	- Leiderschap - Persoonlijke vaardigheden - Samenstelling themagroep - Leiderschap - Leren

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## Barrières en interventies

### Institutioneel

Barrière uit de literatuur	Geobserveerd binnen het BTO	Geobserveerde interventies
Reduced publication or career prospects	✓	- Juiste stimuli
Greater difficulty in accessing research funding	-	
Lack of quality indicators	✓	

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## Conclusies

### Observaties en reflecties (I)

- Ondanks de complexiteit van de opgave en de vele samenhangende barrières zijn alle themagroepen opgeschoven richting meer multidisciplinair ingericht onderzoek, maar de verschillen tussen de groepen en de projecten binnen de groepen zijn groot.
- Co-makership is binnen alle themagroepen een belangrijk thema maar heeft nog altijd aandacht.
- Ambities liggen voornamelijk op het niveau van meer co-makership, de ambitie voor meer interdisciplinariteit is wisselend
- Het streven naar meer multidisciplinair ingericht onderzoek en co-makership gaat niet altijd hand in hand en kan leiden tot spanning en/of trade-offs

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## Conclusies

### Observaties en reflecties (II)

- De samenstelling van de themagroepen is sterk bepalend, echter – voor *an sich* begrijpelijke redenen – moeilijk te beïnvloeden
- Discrepancie tussen ambitie en realiteit betrokkenheid drinkwaterprofessionals bij onderzoek
- KWR onderzoekers ervaren – anders dan vaak gerapporteerd in de literatuur – relatief weinig moeilijkheden de waarde van praktijkkennis te onderkennen
- (Ambitie)niveau van multidisciplinariteit in de themagroepen hangt samen met het “in de plaats komen/verdringen van” gewaardeerd disciplinair onderzoek

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## Conclusies

### Tot slot

- Bij het vaststellen van transdisciplinariteit doelstellingen dienen de samenhangende barrières in oogschouw genomen te worden en gerelateerd aan de organisationele wil en (on)mogelijkheden deze het hoofd te bieden, inclusief bijvoorbeeld (gepercipieerde) productiviteitsdruk

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