MONASH University

Practitioners delivering multifunctional landscapes in cities: Exploring the role of transdisciplinarity

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Notice 1

Contents

Abstract

Society faces numerous environmental problems in cities. In response to these concerns careful thought must go into the use of urban landscapes in order to manage and deliver multiple benefits to nature and society. For this reason academia recommends the creation of multifunctional landscapes and the use of transdisciplinarity for this purpose. In fact, academia – as suggested in the literature – considers the use of transdisciplinarity to be essential.

Transdisciplinarity can be defined as the integration and cooperation of actors from different sectors, and with different types of knowledge, in order to solve real and complex problems. However, despite its relevance there is a lack of empirical evidence on transdisciplinarity in local contexts. This raises questions, then, on what transdisciplinarity would look like in practice and, more fundamentally, whether the call for transdisciplinarity in projects delivering multifunctional landscapes is valid.

The motivation driving this research is to explore and explain the role of transdisciplinary practice in projects delivering multifunctional landscapes in the urban water sector. Through multiple case studies, this research assesses three municipal water projects delivering multifunctional landscapes in Brisbane, Melbourne and Sydney. The analysis focuses on identifying and illustrating, within an explanatory framework, the enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring actors together in the projects. Overall, the results revealed the use of transdisciplinarity in the initial phases of the projects both to establish a shared understanding of environmental problems, and to define common goals in solving them.

Transdisciplinarity was also applied in the planning and design of a project involving participation of a local community group and interests from the municipality in applying an organisational change program for implementing projects with multiple objectives. Other disciplinary approaches such as interdisciplinarity, multidisciplinarity and monodisciplinarity also had a role in other project phases. The variety of disciplinary dynamics were related to contextual factors such as time; the complexity level for the development of the objectives; the location of the project; the interest of the community and its level of education; transdisciplinary training and the formal commitment of the organisations.

The importance of this thesis lies in its provision of evidence in response to the call for transdisciplinarity in the delivery of multifunctional landscapes. This study demonstrates

that transdisciplinarity is not essential at every stage of a project for the successful delivery of multifunctional landscapes. Therefore, any call for transdisciplinarity should specify the phases that require transdisciplinarity, and not neglect the role of other disciplinary practices for delivering multifunctional landscapes. Thus, the identification of enabling conditions, disciplinary dynamics and strategies applied by practitioners addresses transdisciplinary research gaps such in areas such as process management, organisational change and learning, team dynamics and knowledge integration by practitioners, all in local contexts.

The explanatory framework developed in this research is useful for practitioners in understanding and clarifying the characteristics, benefits and limitations of transdisciplinarity in projects delivering multifunctional landscapes. In addition, in showing insights into windows of opportunity, key enabling conditions and strategies that facilitate the projects, the framework can be used as a roadmap to evaluate past projects and design future ones.

Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Publications during enrolment

I hereby declare that this thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

This thesis includes (*1)* original paper published in peer-reviewed journals and (*3)* unpublished publications. The core theme of the thesis is *Practitioners delivering multifunctional landscapes in cities: Exploring the role of transdisciplinarity.* The ideas, development and writing up of all the papers in the thesis were the principal responsibility of myself, the candidate, working under the supervision of *Professor Rebekah Brown and Dr. Meredith Dobbie*.

In the case of *Chapters 2,4,5,6*, my contribution to the work involved the following:

Thesis chapter	Publication title	Publication status*	Nature and extent (%) of students contribution
2	Insights and future direction of transdisciplinary practice in urban water sector	Published	Formulation of research problem and the context of the research in the wider literature; interpretation of literature and writing (90%).
4	A multifunctional Sydney laneway: what's transdisciplinarity got to do with it?	Under review	Formulation of research problem and the context of the research in the wider literature; data collection; data analysis, interpretation of results and writing (90%).
5	Toward multifunctional landscapes in Australian cities: what disciplinary dynamics and	Under review	Formulation of research problem and the context of the research in the wider literature; data collection; data analysis,

	practitioner strategies inform transdisciplinary practice?		interpretation of results and writing (90%).
6	How are actors applying transdisciplinary practice? An explanatory framework of processes that enable multifunctional landscapes in cities	Submitted	Formulation of research problem and the context of the research in the wider literature; data collection; data analysis, interpretation of results and writing (90%).

I have renumbered sections of submitted or published papers in order to generate a consistent presentation within the thesis.

Student signature: Date:

The undersigned hereby certify that the above declaration correctly reflects the nature and extent of the student and co-authors' contributions to this work.

Main Supervisor signature: Date:

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This research would not have been possible without the help and support of many people, and I am deeply grateful to all of them. I had the privilege of being supervised by Professor Rebekah Brown and Doctor Meredith Dobbie. I want to thank you Rebekah for helping me to reach this personal goal and find my way to Australia. Without your help, I would not have started and now finalised this research. I am grateful for your vision, inspiration, and guidance on theoretical aspects of the research.

Meredith, I cannot thank you enough for helping me in many ways over the years. I am very grateful for your insights and helpful feedback. I appreciated how you show me real examples of how Australian practitioners work and think about the best way to approach this research.

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My deepest gratitude goes to the people who have kept me in touch with life outside of work. Mum and Dad, without your love, affection and sacrifice I would not have been able to finish this PhD. Your advice and wisdom helped me to push past many barriers. Also, I would like to thank my sisters Adriana, Mónica and Carolina, close friend Viviana Jiménez and my partner Daniel Walsh for their love, patience and support during these years.

List of Publications

Journals

Guzmán Ruiz, A., Dobbie, M., and Brown, R. 2015. Insights and future directions of transdisciplinary practice in the urban water sector. Journal of Environmental Sciences and Studies. doi: 10.1007/s13412-015-0351-8

Guzmán Ruiz, A., Dobbie, M., and Brown, R. A multifunctional Sydney laneway: what's transdisciplinarity got to do with it?

Guzmán Ruiz, A., Dobbie, M., and Brown, R. Toward multifunctional landscapes in Australian cities: what disciplinary dynamics and practitioner strategies inform transdisciplinary practice?

Guzmán Ruiz, A., Dobbie, M., and Brown, R. How are actors applying transdisciplinary practice? An explanatory framework of processes that enable multifunctional landscapes in cities

Conferences

Guzmán, Ruiz A., Brown, R.R and Dobbie, M.F. (2013). Exploring transdisciplinary practices in local government. 8th International Water Sensitive Urban Design Conference, 25-29 November 2013, Gold Coast, Australia.

Chapter 1

Introduction

1.1 Research problem

Innovative ways are needed to deal with current societal challenges and environmental problems. In response to these concerns careful thought must go into our use of landscape. The creation of multifunctional landscapes is one response to these challenges. In this context, transdisciplinarity is considered appropriate as it attempts to integrate formal and informal knowledge in a changing emphasis 'science for society' to 'science with society' in order to solve complex and real problems (Scholz 1995; Häberli and Grossenbacher-Mansuy 1998; Scholz 2015; Scholz and Steiner 2015). Transdisciplinarity addresses problems that are user-inspired and context-driven, embracing complexity and facilitating mutual learning processes among actors with different values and perspectives (Nicolescu 2002; Lawrence and Després 2004; Max-Neef 2005; Hirsch Hadorn et al. 2008).

Following the Rio Summit of the 1990´s, there has been an upsurge in publications mentioning the relevance of transdisciplinarity in solving environmental problems (Jahn 2012). More recently, transdisciplinarity has been declared as the most suitable disciplinary approach to investigate and dealing with the complexity and multidimensionality of sustainability (Scholz and Marks 2001; Petts et al. 2008). Therefore, transdisciplinarity is viewed as the new paradigm in landscape research by several authors such as Antrop and Rogge (2006); Naveh (2001); Potschin and Haines-Young (2006); Sevenant and Antrop (2010);Tress and Tress (2001) and Tress et al. (2001). The EU Sixth Environmental Action Programme (European Commission 2002) and European Landscape Convention (ELC) (Council of Europe 2000) consider transdisciplinarity useful in determining the aspirations of the public towards landscape policies (Sevenant and Antrop 2010).

Similarly, contemporary urban water research, involving concepts and strategies such as water sensitive cities and integrated urban water management (IUWM), illustrates the importance of transdisciplinary approaches in solving urban water problems and reinforcing water sensitive behaviours (Mitchell 2006; Wong and Brown 2009). Additionally, the water framework directive for Europe (WFD, EC2000/60) suggested that is transdisciplinarity that will provide greater insight into the complex and interlinked networks of water problems (Mollinga 2009; Futter et al. 2011).

Transdisciplinarity is considered essential for the delivery of multifunctional landscapes (e.g; Fry 2001; Tress et al. 2003; O'Farrell and Anderson 2010). Multifunctional landscapes are defined as urban spaces that can simultaneously offer diverse functions and benefits for nature and society, thereby helping with challenges cities face such as adaptation to climate change, limited urban spaces and conflicting citizens demands (Kato and Ahern 2009; Brown et al. 2009; Brandt et al. 2013). Multifunctional landscapes are conceived as complex systems in which nature and culture interact to 1) maintain food security, livelihood opportunities and ecological functions; 2) offer cultural, aesthetic, and recreational opportunities for citizens; and 3) reduce capital costs due to the efficient use of infrastructure, energy and water (Naveh 2001; Danler and Langellotto-Rhodaback 2005; O'Farrell and Anderson 2010).

There are, however, social and institutional barriers to transdisciplinarity: these include resistance to integration of knowledge from disciplines, uneven power relationships between team members, unclear roles and responsibilities, disciplinary silos and lack of coordination (e.g., Cole 2006; Ramadier 2004; Kötter and Balsiger 1999). Matos Castaño et al. (2015), Groot et al. (2010) and Naveh (2001) describe similar barriers in projects that attempt to deliver multifunctional landscapes, due to their complicated organisational context. The objectives of the projects can involve numerous actors who may have diverging interpretations of the objectives and outcomes of the project. And in the development of the objectives of projects, spatial, legal, economic, social and technical conflicts can emerge at administrative levels.

For example, in the design of the projects, different disciplines might work with their preferred design, ignoring user interests or other professional opinions (Henderson et al. 2012). Water professionals and natural scientists might work only on water access or quality (Elliott 2011; Fratini et al. 2012). Landscape ecologists and planners might follow different design perspectives based on their rules and time limits (Antrop 2001). Engineers may focus on solving technological problems, looking at only one dimension of the project, whereas social scientists might focus on gender and cultural perspectives for the provision of water (Scholz et al. 2006; Elliott 2011). Due to the lack of cooperation among professionals and the maintenance of discipline silos, the projects attempting to deliver multifunctional landscapes might offer few ecosystem services and poor site integration, as well as limited amenities and a lack of community acceptance (Henderson et al. 2012).

Thus, transdisciplinarity in a general sense is heralded by academia as a promising choice for delivering multifunctional landscapes, as it can deliver multiple benefits. However, various social and institutional barriers can hinder transdisciplinary practices. These different perspectives on transdisciplinarity and its relevance for the delivery of multifunctional landscapes demand in-depth analysis of the literature on transdisciplinarity relating to the water and urban water sectors (Chapter 2). The review of the literature focuses on these sectors due to the opportunities that water offers in the delivery of multifunctional landscapes and the variety of actors, values and expectations that operate at multiple spatial scales (Pahl-Wostl and Hare 2004). Additionally, water is an integral component of cities and citizens are becoming more sensitive and aware of multiple uses of water in urban landscapes (Brown 2003; Mitchell 2006; Bettini 2013).

The literature review reveals that transdisciplinarity is the youngest of the disciplinary approaches and, as a recent area of knowledge, its theory and practice is still developing (Ramadier 2004; Max-Neef 2005). Much has been written about the conceptual basis of transdisciplinarity, including its premises and elements (King et al. 2009). Definitions, similarities to and differences from other disciplines, especially interdisciplinarity, have been subject to an intensive scholarly discourse over the last 40 years (Nicolescu 2006). Transdisciplinarity has become *à la mode,* and different research groups are focusing on the development of tools, models or frameworks to facilitate transdisciplinary processes, while other groups are assessing transdisciplinary processes developed mainly in research centres and networks funded by public agencies and private organisations (Stokols 2006; Tötzer et al. 2011). However, research on transdisciplinary practice in the urban water sector is scarce. Few researchers in alliance with practitioners working in public entities are investigating transdisciplinary processes developed by practitioners in cities (Fam et al. 2013; Edwards, Lamshed, and Francey 2007). This literature review did not identify investigations focusing on transdisciplinarity and its role in the delivery of multifunctional landscapes. This must lead to uncertainty in the role of transdisciplinarity in practice and is a sign that transdisciplinarity remains predominantly an academic aspiration demanding research that explores practitioners' perspectives on its merits and potential (Bracken et al. 2014).

1.2 Research focus

Given the high expectations for transdisciplinarity in the delivery of multifunctional landscapes – but uncertainty in its role due to a lack of empirical evidence – the aim of this research is to explain the role of transdisciplinary practice in successful projects delivering multifunctional landscapes in the urban water sector.

The following research question will be investigated: *Is transdisciplinarity essential to realising multifunctional landscape outcomes in the urban water sector?*

In response to this research question, there is one main objective: To identify and illustrate with an explanatory framework the enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring actors together in water projects delivering multifunctional landscapes.

The empirical evidence of enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring actors together in water projects can increase knowledge in research gaps identified in the transdisciplinary literature in areas such as process management, organisational change and learning, team dynamics and knowledge integration by practitioners (Ryan-Vincek et al. 1995; Huang and Newell 2003; King et al. 2009; Daniell et al. 2010; Tötzer et al. 2011; Fam et al. 2013). Identifying and understanding enabling conditions can help practitioners to plan transdisciplinary projects better, and increase opportunities for investments in transdisciplinary processes by organisations (Stokols et al. 2008; Jacobs and Nienaber 2011; Lang et al. 2012). The identification and effectiveness of strategies applied in transdisciplinary processes is not clear (Stokols et al. 2005). In addition, Brouwer (2015) and Farrelly and Brown (2008) identified the need to increase research on strategies to overcome socio-institutional barriers in urban water management. Disciplinary dynamics can give insights into the experiences and processes of transdisciplinary teams, which are not largely explored, and can favour the new trend in understanding knowledge integration by teams, instead of by individuals (Stokols 1998; Stokols 2006; Bock Hong and Reynolds-keefer 2013).

The evidence presented in an explanatory framework can contribute to the conceptualisation of transdisciplinary practice. Models that describe practitioners' roles and experiences are needed to facilitate the implementation of efficient and well-functioning transdisciplinary teams (Bock Hong and Reynolds-keefer 2013). Additionally,

the explanatory framework can help visualise the processes and strategies that organisations follow to develop sustainability goals (Stubbs and Cocklin 2008).

1.3 Overview of the research design and methods

A constructivist perspective was adopted for this research (Berger and Luckman 1967; Lincoln and Guba 1985). This perspective is appropriate for understanding the meanings that multiple actors attach to the world in which they live. Thus, the researcher identified interactions among the participants, described their settings and developed inductively theories and patterns of meaning from the data collected in the field (Crotty 1998; Creswell 2003). It is considered appropriate for this research, due to the interests of the author, to understand the role of transdisciplinarity in current projects implemented by municipalities, relying as much as possible on practitioners' meanings and interactions.

A constructivist perspective supports a qualitative research approach (Creswell 2003). A qualitative approach has three key features:

1. It takes place in the natural setting of the participants (Rossman and Rallis 1998);
2. It allows different methods of data collection that might involve the participation of participants and facilitate a holistic view of a phenomenon (Rossman and Rallis 1998);
3. It reveals multiple realities and contradictory views of participants in relation to a phenomenon (Stake 1995), with the researcher acting as an interpreter of the opinions and factors that allow transdisciplinary practices in projects delivering multifunctional landscapes.

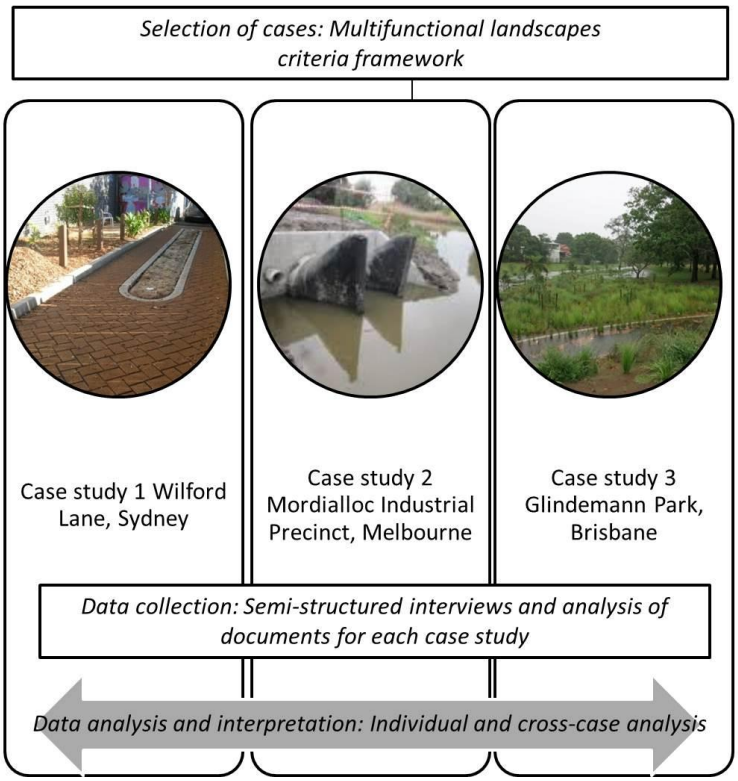
Diverse methodologies are associated with a qualitative approach. The methodology chosen for this research was multiple case studies. Through multiple case studies, the researcher can explore in detail the complexity of an event, an activity or process, collecting data from different sources over a period of time (Stake 1995). Transdisciplinary experts consider that multiple case studies capture the uncertainty, multiple connections and complexity of transdisciplinary processes (Scholz and Steiner 2015). Also, outcomes of case studies can identify organisational processes and strategies that promote transdisciplinarity (Stokols et al. 2005).

The multiple case studies were located in a municipal context. The municipalities, typically known in Australia as local councils, were chosen due to the need for empirical evidence

of transdisciplinarity in local contexts, and the municipalities' important role in the management of urban landscapes (Apgar et al. 2009; World Bank 2011). Furthermore, municipalities are acknowledged as place shapers, building local identity through the delivery of multiple services and infrastructure (Aulich 2005; Lyons 2005).

Figure 1-1 summarises the overall design of the research. For the selection of the cases, the researcher contacted practitioners and academics that could give information about successful projects delivering multifunctional landscapes in Australia. Additionally, municipalities' web pages and other institutions' pages were reviewed to find projects delivering multifunctional landscapes. As a result, 17 projects were identified as possible candidates for the research. Then, a multifunctional landscapes criteria framework was developed, comprising factors such as stage (in design, under construction or already implemented); scale; gradient of multifunctionality; objectives of the projects; and delivery of urban ecosystem services. Through the criteria framework, the 17 projects were assessed for their success as multifunctional projects in the delivery of multiple ecosystem services.

Figure 1-1 Research design



Three multifunctional projects implemented in Brisbane, Melbourne and Sydney by municipalities were chosen for the research:

- A creek filtration system in Brisbane, developed to decrease storm water runoff and transform a fragmented open space into a network of landscapes. This offered new ecological and social benefits such as improved water quality and flow regimes; productive vegetation and increased carbon; and improved social amenity and shade (Brisbane City Council 2014).
- An industrial precinct in Melbourne, which involved the redesign of three roads in an industrial area. This harvested runoff to treat, store and use stormwater to conserve aquatic and terrestrial habitats while irrigating sports grounds and street trees, reducing potable water use, and increasing flood protection and aesthetic amenity (Clearwater 2014).
- A multifunctional green space in Sydney, created by installing buffer strips, permeable pavement, solar energy panels, and a rain tank, and by planting trees and creating a social space for citizens' activities (Marrickville 2013)

Data collection in the multiple case studies was mainly by semi-structured interviews of the teams involved in the projects, and analysis of documents related to the projects. The interviews explored the history and key events in the projects, the teams involved in the different project phases, and the main challenges and strategies applied to enable the projects. Data analysis and interpretation consisted of inductive logic in the establishment of different themes. Broad patterns were developed and compared with the literature. Four relevant studies helped frame the analysis:

1. The description of social-ecological phases linked to a window of opportunity by Olsson et al. (2006).
2. The study by Brown and Clarke (2007) for the identification of enabling conditions of the case studies.
3. Features of monodisciplinarity, multidisciplinarity, interdisciplinarity and transdisciplinarity for the identification of disciplinary dynamics involved in the projects (e.g., Balsiger 2004; Max-Neef 2005; Choi and Pak 2006).

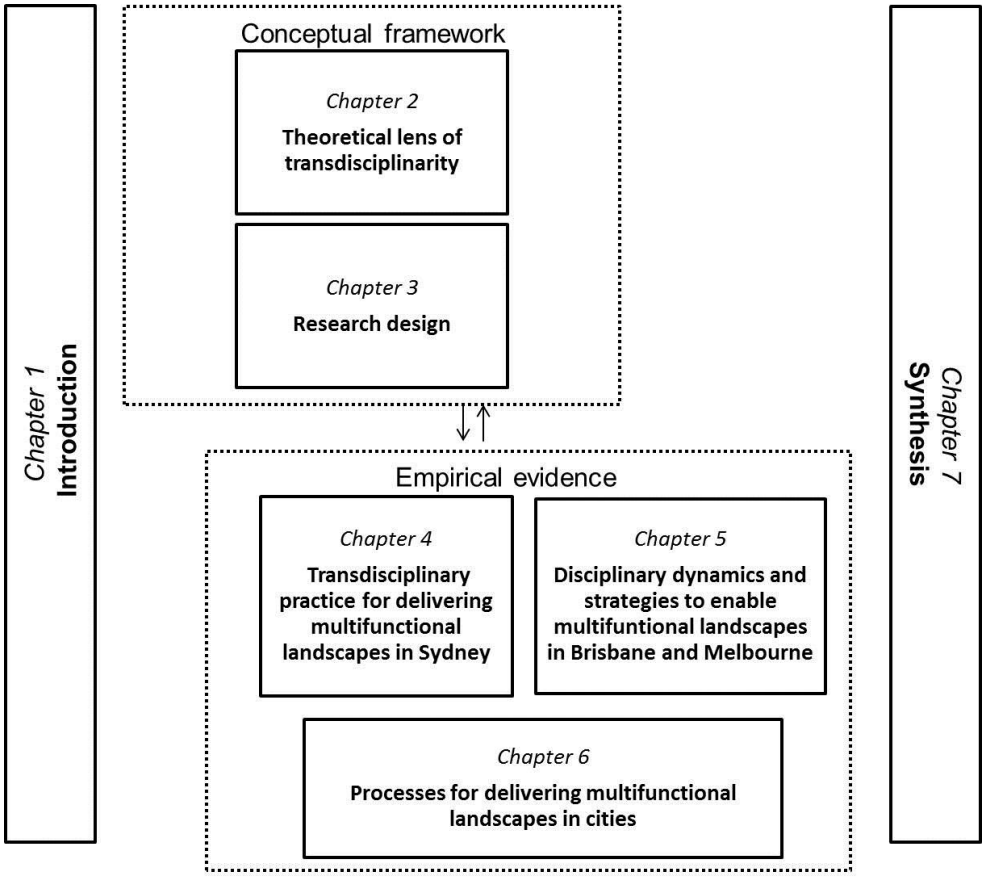
4. Entrepreneurial change strategies for water governance, developed by Brouwer (2015), to guide interpretation of strategies used by practitioners to overcome socio-institutional barriers and bring actors together to enable the projects.

These studies contributed to the creation of a preliminary framework, and then a final framework, which are explained in detail in chapters 4 and 6. Further information on the research design, data collection and analysis is in chapter 3.

1.4 Outline of the thesis

This thesis consists of seven chapters, including this general introduction (Figure 1-2).

Figure 1-2 Thesis Outline



Chapter 2 is the conceptual core of the thesis, which guides the research. It provides an overview of the key features and areas of interest of transdisciplinary research and practice, highlighting outcomes, research gaps and future directions. It is also the basis for comparing and contrasting the findings of the research. Chapter 3 focuses on the research design, describing the main approach and methods used in this study. Chapter 4 presents

the first case study, which is the project developed in Sydney. This is followed by chapter5, which comprises the analysis of the Brisbane and Melbourne projects. Chapter 6 focuses on the cross-case analysis of the Brisbane, Melbourne and Sydney cases, developing the explanatory framework of the processes that enable multifunctional landscapes. The main reflection, contribution and limitations of the study and further research are discussed in the concluding Chapter 7.

Chapter 2

Theoretical lens of transdisciplinarity

2.1 Introduction

The purpose of this chapter is to provide an overview of the main characteristics, areas of interest, research gaps and future directions of trandisciplinarity in the urban water sector. A scoping study was chosen for the analysis of the literature involving peer-reviewed publications on this topic, written from 1970 until 2014. As result, a typology was created to identify the research groups working in transdisciplinary research and transdisciplinary practice in the water and urban sectors. Two studies were related to transdisciplinary practice in the urban water sector. The papers are written in 2007 and 2013 by academics and practitioners. These investigations explain outcomes and experiences of transdisciplinary processes to facilitate decision-making processes in entities in charge of water management. At the end of the literature analysis, the author suggests enabling conditions, disciplinary dynamics and strategies applied by practitioners in water projects as future directions in transdisciplinary practice in the urban water sector. These factors are explored in detail in chapters 4, 5 and 6.

2.2 Publication 1 - Insights and future directions of transdisciplinary practice in the urban water sector

Published in Journal of Environmental Studies and Sciences. The final publication is available at link.springer.com. http://link.springer.com/article/10.1007/s13412-015-0351-8

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Abstract

Bringing together stakeholders with different backgrounds and interests to create new understandings and relationships is essential to advance the sustainable management of urban water. This is a transdisciplinary challenge, with multiple benefits but also obstacles and uncertainties in its applicability. Although transdisciplinary practice is believed to be desirable to enable sustainable urban water management, its role is not clear. Thus, the purpose of this paper is to provide insights into transdisciplinary practice in the urban water sector, highlighting advances and research gaps. This analysis draws upon a scoping process from 1970 until now. It concludes that little research explores transdisciplinary practice in the urban water sector. Future research is necessary into organizational processes, disciplinary dynamics and strategies applied by water practitioners to bring stakeholders together and achieve transdisciplinary practice in the design and implementation of urban water projects. These future directions of research are relevant to water practitioners dealing with urban water management and could lead to the development of practical guidelines to facilitate transdisciplinary practice.

Keywords: Transdisciplinary practice, transdisciplinary research, urban water management, water practitioners

Electronic supplementary material (Appendix A)

2.2.1 Introduction

Formal and informal knowledge have influenced and played a role in solving complex, multidimensional and controversial problems associated with contemporary urban water management. Formal knowledge is academic and expert knowledge validated by scientific models and methods. It is provided by various water practitioners trained in different disciplines (Irwin et al. 1999; Edelenbos et al. 2011). Natural and physical scientists and engineers provide technical knowledge to describe how urban water systems work and to develop and analyse diverse technical solutions that provide human benefits. Social

scientists reveal the institutional, social and political contexts of urban water problems, identifying mechanisms and alternatives to facilitate the implementation of technical solutions (Harding et al. 2009). Informal knowledge is practical, traditional, experiential or non-scientific knowledge applied on specific contexts or locations. Informal knowledge is identified mainly on local communities and citizens experiences managing urban water contexts (Eshuis and Stuiver 2005; Edelenbos et al. 2011; Brugnach and Ingram 2012).

The integration of formal and informal knowledge to address current urban water problems is a social and cultural challenge. Each type of knowledge has a particular set of skills, values and ethics, and formal knowledge might be considered superior to informal knowledge, creating uneven power relationships. The social behaviours associated with each type of knowledge can lead to poor communication and co-operation between water practitioners, researchers, policy makers and communities involved in planning and decision-making (Kötter and Balsiger 1999; Tejada-Guibert and Maksimovic 2003; Ramadier 2004; Max-Neef 2005; Wickson et al. 2006; Brown and Farrelly 2009; Harding et al. 2009; Wen et al. 2014). This goal in the urban water sector is closely related to the interests, principles and manifesto of transdisciplinarity (Nicolescu 2006). Transdisciplinarity is viewed as a fusion of disciplines (Lawrence and Després 2004) and it is not restricted to formal knowledge as "ideally anybody who has something to say about a particular problem and is willing to participate can have a role" (Klein Thompson et al. 2001, p.7).

Strategies, policies and contemporary research related to Integrated Urban Water Management (IUWM) and such concepts as the Water Sensitive City, continually highlight the need to apply integrative, participatory and transdisciplinary approaches including formal and informal knowledge to address urban water problems (Brown and Farrelly, 2009; Daniell et al. 2010; Mitchell, 2006; Wen et al. 2014; Wong and Brown, 2009; Wong et al. 2011).

Academics and water practitioners working in the urban water sector acknowledge the multiple benefits of transdisciplinary practice. Nevertheless, they are aware of the obstacles, challenges and uncertainties of transdisciplinary practice. The role and applicability of transdisciplinary practice are still far from being accepted and institutionalized in the urban water sector. In transdisciplinary practice, the traditional roles and responsibilities of water practitioners change, as they no longer follow rules specific to each discipline or focus on one dimension of the water problems. They work in co-

operation with other professionals and users of the water infrastructure (Antrop 2001; Scholz et al. 2006; Fratini et al. 2012b). Comments on this approach are “it’s easier said than done” (Ramadier 2004, p.437) and “It is easy to say this but what does this actually mean?” (Ison 2008, p.287). Similarly, few concrete examples of transdisciplinary practice, especially in existing water governance frameworks, can be found in the literature (Klein Thompson et al. 2001; Wickson et al. 2006; Palmen 2011; Lundy and Wade 2011; Jahn et al. 2012; Renner et al. 2013).

Given this context, the purpose of this paper is to explore the state of transdisciplinary practice in the urban water sector, identifying what research is necessary to support transdisciplinary practice by water practitioners. For this purpose, the paper gives a general overview of transdisciplinary research as important background for this study. Then, it provides insights into transdisciplinary research and transdisciplinary practice in the water sector, and, more specifically, the urban water sector, based on a scoping study of publications that contain the key words ‘transdisciplinarity’, ‘transdisciplinary research’, ‘transdisciplinary practice’, ‘urban water sector’, ‘urban water management’, ‘water management’ and ‘cities’. Based on the scoping study, we suggest further research into transdisciplinary practice undertaken by water practitioners.

2.2.2 Research approach

A scoping study was chosen to analyse the existing literature on transdisciplinary research and practice in the water and urban water sectors. This literature review technique is commonly used to summarize research findings and identify key concepts or gaps in a field of knowledge (Arksey and O’Malley 2005; Anderson et al. 2008). The scoping study reported in this paper applied the scoping framework developed by Arksey and O’Malley (2005) as it offers an excellent methodological foundation (Levac et al. 2010; Armstrong et al. 2011). This scoping framework consists of six stages:

1) Identifying the research question;
2) Searching for relevant studies;
3) Selecting studies;
4) Charting and collating data;
5) Summarizing and reporting the results, and
6) Making recommendations.

The scoping research questions are considered broad by nature. The research question of this paper is: What is known from the existing literature about transdisciplinary practice in the urban water sector? Levac et al. (2010) recommend linking a purpose or scope of inquiry to the research question to facilitate direction, clarity, and focus for the subsequent stages of the scoping framework. The specific purpose linked to the research question in this paper is to identify explicitly the literature on transdisciplinary practice in the urban water sector making recommendations for further research.

Arksey and O'Malley (2005) suggest establishing criteria to identify relevant studies. These criteria need to take into account the necessary number of references related to the research question and practical issues such as financial resources and time for the scoping process. To identify relevant studies, the following criteria were established:

1. Peer-reviewed publications in English were selected for the analysis.
2. The literature was sourced through the electronic bibliographic databases Google Scholar™ and Scopus.
3. Td-net, the Network for Transdisciplinary Research (Swiss Academies of Art and Sciences 2013) is an initiative of the Swiss Academies of Arts and Sciences and it comprises transdisciplinary lecturers and researchers from Switzerland. This network was used as experts on transdisciplinary research suggested publications on the topic from 2006 to 2014.
4. References were searched from 1970, when the term 'transdisciplinarity' was created, until 2014.
5. Publications were selected for analysis if the titles and abstracts mentioned the keywords: transdisciplinarity, transdisciplinary research, transdisciplinary practice, urban water sector, urban water management, water management and cities.

In all, 277 publications were initially identified as potentially relevant from the search in the two electronic databases and the td-net, Network for Transdisciplinary Research (Swiss Academies of Art and Sciences 2013). For inclusion in the scoping review, the articles had to contain information relating to some or all of the following:

1. Definitions and principles of transdisciplinarity;
2. Transdisciplinary tools, models or frameworks;

3. Outcomes and experiences of transdisciplinary processes developed by researchers and/or practitioners, and
4. Roles and skills that practitioners should have in transdisciplinary processes.

Articles were thoroughly read, especially if there was ambiguity of their relevance according to the guiding research question. Given the research question, 44 references in all were considered eligible for this review. An information matrix was developed to chart or extract data including title; aim of the study; methodology; year and author affiliation (Pawson 2002; Arksey and O'Malley 2005; Levac et al. 2010). Consequently, an analytical framework was developed in which each article was categorized into one of two main groups: Transdisciplinary research and transdisciplinary practice, and subsequent subgroups.

The group of transdisciplinary research was divided into the subgroups:

1. Definitions, principles, concepts or differences with other disciplines;
2. Tools, models or frameworks;
3. Outcomes and experiences of transdisciplinary processes;
4. Broad transdisciplinary scope, and
5. Narrow transdisciplinary scope.

Similarly, the group of transdisciplinary practice was divided into the subgroups:

1. Outcomes and experiences of transdisciplinary processes, and
2. Roles and skills that practitioners should have in transdisciplinary processes.

The classification of the subgroups reflected how the study selection processes evolved as the authors became familiar with the available literature. In this process, it is important to highlight that articles could be classified in more than one subgroup. The information matrix and analytical framework are given in Online Resource 1. A narrative style was chosen for collating, summarizing and reporting the results.

2.2.3 Transdisciplinary research

Transdisciplinary research has been conducted in three main areas: Transdisciplinary definitions, similarities to and differences from other disciplines; transdisciplinary frameworks; and implementation and outcomes of transdisciplinary research processes.

The first area focuses on transdisciplinary definitions, and similarities to and differences from other disciplinary approaches. After 40 years of intensive scholarly discourse, there is still a 'war' on transdisciplinary definitions (Nicolescu 2006). In particular, the similarities and differences with other disciplinary approaches are still disputed, especially with 'interdisciplinarity', as the two concepts are ambiguous, fuzzy and hard to grasp and differentiate (Lawrence and Després 2004; Nicolescu 2006; Klein 2008; Mobjörk 2010; Jahn et al. 2012; Swiss academies of Art and Sciences 2013). According to Apostel et al. (1972), Balsiger (2004), Lawrence and Després (2004) and Ramadier (2004), the term 'interdisciplinarity' has been commonly applied to scientific research involving a number of disciplines and it is viewed as a mixing of disciplines and articulations of different types of knowledge. One of the definitions of interdisciplinary research is: "Mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice"(NAS/NAE/IOM 2005, p.26)

Balsiger (2004), Rosenfield (1992), Stokols et al. (2003) and Gibbons et al. (1994) consider that the main difference between interdisciplinary and transdisciplinary approaches is the higher degree of knowledge integration and strong orientation towards societal problems in trandisciplinarity. Given the multiple definitions, for the purpose of this study we chose the following definition for transdisciplinary research: "A reflexive research approach that addresses societal problems by means of interdisciplinary collaboration as well as the collaboration between researchers and extra-scientific actors; its aim is to enable mutual learning processes between science and society; integration is the main cognitive challenge of the research process" (Jahn et al. 2012, p. 4). It is important to highlight two points of this definition in relation to our study. Firstly, Jahn et al. (2012) and Resweber (2000) consider interdisciplinarity an integral part of transdisciplinarity. Interdisciplinarity is conceived as the science-driven process needed to generate the new knowledge from interplay and integration of teams composed by researchers and extra-scientific actors. In this context, transdisciplinarity sets the frame for dynamics to integrate and evaluate societal and scientific progress. Secondly, mutual learning and integration are core elements and challenges of transdisciplinarity involving actors at different hierarchical levels or sectors such as academia, industry, business, non-governmental

organizations (NGOs), politics and the local public (Resweber 2000; Scholz et al. 2000; Klein Thompson et al. 2001; Tress et al. 2003; Max-Neef 2005).

In the literature, it is possible to find several transdisciplinary research frameworks to evaluate and classify the success of transdisciplinarity in research proposals and projects. Despite different contexts, the conceptual models have three common phases:

1. Collaborative problem framing and building a collaborative research team;
2. Co-creation of solution-oriented and transferable knowledge through collaborative research, and
3. Re-integrating and applying the co-created knowledge.

The end-point of the frameworks is the possible contribution to society and scientific progress in terms of the creation of new knowledge within and beyond disciplines (Scholz et al. 2006; Kueffer et al. 2007; Jahn 2008; Pohl and Hadorn 2008a; Wiek and Walter 2009; Jahn et al. 2012). In the phases, different types of knowledge and contextual factors interact efficiently to solve the social and scientific problem (Hirsch Hadorn et al. 2006; Pohl and Hadorn 2007; Stokols et al. 2008a; Jahn et al. 2012). As a consequence, the phases do not have an equal weight, are not strictly linear and may have feed-back loops or overlapping stages in practice (Pohl and Hadorn 2008a; Jahn et al. 2012; Enengel et al. 2012).

Implementation and outcomes of transdisciplinary research processes focus on the analysis and assessment of the conceptual frameworks in research initiatives and centres. Many of these assessments are carried out in the health sector (e.g. Hall et al. 2008; Stokols et al. 2008b; Stokols et al. 2005). The results of these studies identify the need to focus on enhancing quality standards and the community of peers that guide and assess the processes and the role of researchers, program managers and financial donors (Wickson et al. 2006; Jahn et al. 2012; Brandt et al. 2013).

Transdisciplinary research in the water sector

Transdisciplinary research in the water sector comprises five subgroups: 1) Definitions, principles, concepts or differences with other disciplines; 2) Tools, models or frameworks; 3) Outcomes and experiences of transdisciplinary processes; 4) Broad transdisciplinary scope; and 5) Narrow transdisciplinary scope.

1. Definitions, principles, concepts or differences with other disciplines: The focus of this subgroup is the definitions and principles of transdisciplinary research for groundwater management and water pollution and human health research initiatives (Scholz et al. 2000; Mollinga 2010). Also included in this subgroup are the identification and description of concepts shared by different disciplines in integrated catchment management (Attwater et al. 2005). The authors of these papers suggest the relevance of new methods of knowledge management and use of shared concepts to complement traditional disciplines and decrease disciplinary boundaries (Scholz et al. 2000; Attwater et al. 2005). Mollinga (2010) also highlights the importance of appropriate time and attention in the implementation of research initiatives to understand better the practical side and trade-offs of transdisciplinary research.

2. Tools, models or frameworks: Different transdisciplinary tools, models or frameworks have been designed to improve and facilitate the management of water, sanitation and public health; catchments; protected freshwater areas; mobile organic xenobiotics in surface waters and water infrastructures. The objective of the tools, models or frameworks is to address the lack of communication and participation among actors from different sectors, and the poor integration of data from natural and socio-economic sciences; and to overcome diverse social and institutional limitations. Key outcomes of these frameworks, tools or models are robust theoretical backgrounds (Elliott 2011); perception graphs and causal maps (Döll et al. 2013) and common model structures, meta-modelling language and interfaces for information exchange, including informal knowledge (Ludwig et al. 2003). Various authors believe that successful application of the frameworks, tools or models depends on facilitation processes and early involvement of actors (Lawrence et al. 2000); common vision and hierarchy of objectives linked to indicators (Kingsford et al. 2011); and communication structures such as bilateral co-operation, working groups, workshops and colloquia (Ludwig et al. 2003).

3. Outcomes and experiences of transdisciplinary processes: Despite differences in purpose and length of the studies from this subgroup, it is possible to identify a common interest of the researchers to understand the views of actors defining social and/or scientific problems related to water management; and to describe transdisciplinary processes and/or identify mechanisms to integrate knowledge.

To understand the views of actors defining a social and/or scientific problem related to water management, Titz and Döll (2009) apply actor modelling for the identification of management strategies for pharmaceuticals in drinking water. De Jong et al. (2008) highlight the logistical and technical limitations to understanding the hydrology and hydrogeology of karst areas in Morocco. In the same way, Iglesias and Buono (2009) present a water policy evaluation in Morocco, Lebanon and Spain based on a transdisciplinary approach. These studies give different recommendations. Actor modelling is considered useful to understand the views of actors; however, it cannot take into account the strong effects of power relationships and changing problem perceptions (Titz and Döll 2009). In addition, local public discourse is relevant in the evaluation of water policies. The evaluation should include a certain degree of uncertainty, and qualitative data should be as robust as possible, to avoid assumptions (Iglesias and Buono 2009).

Other studies describe transdisciplinary processes and/or identify mechanisms for the integration of knowledge. For instance, Cole (2006) explained the cooperative process of scientists, planners and local residents in different steps involved in the Motueka catchment futures model (New Zealand). Bohnet (2010) clearly illustrates the outcomes of processes and a range of tools applied in a socio-ecological framework for the Tully–Murray Basin (Australia), testing effectiveness of the framework in knowledge integration. In the same way, the integration of different types of knowledge to narrow disciplinary boundaries and to contribute practical guidelines is analysed in the management of Mediterranean streams at a local scale (Gonzalez et al. 2009). The studies describing transdisciplinary processes reveal interesting findings. Cole (2006) believes that horizontal and transversal knowledge integration is fundamental for catchment management but not sufficient to address specific issues. According to this author, the main limitations derive from epistemological reasons and resistance of science to simplify the complexity of the water problems to a single level of perception and reality. Therefore, disciplinary filters and system reduction are needed to tackle water problems. Bohnet (2010) refers to the risk of disengagement of actors in transdisciplinary processes, recommending investigations of roles and accountability of multiple actors in the integration of knowledge. Additionally, Gonzalez et al. (2009) stress the sharing agendas between different sectors and dedicating time to listen and have dialog

among actors to facilitate transdisciplinary processes, incorporating new knowledge and visions in the management of socio-ecological systems.

In reference to mechanisms for the integration of knowledge, Dewulf et al. (2007) investigate cross-disciplinary research collaborations in adaptive water management, emphasizing the mechanisms to diminish misunderstandings and mismatched expectations. The mechanisms are interactive workshops, facilitation, group model building, and concrete case contexts to help in the integration of different frames and increase joint learning and knowledge construction. Moreover, Renner et al. (2013) analyse barriers, challenges, strategies and mechanisms for integration of disciplines and different types of knowledge in the assessment of five water governance research projects in Austria and Switzerland. The assessment made by Renner et al. (2013) identifies four main challenges: Ensuring stakeholder legitimacy and balance, encouraging participation, managing expectations, and preventing misuse of data and results. For each of these challenges, the authors propose strategies such as actor analysis; facilitation of fair debate; building of trust; making participation as easy as possible; establishing rules and responsibilities; clarifying expectations and limitations, and moderating power imbalances.

4. Broad transdisciplinary scope: A group of articles mentions in a general way the need for transdisciplinary approaches to solve water problems. Nevertheless, these articles do not necessarily explain how these transdisciplinary approaches should be developed, making it difficult to assign them to a specific category of the scoping process. Examples of this subgroup are the articles by Kato and Ahern (2008); Haasnoot et al. (2011); Futter et al.(2011) and Bunch et al. (2011).

5. Narrow transdisciplinary scope: In contrast to the subgroup of broad transdisciplinary scope, the subgroup of narrow transdisciplinary scope is characterized by transdisciplinary studies that describe dynamics on specific groups of actors such as researchers, graziers, actors involved in water user associations or knowledge fields such as ecohydrology. For instance, Patterson et al. (2013) describe professional, philosophical, methodological, project-related and personal challenges facing early-career researchers interested in transdisciplinary water governance. A typology for graziers of the Bowen-Broken Basin (Australia) is developed by Bohnet et al. (2011) based on a transdisciplinary approach to support natural resource management policies and agricultural extension programs.

Djanibekov et al. (2012) found that researchers, farmers and staff members apply social mobilization and institutional strengthening approaches in the water users association of Uzbekistan. The studies identify the strong influence of institutional factors on the level of cooperation among actors and therefore the success of transdisciplinary processes. As a result, a high degree of flexibility is essential in the planning and timeline of key activities (Djanibekov et al. 2012) and spaces for reflection and interactive learning (Patterson et al. 2013).

In parallel to the studies on specific groups of actors, an area of knowledge that includes different transdisciplinary perspectives is ecohydrology, which involves different disciplines and relationships from molecular to landscape scales (Zalewski et al. 2009). Three references illustrate this work: Zalewski (2014); Zalewski et al.(2009) and Huili Gong et al. (2010).

Transdisciplinary research in the urban water sector

Within the literature on transdisciplinary research in the urban water sector, twelve references include 1) Definitions, principles, concepts or differences with other disciplines; 2) Tools, models or frameworks; 3) Outcomes and experiences of transdisciplinary processes; 4) Broad transdisciplinary scope; or 5) Narrow transdisciplinary scope.

1. Definitions, principles, concepts or differences with other disciplines: Research undertaken in the suburbs of Quebec and Strasbourg, France, by Ramadier (2004) is the basis for an analysis of definitions, differences with other disciplines and challenges of transdisciplinarity in urban areas. The findings emphasize that the principle of unity of knowledge should be modified to articulate disciplines and apply transdisciplinary practices and that researchers need to work more on the integration of methods than on the specific points of view and methodologies of their own disciplines. The researchers' cognitive, personal and cultural perspectives are the main obstacles in this process.

2. Tools, models or frameworks: The three-points approach tool developed by Fratini et al. (2012b) for urban flood risk management falls into this subgroup. This tool facilitates decision-making processes related to three main areas of work for water practitioners: standards and guidelines for urban drainage systems or technical optimisation; increased resilience of urban areas in the context of climate change; and satisfying the needs of different actors for engagement and awareness. Outcomes of the implementation of this tool are multifunctional

solutions and opportunities for consensus in a decision-making process involving different actors (Fratini et al. 2012b).

A framework for integrating different disciplinary languages to strengthen communication and improve social preparedness for climate change, by Fratini et al. (2012a), is another example within this subgroup. This framework was created to fill a gap in standardised methods and guidelines for transdisciplinary processes in urban water management. A water utility company and two municipalities of Denmark are evaluating the framework. The end point of this framework is to establish local strategies that encompass individual and collective rules and subjective and objective perspectives, to contribute more to integrative approaches in urban water management.

Similarly, experts from different disciplines established an integrated framework for urban green spaces, including ecosystem services, physicality, experience, valuation, management and governance (James et al. 2009). The framework provides an alternative structure for research into urban green space that is resilient to changes in knowledge and disciplinary boundaries.

3. Outcomes and experiences of transdisciplinary processes: The papers of this subgroup are represented by five studies examining research programs and collaborative planning of suburbs; collaborative research in demonstration projects; relevance and role of transdisciplinarity at regional scale, and interaction of academics working in urban water science.

Two studies (Després et al. 2004; Després et al. 2011) explore the interactions of actors in a transdisciplinary research program and collaborative planning for Quebec suburbs. Two main lessons are learned from this process. Firstly, architects, planners and researchers must be capable of understanding different areas of urban knowledge and get training in knowledge transfer. Secondly, the way of working on collaborative projects is relevant and requires practical guidelines.

The study of van Herk et al. (2011) evaluates collaborative research in demonstration projects as little research is developed in this crucial topic for an integrated approach to flood risk management. Recommendations from this study are to promote informal and neutral environments where actors have the freedom to discuss perceptions and solutions of the problems. To increase partnerships, the

design of the collaborative research should be based on the level of receptivity of actors.

Tötzer et al. (2011) are interested in, analysed and answered three questions relevant to transdisciplinarity at a regional scale: How does transdisciplinarity work in practice; what are the benefits and limitations of transdisciplinary research; and how can transdisciplinary research contribute to the long-term process of building sustainable networks and structures in the region? The study concluded that transdisciplinary research offers clear benefits compared to sole expert solutions in cities with a long industrial history and traditions. Transdisciplinary research facilitated the communication process and knowledge transfer in different ways, creating socially robust solutions. The limitations of transdisciplinary research are related to the mindset of participants, especially actors that use linear knowledge, path-dependent structures or are sceptical of new procedures. Transdisciplinary research, in practice, is time consuming, thus researchers need to be highly co-operative to learn new roles and tasks. Process management is a priority. Concepts and methodologies are important to organize transdisciplinary processes but these techniques must be adapted to local contexts to increase possibilities of ownership, joint building of knowledge and implementation of transdisciplinary research.

Lastly, Wen et al. (2014) give an overview of the level of cross-boundary interactions in professional networks and collaborations in research publishing in urban water science. The outcomes of the analysis confirm cross-boundary interactions. The authors indicate a change from technocratic water engineering to participatory management that includes other disciplines, industry, government and communities. Despite this change, academic communities are working in a limited way compared with practitioners, who are using broad communication and interaction channels. To increase interactions and collaborations, scientific communities need to understand better the inner workings of practitioners. Congresses and events can be the right spaces for actors to exchange ideas, creating common visions and strengthening the sustainability of urban water management.

4. Broad transdisciplinary scope: Examples of this subgroup are the framework for multifunctional landscapes and urban ecosystems services related to water (Lundy and Wade 2011) and the study of people´s awareness, perceptions, attitudes and

preferences in water management in Auckland and Christchurch, New Zealand (Kviberg 2010).

5. Narrow transdisciplinary scope: Research into the need for a transdisciplinary framework and the identification of variables for institutional capacity for urban stormwater planning (Brown et al. 2001) falls into the narrow scope of transdisciplinarity in the literature. In addition, transdisciplinarity is considered as one of the governance challenges for climate change adaptive capacity in the city of Santiago de Chile (Barton 2013).

2.2.4 Transdisciplinary practice

Parallel to transdisciplinary research committed to understanding transdisciplinary definitions, principles or differences with other disciplines, to create frameworks, models or tools, and to implement or assess outcomes of transdisciplinary research processes, transdisciplinary practice is influenced by and takes place in different life-world contexts as well. For the purpose of this paper, transdisciplinary practice is defined as roles, interactions, processes and experiences of state or local governments, regional agencies, industry, local community groups, indigenous people, NGOs, or private consultant firms to implement projects on the ground in order to solve societal problems. In some cases, the projects might be supported by researchers; however the practitioners are the main actors responsible to implement the projects. Insights and empirical evidence into these life-world experiences and local contexts are highly desirable to understand the role and applicability of transdisciplinary practice (Bammer 2005; Max-Neef 2005; Kueffer et al. 2007; Klein 2008; Wiek and Walter 2009; Lang et al. 2012). Fields that have to date demanded transdisciplinary practice are resilience of ecological and social systems, post-normal science and environmental research, landscape ecology, global change, systems and complexity, ecological economics, professional development and education, and health (Attwater et al. 2005). From these fields, most of the studies of transdisciplinary practice have been in the health sector, especially in early childhood special education and early intervention. These studies are written mainly by practitioners rather than researchers (Chapman and Ware 1999; Rapport et al. 2004; King et al. 2009; Bell et al. 2010; Bock Hong and Reynolds-keefer 2013).

Transdisciplinary practices in the water sector

Transdisciplinary practice in the water sector is addressed in four articles written by practitioners and researchers from 2009 to 2013. These articles are part of the subgroups 1) Outcomes and experiences of transdisciplinary processes and 2) Roles and skills that practitioners should have in transdisciplinary processes.

1.Outcomes and experiences of transdisciplinary processes: In this subgroup, one study (Daniell et al. 2010) analyses objectives, conflicts and negotiations in project teams for participatory water management processes in Australia and Bulgaria. These dynamics are part of a process called co-engineering. Outcomes of the study are that language barriers are not necessarily limitations in the design and execution of participatory water management processes. On the contrary, language barriers might be drivers for stakeholder appropriation, collective learning and skills transfer. Similarly, diversity in co-engineering groups is challenging. Nevertheless, the application of integrative negotiations and collaborative work can bring opportunities and positive effects in the management of different profiles in the groups. Another paper in this subgroup (Lynch et al. 2012) is the analysis of the legacy and common interests of the indigenous Yorta Yorta people in the management of the Murray-Darling Basin, Australia. Customary law and practices of the Yorta Yorta suggest that shared regional governance with consensus on the outcomes, adaptive planning with longer time horizons and mutual respect are central for sustainable basin management.

2.Roles and skills that practitioners should have in transdisciplinary processes: A good example of this subgroup is the relevance of transdisciplinary teams and individuals in the management of southern African river basins by Nienaber and Jacobs (2010). Six traits are identified to develop transdisciplinary individuals, such as to be able to build networks and to discuss topics accepting multiple points of view. Societal conscience and the ability to think in a complex interlinked way are highly recommended. The paper suggests modest positionality from a transdisciplinary individual perspective, admitting the complexity of problems and the lack of perfection in the solutions.

In parallel, Mollinga (2009) identified the attitudes, challenges and opportunities for water practitioners working in the transdisciplinary agricultural water sector. Literally, the challenges are: a) internalising ecological concerns into water systems

design, management and governance; (b) shaping the co-evolution of the water technological/infrastructural system and the water social system from a human development perspective; and (c) constructive involvement of the water-control-systems-associated interest groups in the design, management and governance of these systems. To cope with these challenges, water practitioners need to apply conceptual, instrumental, behavioural and institutional design skills. Conceptual and instrumental skills can help to understand the multidimensionality of water and establish water systems for different uses and users. Behavioural and institutional design skills are important so that water practitioners can participate actively in design, management and governance processes.

Transdisciplinary practices in the urban water sector

In relation to the urban water sector, the scoping process identified two articles related to the subgroup Outcomes and experiences of transdisciplinary processes. These articles are written by practitioners and researchers from Australia. There were no identified articles related to the subgroup of roles and skills that practitioners should have in transdisciplinary process.

One paper ((Edwards et al. 2007)) suggests how the different stormwater programs of local governments should move from a multidisciplinary way of working to transdisciplinary approaches to manage water in Melbourne. The authors identify resistance to change at local government level. Nonetheless, each organization is in a different stage of change and multiple strategies are contributing to make a difference in the stormwater programs. Some of the strategies are the identification of opportunities, joint implementation target setting and community engagement. Participation of consultancy organizations offering specific services and knowledge in different topics is also valuable. Other ways to improve transdisciplinary practices are investment in internal resources and constant institutional capacity building. Knowledge brokers, correct governance tools and evaluation and evolution programs are fundamental for feedback and better understanding of the collaboration and organizational change processes.

The second paper (Fam et al. 2013) describes organizational learning processes in a corporatized urban water utility. Sustainable systems of service are tested and analysed by different staff and residents. Different outcomes are established from this process of organizational learning. The paper recognized the value of strategies to facilitate communication and collaboration between departments, staff and residents. Adopting

qualitative social research, regular meetings and spaces to share different points of view are important to capture unexpected insights of the actors and analyse outcomes of projects, translating individual learning to organisational learning.

2.2.5 Transdisciplinary practice applied by urban water practitioners

The literature analysis revealed different insights of transdisciplinarity in the water and urban water sectors. Transdisciplinary practice in these sectors is in a growing phase. Concrete evidence exists of the contribution of transdisciplinarity to achieve robust societal solutions to water problems and clear interests of academia and practitioners to expand cross-boundary interactions in different scenarios, at different scales. In this evolution, advances are reflected in the identification of common languages and structures, use of actor-based modelling, typology of actors, establishment of frameworks and tools and assessment of transdisciplinary projects. Future directions for transdisciplinary practice include process management, knowledge integration and organizational learning and change.

The scoping process located few studies in transdisciplinary practice. This research gap is confirmed by authors such as Apgar et al. (2009); Bock Hong and Reynolds-keefer (2013); Bohnet (2010); King et al. (2009); Munasinghe (2001) and Ryan-Vincek et al. (1995). According to these authors, there is a lack of research in life-contexts outside academic circles or research initiatives A tendency to discard local and traditional types of knowledge is common and few investigations involved relationships of different disciplines and roles and responsibilities of multiple stakeholders for knowledge integration. Specifically, research on the practitioner perspective is very limited. Increased knowledge is needed of 1) Roles, responsibilities and experiences of practitioners in transdisciplinary processes, 2) Structures and support of transdisciplinary processes involving practitioners, and 3) Types of services developed and delivered by practitioners through transdisciplinary practices. In the urban water sector, practitioners are professionals with backgrounds in hydrology, civil engineering, ecology, town planning, landscape architecture and social science, among others. These professionals learn and take different decisions, based not only on different technical skills but also different personal skills, such as negotiation, active listening, networking or leadership, in engaging with communities and other disciplines to manage urban water resources (Brown et al. 2005).

We suggest analysing urban water projects in order to understand how water practitioners work in terms of transdisciplinary practice. Through these analyses, it should be possible

to understand what promotes or hinders this disciplinary approach and its contribution to the management of urban water resources and the transition to water sensitive cities. Authors such as Pohl and Hadorn (2008b) recommend research on how practitioners understand and structure societal problems in specific projects to enrich the theory, methodology and formalization of transdisciplinary practice. Daniell et al. (2010) claim few studies are analysing project teams that design and organize participatory water management processes. Research is needed in leadership and networks in these teams as well, to understand better the dynamics and effects of co-engineering on participatory water management processes.

Integrated urban water management in Australia has advanced in documenting and reviewing the learning-by-doing in the planning and implementation of 'demonstration sites'. These pioneer experiences contribute to the acceptance of wider practices by the water industry (Mouritz 2000; Mitchell 2006).

Three areas are considered important to analyse in urban water projects: 1) Mapping the chronological development of organizing processes, 2) understanding the disciplinary dynamics and interactions; and 3) describing the mechanisms and strategies applied by individuals and organizations to facilitate transdisciplinary practices. We believe that these three areas could contribute to the creation of an explanatory framework of transdisciplinary processes and dynamics developed by water practitioners in urban water projects. This type of framework is needed in transdisciplinary practice. Abstract scientific concepts need to be understood locally and include human and temporal dimensions. In this way, transdisciplinary practice is more inclusive, facilitating decisions relating to water problems and the establishment of effective transdisciplinary teams (Apgar et al. 2009).

Organizational processes related to urban water projects

We suggest analysing the sequence of organizational activities and events related to the decision-making processes of urban water projects. This analysis would provide insights on the way water practitioners frame a problem, establish a team, assign responsibilities and integrate knowledge to deliver different outcomes. Aspects of institutional capacity, such as human resources, intra- and inter-organisational capacity or external rules and incentives for urban water management, suggested by Brown et al. (2005), are an appropriate guide for identifying and understanding the organizational processes of the water projects. The contextual factors for transdisciplinary collaboration by Stokols et al. (2008b) are also relevant to this analysis.

Disciplinary dynamics and interactions of project teams

The urban water sector needs to learn about participatory levels and teamwork appropriate to management processes and outcomes (Daniell et al. 2010). Therefore, we suggest investigating the disciplinary dynamics and interactions applied in urban water projects. For this purpose, firstly, it is important to recognize the main characteristics and similarities and differences of transdisciplinary practice in relation to other disciplinary approaches. It is important to acknowledge a continuum starting from uni or monodisciplinarity, multidisciplinarity, interdisciplinarity, to transdisciplinarity as well. The applicability of each discipline in this continuum depends on the complexity of the problem and the level of cooperation amongst actors (Lawrence and Després 2004; Ramadier 2004; Max-Neef 2005; Nicolescu 2006; Jahn et al. 2012).

Secondly, continuous participation of multiple actors is highly desirable in transdisciplinary processes but the assessment of transdisciplinary projects shows diverse consultative and participatory dynamics. For instance, the participation of different social actors takes place mainly in the initial or final phase of the processes while the data analysis or middle phase is often developed by researchers (Pohl and Hadorn 2007; Elzinga 2008; Mobjörk 2010; Enengel et al. 2012).

Thirdly, disciplinary dynamics and interactions in urban water projects could be displayed in a typology that can clarify the role and applicability of transdisciplinarity in this sector. The conceptual framework created by Fratini et al. (2012a) to facilitate the integration of different disciplinary approaches in order to address urban complexity is relevant to this purpose. The co-engineering participatory water management processes in the Australian and Bulgarian context might be useful as it is a pioneer study of project teams that design and organize participatory water management processes (Daniell et al. 2010)

Mechanisms and strategies to bring actors together

The participation and diversity of actors involved in transdisciplinary processes may be very low as transdisciplinarity faces many cognitive, conceptual and personal challenges (Ramadier 2004). In this sense, studies are needed that focus on how and to what extent individuals are establishing teams and networks to allow transdisciplinary processes (Bass and Avolio 1994; Jackson and Stainsby 2000; Katzenbach and Smith 2001; Gratton et al. 2007). For this reason, we suggest analysing the formal and informal mechanisms and strategies applied by transdisciplinary individuals to bring actors together and develop urban water projects. This knowledge may be useful to understand the decision-making

process, integration of knowledge and the acceptance of transdisciplinary practices by other individuals involved in urban water projects. The literature in urban water management considers it is fundamental to understand the role of these leaders (e.g Brown et al. 2013; Meijerink and Huitema, 2010; Taylor, 2010). Different studies identified the skills and attributes of these leaders. For example, dependant on the group of professionals, these leaders can manipulate and transfer local and scientific knowledge and information through diverse templates and narratives facilitating cognitive and decision-making processes (Payton et al. 2003; Suddaby and Greenwood 2005; Battilana et al. 2009; Thornton et al. 2012). Similarly, they put in practice negotiation, persuasion, conflict management and diplomacy strategies in a very creative way and, through different levels of trust, legitimacy and power, bring unexpected people to participate in the processes (Forester 1999; Uhrwing 2003; van Mansfeld 2003; Mollinga 2009; Williams 2012; Edelenbos et al. 2013)

2.2.6 Concluding comment

This paper has described the main characteristics and areas of interest of transdisciplinary research and practice, giving special attention to the water and urban water sectors. From a review of the literature, it is apparent that knowledge of transdisciplinarity is in a growing phase. Research has shown interest in finding common concepts and languages to articulate disciplines. Models, typologies, frameworks and tools are designed to strengthen communication among actors and facilitate decision-making. Transdisciplinary processes are describing the different views of actors and identifying mechanisms to integrate knowledge. The literature indicates a need to tackle social and institutional limitations such as resistance to simplify knowledge; uneven power relationships; unclear roles and responsibilities; and lack of practical guidelines, among others. Several studies suggest informal and formal spaces such as interactive workshops and channels, group model building and concrete case contexts to discuss the perceptions of actors, create common visions and establish roles and rules. However, a gap exists in research focusing on transdisciplinarity in life contexts developed by water practitioners. The little research on transdisciplinary practice addresses firstly, attitudes, conflicts, challenges and opportunities for transdisciplinary individuals and teams and, secondly, organizational learning processes to move from multidisciplinary to transdisciplinary approaches. These studies on transdisciplinary practice indicate as priority the increase of knowledge on process management, knowledge integration, team management and organizational

learning and change. Therefore, future research in transdisciplinary practice in the urban water sector can be linked with the understanding of organizational processes, disciplinary dynamics and strategies that water practitioners are using to bring stakeholders together and to achieve transdisciplinary practice related to water agendas. The understanding of these topics can contribute to an explanatory framework, increasing the empirical knowledge and practical experience needed in transdisciplinary practice. This framework could support water practitioners in identifying, understanding and enhancing areas where they are developing transdisciplinary practice to manage urban water resources in an integrative way.

2.2.7 References

References have been moved to a consolidated reference list at the end of the thesis

Chapter 3

Research design

3.1 Introduction

Research interests, gaps and future directions of transdisciplinarity in the urban water sector were discussed in Chapter 2. As a result of the literature analysis, the following research question was formulated: *Is transdiscipinarity essential to realising multifunctional landscape outcomes in the urban water sector?* To answer this question, an overaching research objective was established: To identify and illustrate with an explanatory framework the enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring actors together in water projects delivering multifunctional landscapes. This chapter explains the methodology, research design and methods used to answer this research question and develop its objective. These methods are presented in chapters 4, 5 and 6 with slight modifications, depending on the characteristics of the individual case studies.

3.2 Methodology: Multiple case study

The methodology in this research used multiple case studies with a qualitative approach. This methodology is recommended for investigations of a phenomenon in its real-life context, explaining the boundaries of the phenomenon and its context (Yin 2009). It is also used to understand phenomena at an organisational scale, thereby allowing a holistic vision of transdisciplinary processes (Stokols 2006; Leedy and Ormrod 2013). Therefore, multiple case studies were considered appropriate to understand the organisational context of the municipalities and the characteristics of transdisciplinary processes involved in successful projects delivering multifunctional landscapes.

3.2.1 Selection of cases: Criteria framework for assessing multifunctional landscapes

There is no specific set number of cases for this qualitative approach. However, a maximum of four or five cases is recommended for in-depth analysis of multiple case studies to identify themes and conduct a proper cross-case analysis (Creswell 2012). The most important requisite in multiple case studies is a selection of cases that represent expected conditions of the phenomenon of study, ensuring comparability of data and greater learning (Stake 1995; Yin 2009).

Due to time and the scope of the research, this study investigated three case studies. Cases were selected in two steps.

1. The researcher contacted prospective informants working for public or private organisations, who could give information on projects delivering multifunctional landscapes in Australia. Moreover, a search was carried out in municipalities' web pages and other institutions' pages offering technical sheets or profiles of projects delivering multifunctional landscapes. In projects identified in Melbourne, the researcher contacted the municipalities and organised field visits to observe the outcomes of the projects. During these visits, staff of the municipalities suggested other projects for the study as well.

2. The researcher created a criteria framework for the assessment of projects delivering multifunctional landscapes (Appendix B). This type of assessment facilitates the identification of suitable cases for the particular research question and objective (Asmussen and Creswell 1995). The criteria had five main elements for assessment of each project. (Table 3-1). These elements were chosen in order

to find successful projects already implemented that accomplished different objectives and offered various benefits and services for society and nature.

Table 3-1 Criteria framework for multifunctional landscapes

1) Stage of the project identified whether the project was in the design stage, under construction, or had already been implemented.
2) Scale and spatial elements were used to identify if the project was in a street lane or precinct and included raingardens, community gardens, street art, sports fields, or porous pavement, among other characteristics (Ahern 2007; Landscape Institute 2009).
3) The gradient of multifunctionality was used to classify projects delivering either one function; attempting to deliver one function but incidentally providing other functions; or focusing on delivering diverse functions simultaneously (US Army Corps; Rodenburg and Nijkamp 2004).
4) Objectives of the project described the principal purpose of the projects in relation to water quality and supply; climate; biodiversity conservation or human health or well-being (Naumann et al. 2011).
5) Urban ecosystem services delivered by each project were determined, such as food supply, water flow and runoff mitigation, urban temperature and climate regulation, noise regulation, air purification, waste treatment, animal sighting, recreation, tourism, aesthetic appreciation, and spiritual experience (TEEB - The Economics of Ecosystems and Biodiversity 2011; Hernández-Morcillo et al. 2013).

The researcher evaluated 17 projects through the criteria framework to find successful projects delivering multifunctional landscapes. Two academics and six practitioners with knowledge and experience in projects implemented by municipalities reviewed the ratings allocated by the researcher. The ratings were binary, either 1 if the element was presented in the project or 0 if it was absent. Three projects had the highest scores in the framework and were chosen for the research: A creek filtration system in Brisbane, an industrial precinct in Melbourne and a green lane in Sydney.

However, the selection of cases did not depend solely on attribute sampling but also on the feasibility of obtaining data (Stake 1995). In other words, the selection of the cases did not only depend on outcomes from the criteria framework, but it also depended on the interest of the municipalities in participating in the research and sharing information about the projects. Therefore the researcher communicated with staff working in the environmental sections of the municipalities that developed the projects with the highest scores, explaining the aim of the research, benefits for their organisations, and requirements of the research. Then a formal letter was sent to each of these municipalities, and it received a positive response. A primary contact was assigned by the municipalities to help the researcher in her work plan with these entities.

3.2.2 Data collection: Semi – structured interviews and document analysis

Before undertaking data collection in multiple case studies, it is recommended to conduct a pilot interview and a pilot case study to train the researcher in the collection of data and to refine the methods, if need be (Sampson 2004; Yin 2009). Therefore the researcher conducted a pilot interview with an actor with extensive experience with municipalities to obtain feedback on the questions and determine the most effective way to interview the participants involved in the projects. The Sydney case was chosen as the pilot case: the researcher had easier access to this case than to the others as she was familiar with the municipality and its staff. However, the method of the pilot case study did not differ from that of the other case studies. In the three cases, the following data collection protocol was applied:

An initial list of actors who participated in the projects was created with the aid of the main contact in the municipalities. The main contact was a manager or technical officer working in the environmental section of the municipalities and with knowledge of the teams involved in the projects. Simultaneously, the researcher had access to different documents that the main contacts considered relevant for the understanding of the project. The researcher identified potential interviewees from the initial list developed with the main contact and documents related to the projects that mentioned names of practitioners and their roles in the projects. The researcher then contacted the interviewees by telephone or email, explaining the purpose of the investigation and her desire to conduct a semi-structured interview to learn more about their role and experience in the projects. In this process, the researcher tried to have interviewees from different hierarchical levels in the

municipalities, to reveal different insights into the projects and the organisations (Nader 1980; Herndon and Kreps 1993).

In each case, arranging the interviews and gaining access to documents was relatively easy. However, there were delays in the planning of the interviews and resistance by some actors to participating in the investigation. The latter difficulty demonstrated to the researcher the complexity of accessing municipalities, which has been acknowledged by other researchers such as Morison (2009), Kloot and Martin (2007) and Pini and Haslam Mckenzie (2007). Various reasons are given by these authors, such as staff members are busy due to different responsibilities and limited time, or they have already participated in several research interviews, they do not consider the investigation useful, or they fear being judged by their actions. These can create resistance to and delays in the research.

The researcher used several strategies to arrange the interviews. In some cases, the main contact of the municipalities communicated directly with the possible interviewee and then the researcher explained in greater detail the purpose of the research, highlighting anonymity. At the same time, the researcher communicated with external actors respected by staff in the municipalities so they could persuade the potential interviewee to participate in the research. When the interviewee claimed lack of time, the researcher expressed how the interview could be adapted to fulfil the time requirements of the interviewee. With the use of these strategies, the researcher was able to organise satisfactory interviews with the actors involved in the projects.

Semi-structured interviews were conducted in this research. These interviews are flexible, with the researcher starting with broad questions and including additional questions as the interview progresses, and allowing dialogue to develop which is relevant to the research (Creswell 2012). In each semi-structured interview, the researcher started with a short introduction to the research, and handed across the interviewee forms required by the ethics committee of Monash University, project number CF14/2377 – 2014001296. These forms explained the confidentiality, anonymity and administration of the information of the research. These forms were read and signed by all the interviewees, giving approval for recording the interviews. In total, 37 semi-structured interviews were conducted throughout 2014 and 2015 with the teams involved in the projects. These teams consisted of senior managers, councillors, coordinators, technical officers, consultants, and local community members.

The questionnaire used in the semi-structured interviews (Appendix C) asked first about the role, position and professional background of the interviewee. Then the interview focused on exploring: 1) The chronological development, key events and organising processes that lead to the projects; 2) team dynamics and experiences working as a team; and 3) the main challenges in the projects and strategies used to overcome these limitations. Interviews lasted from 30 minutes to 1 hour. During the interview, the researcher wrote relevant keywords and notes. At the end of the interviews, some interviewees provided documents they considered relevant to the research. In total, 162 documents were collected, including official reports, management plans and programs, policies, meeting minutes, formal internal communications and media documentation.

3.2.3 Data analysis and interpretation: Individual and cross-case analysis

The analysis of data from each case study involved the simultaneous classification of ideas, events and processes in categories (Schatzman and Strauss 1973; Wolcott 1994; Silverman 2005). To understand better the case study, the researcher organised key information into tables, graphs and timelines to create a picture of the case (Miles and Huberman 1994). Data analysis was a continuous iterative process of verification and comparison of arguments and ideas to find common patterns and divergent views representing rival explanations (Yin 2009; Creswell 2012). Some patterns were identified quickly. Others were discovered while reviewing literature in transdisciplinarity, co-management, co-governance, co-engineering, management processes, team diversity, social learning and participatory processes, among other topics. Theories and concepts used in the research to interpret the data and use in all the publications were those from the study of Olsson et al. (2006) for the analysis of the chronological development of the projects. Monodisciplinarity, multidisciplinarity, interdisciplinarity and transdisciplinarity features used to identify disciplinary dynamics were based on different studies (e.g Klein 1990; Rosenfield 1992; Carpenter 1995; Flinterman et al. 2001; Schummer 2004; Balsiger 2004; Max-Neef 2005; Choi and Pak 2006; Hall et al. 2008; Klein 2008; van Rijnsoever and Hessels 2011; Deady 2012). The publications presented in chapters 5 and 6 used the entrepreneurial change strategies for water governance developed by Brouwer (2015) to identify strategies used by practitioners to bring actors together. The strategies are grouped into four categories: Attention- and support-seeking strategies; linking strategies; relational management strategies; and arena strategies. The publication presented in chapter 6 used the study of Brown and Clarke (2007), which identified eight enabling

conditions that are dependent on leadership in water projects. These enabling conditions are socio-political capital, bridging organisations, the availability of trusted and reliable science, binding targets, accountability, strategic funding, demonstration projects and training and market receptivity.

3.2.4 Research quality

Multiple case studies have been neglected by some authors who consider the reliability, rigour and validity of the methodology low and not a good strategy for social research (Stoecker 1991; Bowen and Wiersema 1999; Rouse and Daellenbach 1999). For this reason, it was critical to ensure construct validity, internal validity, external validity and reliability, to guarantee research quality.

Construct validity means establishing congruence between variables and the operational measures for the concepts chosen for the study (Yin 2009). The validity of this research was developed through triangulation of data from the semi-structured interviews and the analysis of the documents. Chains of evidence were constantly established between the conclusions and the research question formulated for the study. The researcher created a history line of the projects and reports, identifying the key events and teams involved in the different projects' phases. This information was reviewed by key informants, managers and technical officers who had knowledge of all project phases, as well as by academics supervising this research, to ensure the results matched their understanding of the phenomena, thereby providing critical observations and interpretations (Stake 1995).

Internal validity is established in the definition of causal relationships that facilitate the emergence of other factors, creating coherence in the interpretations of the data, whereas external validity defines the limits to the generalisation of data in a domain. The use of multiple case studies strengthens internal validity, and external validity as the outcomes one case study can be confirmed in other cases, defining common crucial factors involved in the phenomenon (Yin 2009). For internal validity, the researcher carried out a rigorous analysis of the data through pattern matching and explanation building. Explanation building was also used to create a logical sequence of the events explained in the cases. External validity was built through the review of the results of the case studies, and cross-case analysis by the key informants and academics mentioned above, with the subsequent analysis by reviewers from the journals (Stake 1995; Scholz and Tieje 2002).

Reliability applies when the procedures for obtaining data can be implemented by other researchers to get the same results (Yin 2009). For this reason, the protocols for the interviews and different document analyses were organised into individual folders, creating a database for the three case studies. The various drafts and versions of each individual report and publications were added to these databases which are now part of the Monash Large Research Data Store (LaRDS). The data will be stored for five years and might be available to other researchers following Monash University policy.

Chapter 4

Transdisciplinary practice for delivering multifunctional landscapes in Sydney

4.1 Introduction

This is the first of three chapters that shows the empirical evidence related to the objective of the research. This chapter explains the case of Sydney in which the municipality with the participation of a community group transformed a lane of this city into a green multifunctional space. To understand this transformation of an urban space, a tentative explanatory framework is developed that explains the enabling conditions that facilitated this project. The framework explains the different disciplinary approaches and strategies used by practitioners throughout the different phases of the project.

4.2 Publication 2 - A multifunctional Sydney laneway: what´s trandisciplinarity got to do with it?

Under review Journal of Integrative Environmental Sciences

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Abstract

Academia and industry increasingly recognise the need for multifunctional urban spaces. But how do we meet this need? Emerging responses point to the promise of transdisciplinarity, as a concept and practice fit to yield coveted multifunctional environments. We critically reflect on this claim by analysing the role of transdisciplinary practice in the successful conversion of a Sydney laneway into a multifunctional urban space through involvement of a community group. What role did transdisciplinarity play in this development? We trace the co-existence of mono-, multi-, inter-, and (some) transdisciplinary practices throughout the project stages, to better understand just how much transdisciplinarity contributed to its success. A tentative explanatory framework emerges from our analysis, and is offered here to map the *enabling conditions*, *disciplinary dynamics*, and *strategies* that allowed this laneway's transformation into a multifunctional space. *Enabling conditions* [we identified] were: the municipality had institutionalized a concern for the environment, showing leadership on sustainable management; an organisational change program ensured the project's independence from the capital budget; and an environmentally aware community group played a core role. The *disciplinary dynamics* observed were diverse, encompassing all modes of disciplinary practice. Project planning and design were transdisciplinary in nature, but project implementation and maintenance were not. Finally, practitioners used various *strategies* to bring actors together: they understood the political nature of the organisation and used it for their benefit; they recognized the different types of actors involved in the

project, and then used appropriate language to communicate ideas and to manage risks and expectations.

Keywords: Municipalities, multifunctional landscapes, transdisciplinary practice

4.2.1 Introduction

Contemporary urban environments face many challenges: their populations are growing despite limited space; their biodiversity is declining, and climate change adds multiple threats. How can cities adapt to remain resilient? One important answer lies in multifunctionality: the idea that a piece of technology or infrastructure should deliver multiple resources, functions, and associated benefits, toward creation of interconnected urban spaces that are resilient, adaptable and sustainable (Kato and Ahern 2009; Lundy and Wade 2011).

But there are barriers to achieving this: our organisations are set up to deliver mono-functional solutions. How to get out of this trap? Transdisciplinarity has been heralded as a promising pathway out of traditional, siloed organisational practices. A growing literature is entrusting this concept with the ability to facilitate multifunctional landscapes in practice, by fostering engagement between researchers from the humanities, the natural and social sciences, and policy and practice professionals involved in land use decision-making processes. The resulting dialogue, it is proposed, leads to a holistic understanding of the urban landscape's needs in question, and will establish tangible nature–culture interacting systems (Fry 2001; Naveh 2001; O'Farrell and Anderson 2010). By coordinating actors with different types of knowledge, and by operating at multiple institutional levels, transdisciplinary practice is said to integrate the functions of those urban spaces based on legal, economic, social and technical attributes (Matos Castaño et al. 2015).

These are promising claims. And yet, transdisciplinarity – both as concept and practice – is still in its infancy. The concept is ambiguous and not clear. Community-based participatory research, action research or experimental action research among others are considered similar approaches to transdisciplinarity (Lang et al. 2012; Scholz and Steiner 2015). This research will use the terms 'transdisciplinarity', 'transdisciplinary research' and 'transdisciplinary practice'. In this context, a literature review found that new knowledge is constantly emerging in this field. Current research focuses on developing definitions of transdisciplinarity that distinguish it from other disciplinary approaches; creating

transdisciplinary frameworks, and implementing and assessing research processes involving academics (Guzmán Ruiz et al. 2015).

Few studies ask how transdisciplinary practices may contribute to the creation of multifunctional landscapes in cities (for examples, see Edwards et al., 2007; Fam et al., 2013; Matos Castaño et al., 2015) – an arguably pressing priority in our quest to future-proof urban life on this planet. This paper puts the theory to the test by analysing what transdisciplinary practice had to do with a municipality's successful transformation of a Sydney laneway into a multifunctional urban space. We deemed the project successful because it decreased flooding risk while increasing green space, amenity values, and security. But to what extent did that success depend on processes deserving of the term "transdisciplinary'? And will the answer apply to other scenarios where multifunctional outcomes were achieved?

We propose that a closer look at individual cases is needed to supplement general theorising with a more nuanced understanding of the complex and divergent ways in which transdisciplinary practices contribute to the creation of multifunctional urban spaces. Drawing on the present case study, our paper therefore offers a tentative explanatory framework of the enabling conditions, disciplinary dynamics, and strategies applied by the practitioners who facilitated the project. We hope that this framework – modelled on a practitioner perspective – will help close gaps in transdisciplinary practice research by addressing the current dearth of empirical evidence and frameworks for local contexts, and the lack of knowledge about process management, team dynamics and organisational change (Apgar et al. 2009; Daniell et al. 2010; Fam et al. 2013). We envision our tentative explanatory framework to serve as a learning platform for practitioners and academics interested in understanding how transdisciplinary practices can help create multifunctional landscapes in cities.

4.2.2 Theory

Offering simultaneous benefits for citizens and nature, to lead social and ecological transformation: that was the objective of the Sydney-based project we present here as our case study. According to Olsson et al. (2006), a socio ecological transformation follows two phases – a preparation and a transition phase – linked by a window of opportunity. We suggest that these phases can help us understand the historical context and conditions that enabled practitioners to succeed in the case-study project (what we call enabling

conditions), the disciplinary dynamics at play, and the strategies used by the practitioners involved. In the framework we propose, enabling conditions are linked to Olsson et al. (2006) preparation phase and its associated window of opportunity, where a system – in our case the organisation – gets ready for change: exploring new system configurations and strategies, and establishing networks that integrate and build knowledge. In this process, new forms of leadership emerge that help open up the window of opportunity (Olsson et al. 2006) which relies on three criteria that also proved critical in our case study – first, that a problem is recognized; second, that a solution is available; and third, that the political climate is conducive to the change and actions required to achieve that solution (Kingdon 1995; Olsson et al. 2006).

Next, our framework proposes that the disciplinary dynamics and the *strategies* practitioners use to deal with social-institutional barriers to facilitate the project can be linked to Olsson et al. (2006) transition phase: here, flexibility and improvisation are central to practitioners' handling of uncertainties in new processes. Key elements of transformation are dynamics of cross-scale interactions, the management of problems in different domains, and the development of solutions to these problems (Olsson et al. 2006). To analyse the disciplinary dynamics operating at each phase, we used the following terminological definition: transdisciplinary practice coordinates and integrates actors at different hierarchical levels and sectors – for example, industry, academia, government and the local public – to develop a common goal through mutual learning directed at understanding and solving complex social problems (Max-Neef 2005). Features of transdisciplinary practices are: team members have diverse disciplinary perspectives and abilities, and integrate participants from different backgrounds; collaborative teams receive incentives from their organisation; team members communicate effectively to develop a joint understanding of the problem; and they are willing to devote time to manage the inherent tension of such collaborations (Stokols et al. 2008b).

This is a comprehensive definition and – perhaps not surprisingly – authors such as Ramadier (2004) consider it difficult to implement all of its features in practice: cognitive, conceptual and personal challenges may all decrease the participation and diversity of actors involved in transdisciplinary processes. Both underrepresentation or overrepresentation of certain actors can threaten the transdisciplinary nature of a given project – as can contexts where participation of diverse actors becomes unmanageable (Lang et al. 2012). Similarly, a project may only be deemed transdisciplinary in the initial or

final phase (with different social actors participating), while other phases may be developed by a homogenous group of same-sector actors (Jahn et al. 2012). In short: the disciplinary dynamics and the degree of cooperation among actors during each project phase are context-dependent, and reflect the complexity of the social problem that needs to be solved (Mobjörk 2010). More often than not, social and ecological transformation will not proceed in a purely transdisciplinary fashion, but will involve inter-, multi- and monodisciplinary practices.

As interdisciplinary we define practices that involve unrelated academic disciplines working together to achieve a common goal. Such collaboration creates a common terminology as a result of fusion of concepts and methodologies from different disciplines (Tress et al. 2003). Multidisciplinary practice involves teams dealing with the same subject matter, but each member pursuing separate goals and analyses, without a common dialogue that could advance problem-solving, or lead to integration and synthesis of knowledge and outcomes (Elliott 2011). Finally, monodisciplinary practice is specialized practice: it requires isolation or simplification, since it seeks to understand a complex problem through the lens of a single discipline or subject area (Max-Neef 2005).

In addition to the analysis of the disciplinary dynamics applied in the project's transition phase, it is critical to understand what *strategies* practitioners use to bring actors together despite socio-institutional barriers (Farrelly and Brown 2008). Strategies can be defined as the modus operandi of practitioners who pursue change (Brouwer, 2015). The strategies might include negotiation, persuasion, conflict management and diplomacy, depending on practitioners' different levels of trust, legitimacy and power to bring actors together, and reflecting their knowledge of the political nature of the organisation (Williams 2012).

Practitioners might also manipulate and transfer local and scientific knowledge and information through diverse narratives and communication styles, to facilitate cognitive and decision-making processes, thereby revealing the interests and motivations of the actors involved (Battilana et al. 2009). When a project is pioneering and innovative in nature, practitioners may use strategies to manage multiple expectations and risks by clarifying possibilities and limitations, and by maintaining continuous communication and a common perspective of the project among all actors (Renner et al., 2013).

4.2.3 Research approach

We used a case study approach to investigate how a local Australian government organisation – here called a municipality – transformed a Sydney laneway into a multifunctional urban space, and to what extent transdisciplinary practices were applied in this project. This approach is particularly suitable when: firstly, little is known about characteristics involved in decision-making processes at the organisational level; and secondly, the information generated by the analysis may inform practice in similar contexts (Leedy and Ormrod 2013).

Selection of case study

To select an appropriate case study, we created a criteria framework for projects delivering multifunctional landscapes, based on urban ecosystem services and green infrastructure indicators at different scales (lot; streetscape and lanes; precinct and catchment) (Ahern 2007; TEEB - The Economics of Ecosystems and Biodiversity 2011; Gómez-Baggethun and Barton 2013). Two academics and six practitioners reviewed the rating gave to seventeen representative projects in Australia. The Sydney laneway case study was chosen as it received one of the highest scores in relation to our criteria framework, involving an increase in the area of green space, amenity values and security, and a decrease in flooding risk.

Case study analysis

Multiple methods were applied to obtain detailed information about the project. To understand the historical context and enabling conditions, we analysed a total of ninety-two documents comprising management plans and programs, policies, meeting minutes, official internal communications and newspaper articles. Five semi-structured interviews were conducted with senior managers and a local politician of the municipality, as well as coordinators and members of a local community group, to elicit information about the main events and decision-making processes during the project. To identify the disciplinary dynamics and the strategies used by practitioners to bring actors together, we conducted ten semi-structured interviews with managers, coordinators, a local community leader and community group members. Interviewees answered questions exploring personal experience, communication and interactions among team members working on the project, and the main strategies used to deal with challenges or difficulties in the project.

Thematic analysis of our data involved an on-going, critical and analytical review process (Creswell 2003). Key actors from the municipality and the community verified the history and the description of the organisational processes. Since knowledge of transdisciplinary practice is limited, we distilled the results of our case analysis into a tentative explanatory framework that maps the project's enabling conditions, disciplinary dynamics and actors' strategies onto Olsson et al. (2006) phases for transformation of social-ecological systems

Enabling conditions were analysed in terms of the processes that prepared the organisation to develop the project (preparation phase), and the characteristics of the window of opportunity. For the transition phase, we analysed the disciplinary dynamics based on our terminological definition of mono-, multi-, inter- and transdisciplinary practices outlined above (see 2.). Finally, we described the main socio-institutional barriers to transdisciplinary practices in this project, and analysed the strategies practitioners used to overcome these barriers and to bring actors together. Given the dearth of research on transdisciplinary practice in the context of projects delivering multifunctional landscapes, our data analysis and discussion of results draw on a broad body of literature from domains such as co-management, co-governance, co-engineering, management processes, team diversity, project management, social learning and participatory processes in public administration, policy or development studies.

Redesigning a Sydney laneway: case study context

Imagine a shady little laneway in metropolitan Sydney, Australia: always littered, regularly flooded, and habitually frequented for illegal activities. The need for change was inevitable: an urban transformation project was born. The flooding, littering, and illegal activities had to stop, or at least abate. To achieve this, a multifunctional green space was created (instead of parking lots, as originally intended) by installing buffer strips, permeable pavement, solar energy panels, a rain tank, and by planting trees and creating a social space for citizen interaction. The project was set in the institutional context of a municipality in Australia's state of New South Wales. These organisations are responsible for preparing municipal strategic statements and administering local planning schemes. Their organisational structure commonly comprises local politicians, a general manager and a number of sections and departments responsible for services relating to infrastructure, planning and environment, and community (Allan et al. 2006).

Environmental projects arising in such an institutional setting usually follow a standard procedure: the planning and environmental services departments strategically analyse the project against priority lists and budget availability. If senior managers approve of the project, its technical specifications are then developed by the infrastructure services department, which also implements the work and maintains the finished landscape. However, our case study project did not follow this standard procedure. It was the first urban transformation project lead by this municipality in which a community group actively participated. The project was not part of a pre-planned priority list of works; it was set up involving different hierarchical levels of the organisation, academic experts, senior managers, the community group and one local politician. The design involved multiple workshops between staff from the environmental service and infrastructure service departments and members of the community group. The infrastructure department was responsible for implementing the project. The project spanned eight years for planning processes and two years for design and implementation. The maintenance phase is ongoing: to this day, the municipality maintains the laneway's infrastructure, and the community group its trees.

4.2.4 Results

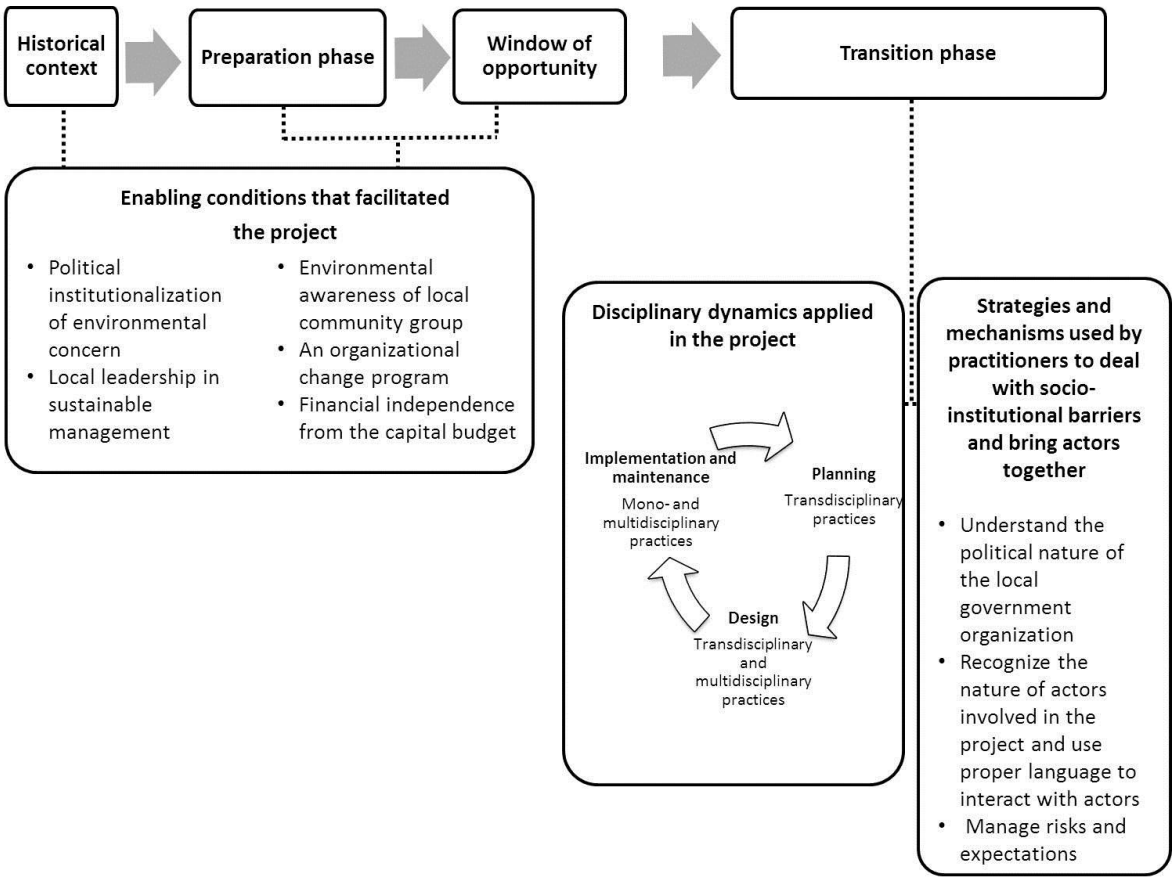
We present our case study findings as a tentative explanatory framework (Figure 4-1) that maps the project's enabling conditions, disciplinary dynamics, and actors' strategies onto phases for transformation of social-ecological systems (Kingdon 1995; Olsson et al. 2006). Our notion of enabling conditions is linked to the preparation phase and its associated window of opportunity, while our concepts of disciplinary dynamics and strategies are tied to the transition phase.

Enabling conditions that facilitated the project

In the historical context and preparation phase (1990–2010 approx.), the municipality went through a period of change that would eventually facilitate development of our case study project. Through legislative reforms in the state of New South Wales (NSW), such as the Local Government Act 1993 and the Local Government Amendment Act 2009, municipalities changed their organisational structure to include environmental management. An environmental services department was established and staff started building knowledge and developing different visions for sustainability programs and actions related to climate change, water management, environmental planning, waste management and energy, among others. Of relevance for our case study project, a water

agenda was established in 2002, with the formation of an alliance between the environmental services department and academics aimed at developing the first integrated and holistic sub-catchment planning process for the municipality. Outcomes of these planning processes included four sub-catchment management plans, a strategy for a water sensitive community, and water sensitive urban design programs including education programs, implementation of rain gardens and green lane programs.

Figure 4-1 Tentative explanatory framework of processes that enable multifunctional urban spaces



Source: based on findings of this study and modelled on Olsson et al. (2006)

The window of opportunity to develop this project initially emerged in 2010, when a building was established in our case study's lane. By law, the NSW State Government demanded that the relevant building company responsible for such development also resurface the lane and provide parking. But a community leader and resident of the lane, who attended water sensitive design workshops and had technical knowledge in design, sent a complaint to the municipality, suggesting that a green space be developed in the lane instead of parking. The proposal included water sensitive urban design and a space

for social interaction by residents and the community, addressing social and environmental problems in the lane. The municipality's environmental services department viewed the complaint and proposal as an opportunity to implement water sensitive urban design through a participatory process with the community.

Similarly, senior managers considered that the project could fit into a new organisational change program that attempted to avoid monofunctional projects and, instead, promote a holistic, integrative and multifunctional approach. In addition, the project could align different policies and strategies of the urban water management agenda of the municipality such as sub-catchment management plans, a strategy for a water sensitive community and water sensitive urban design programs. The actors then started to find financial resources for the project, which benefitted from the stormwater management service charge and rainwater tank incentive scheme established by the New South Wales Government in 2006. In parallel, negotiations with the building developer and the influence of a local politician were crucial to the financial independence of the project. The municipality departments for development assessment and infrastructure services negotiated with the developer to use the money originally allocated to lane resurfacing for the implementation of the project instead. The developer agreed. The community group's leader contacted one of the local politicians of the municipality, who included the project in his plans, thereby increasing the project budget. Importantly, the project's finances were thus independent from the municipality's four- or ten-year work program.

Disciplinary dynamics applied in the project

In the transition phase (2010–2012), practitioners establish different disciplinary dynamics in order to deal with new processes and uncertainties inherent in the project, while also managing problems in different domains (Olsson et al. 2006). Below we explain the disciplinary dynamics that operated during the planning, design, implementation and maintenance of the project.

Project planning: Our case study revealed that transdisciplinary practices operated during project planning in the transition phase: to identify a common problem and develop a shared vision for the project, diverse interactions and negotiations took place between staff of the municipality, the development company, community members and academic researchers. Staff from the environmental services department worked with academics to establish integrative planning processes. The development assessment and infrastructure

services departments negotiated with the development company to get financial resources. Environmental services and legal services departments created a management risk plan to work with the community. The community leader interacted with the local politician to get support, and subsequently the politician worked with senior managers to approve financial incentives for the project.

Project design: We also identified transdisciplinary practices operating during the design of the project, through the integration of interests and ideas from two departments of the municipality and the community group. Several workshops involving fifteen residents and staff from the municipality were held to discuss alternative designs for the relevant section of the lane. The actors involved in the design had knowledge of engineering, environmental sciences, architecture, landscape design and art, establishing a final design that satisfied all contributors. Multidisciplinary features also played a role during project design, since a practitioner from the environmental services department served as direct liaison with the community, discussing interests and ideas for the project, while an engineer from the infrastructure services department was in charge of incorporating the community's ideas into design alternatives. Both professionals were guided by a main coordinator from the environmental services department. Managers from other departments gave specific technical advice for the development of the project as well.

Implementation and maintenance of the project: Staff from the infrastructure services department were in charge of the implementation of the project. This department comprised mainly engineers with similar professional skills and backgrounds, who applied monodisciplinary practices. The infrastructure services department and the community group were responsible for maintaining all of the water infrastructure and the trees, respectively. Multidisciplinary practices were applied here, as each group worked from its own perspective and undertook its responsibilities without communicating or collaborating with the other group.

Practitioners' strategies for dealing with socio-institutional barriers and bringing actors together

In the transition phase of the project, practitioners need to apply different strategies for dealing with socio-institutional barriers and bringing actors together to enable the project. Below we describe the main socio-institutional barriers identified in our case study, and the strategies applied by practitioners to overcome them.

Socio-institutional barriers identified in the project: Practitioners mentioned barriers that applied during the whole project, as well as specific limitations affecting the planning, design, and implementation and maintenance of the project. Main barriers identified for the whole project were a lack of clear processes, no principal manager leading all processes, and the absence of continuous commitment from senior managers, elected officials or decision makers to promote true cooperation among departments. Constraints specific to the planning phase related to the fear of failure and risks associated with the municipality working with the community, as no other project before had been designed and maintained with active community involvement. Limitations identified by the community group were the lack of financial resources to establish the project in the whole lane, and the need to convince people of the value of the project during its planning. Examples of barriers in the design phase were the lack of training of some staff in how to collaborate with the community; high expectations from the community group wishing to redesign the entire lane as a multifunctional space; and biased views and rigid opinions of some community members and government staff, who were not open to alternative solutions and only pushed their own design ideas. In the final phase of the design, the decision-making power of the state of New South Wales' road and traffic authority was considered a barrier, as this was the only entity that could approve or reject the design based on standards for roads, but not necessarily for lanes involving water technologies. The community believed that this step in the design phase reflected excessive bureaucracy or adherence to official rules and regulations. In the implementation phase, limitations were a lack of coordination between design and construction departments, suggesting a lack of trust between, and confidence in, staff of these departments. In the maintenance phase, community group members considered other residents' limited interest in maintenance activities a barrier. To overcome these various barriers, practitioners used the following strategies to support the project.

Strategy 1: Understanding the political nature of the municipality

To overcome socio-institutional barriers, practitioners established different coalitions as a way to facilitate the project. The community leader established alliances with one politician from the municipality. In this way, the project was included in the politician's plans, and he was able to secure financial resources. At the same time, practitioners from the local government organisation strategically tapped into different networks to ensure the organisation would be receptive to, and approve of, the project. To garner support, they

showed evidence of policies, programs, academic research and partnerships to the general manager, senior managers and local politicians; they also created a risk management plan for working with the community, to reduce the likelihood of the project being rejected by municipal management staff and local politicians. In this context, the community group needed to be legally formalized, with clearly defined roles and responsibilities, to facilitate the administrative and legal processes related to the group's role in maintaining the finished landscape. Moreover, practitioners were aware of how some municipality departments work more hierarchically than others. To accommodate this, a strategy used by practitioners was to talk directly to the staff, reminding them that the project had full support from local politicians or the general manager. Practitioners mentioned how staff from very hierarchical departments would easily follow instructions from top managers, a fact that was used to facilitate project development while avoiding formalities.

Strategy 2: Recognizing the nature of actors involved in the project and using proper language to interact with actors

Practitioners involved in our case study project used demographic studies, workshops, surveys and direct interactions to communicate with the local community group, and to understand its vision for the urban space. One practitioner was the main channel of communication between the municipality and the community, listening to and translating local and technical ideas from both sides into suitable narratives. This practitioner was guided by others trained in community liaison, who believed strongly in the contribution communities can make to environmental projects.

Strategy 3: Managing risks and expectations

In our case study project, all actors involved held high expectations with regard to project outcomes. For instance, one of the community group's main expectations was to establish a green space in the whole lane instead of just one section. For engineers expectations were related to the proper functionality of the water infrastructure. In parallel, environmental officers needed to manage the risks associated with transferring maintenance responsibilities to the community. They applied different strategies and mechanisms to manage risks and expectations, including the use of discussions, priority lists and surveys. For example, environmental officers showed community group members green lanes and management plans created in other cities of the world, to clarify expectations and risks. They also reiterated the message that the project was a trial of an

organisational change program. By emphasizing the collaborative nature of the project, practitioners kept the environmental officers' focus on its main goal. Outcomes of surveys and discussions, as well as joint leadership, were useful in dealing with dominant individuals or actors who promoted only a single interest.

4.2.5 Discussion

The municipality behind our chosen case study project promotes programs and actions in areas such as climate change, environmental planning, waste management, and energy. In relation to water management, the organisation had established a water agenda comprising integrative and holistic strategies. The political institutionalization of environmental concern, and the municipalities local leadership in sustainable management (Brown, 2008; Dollery et al., 2011), stand out as important enabling conditions during the preparation phase of the project. The municipality involved in this case study may be said to exhibit moderate levels of transdisciplinary practices, as it had created a network with research institutions to develop a water agenda, including water sensitive community and education programs, which confirm the interest of the organisation in transdisciplinary collaboration and commitment to community expectations (Brown 2008; Morison 2009).

In this context, a window of opportunity emerged with enabling conditions such as awareness of a problem and identification of possible solutions that were supported by the political context (Kingdon 1995; Olsson et al. 2006). The window of opportunity originally emerged from a complaint and proposal related to an environmental problem, confirming awareness and interest from the community. A possible solution for the environmental problem was to apply water sensitive design through participatory processes. The political climate supported this solution, since senior managers were interested in implementing an organisational change program for holistic, integrative and multifunctional approaches. This organisation's interest might be linked to the desire of municipalities in Australia to increase their economic efficiency, generate cost savings, and expand and improve their service to the community (Dollery et al., 2006). Decision-making processes involving community might favour new knowledge, which can contribute to organisational change as well (Boxelaar, 2004).

The project's window of opportunity opened up the possibility to use financial sources such as property taxes, fees and charges for services, grants from higher tiers of government and developer charges (Allan et al., 2006). In this case, the financial sources were a

rainwater tank incentive scheme, a stormwater management service charge, and money raised through negotiation with the developer and from a local politician's agenda. For these reasons, the budget was independent of the capital project budget. Importantly, these financial sources provided the freedom, flexibility and openness to innovation that were needed to apply transdisciplinary practices in the different phases – which differs markedly from other projects that have scarce resources or are dependent on fixed timetables and formal procedural steps within an organisation (Mollinga, 2010).

And yet, despite the numerous advantages of this project, it is questionable to what extent its success was defined by transdisciplinary practices. After all, the planning of the project involved only a small percentage of the community, and few actors from the private and public sectors. Should we speak of "weak transdisciplinarity" in our case study's planning phase? It seems so: for when actors are underrepresented, when disciplinary boundaries are rarely crossed, and when only one view of reality is recognised (not multiple perceptions thereof), then these are signals of weak transdisciplinarity (Max-Neef 2005; Lang et al. 2012). In our case study, the project team did not necessarily cross disciplinary boundaries during activities related to creating, synthesising, translating or mobilising knowledge (Daniell et al., 2010; Elliott, 2011).

A clear – and perhaps our case study's strongest – example of transdisciplinary practice can be found during the project's design. While the number of different actors involved might be deemed low, we note that all participants continuously interacted to discuss alternatives and find a common vision for the design of the lane. This on-going interaction may be said to have diminished disciplinary boundaries, enabling all participants to learn about urban water design, and to understand others' perspectives. Similar transdisciplinary practices have been developed in participatory processes in Queensland, Australia. The creative design process among diverse professionals and actors can offer collective learning and encourage the emergence of natural leaders, stakeholder appropriation (where participants take ownership of the process), and skills transferal (Daniell et al., 2010; P. Lawrence, Shaw, Lane, & Rowan, 2000).

How can we explain that – after such strong transdisciplinary practice during the project's design – "only" multidisciplinary and monodisciplinary practices were applied during the implementation and maintenance of the project? We suggest that this is due to the fact that multidisciplinary approaches are typical in municipalities in Australia, where project teams disperse after reaching an agreement on actions to be taken. Further, project

implementation and maintenance also demand expertise and specific skills that are only available through multidisciplinary and monodisciplinary practices (Edwards, Lamshed, & Francey, 2007; Daniell et al., 2010)

During the transition phase, these disciplinary dynamics may have helped practitioners to manage different socio-institutional barriers and changing conditions without losing momentum (Olsson et al. 2006). Specific socio-institutional barriers to transdisciplinary practice identified in our case study project were: lack of clear processes and coordination, no principal manager leading all processes, fear of failure, and risks of the municipality working with the community. Further, we identified a lack of training of some staff in transdisciplinary processes, high levels of expectations and strong personalities in the community group, excessive bureaucracy or adherence to official rules, and a lack of trust and confidence between staff. These results are consistent with previous studies (Dewulf et al. 2007; Farrelly and Brown 2008), which point to socio-institutional barriers such as insufficient legitimacy of actors, discontinuous participation, fear of failure, vagueness and ambiguity of results, communication and coordination problems, misunderstandings, and mismatched expectations. Others similarly noted that practitioners from municipalities of New South Wales faced constraints such as the lack of staff capacity and high staff turnover, competing priorities, and difficulty dealing with government agencies (Pillora, Blackburn, & Artist, 2009).

We suggest that practitioners need to apply particular strategies to deal with these socio-institutional barriers in a way that differs from their normal, day-to-day practice. Among these strategies is their capacity to understand the political nature of the organisation involved, and to use that knowledge to their advantage. For instance, the community leader knew how the local government organisation worked, which enabled him to approach the local politician. The politician decided to support the community leader. This finding is in line with the study of Morison (2009) that confirmed how local politicians acknowledged the community's environmentalism and assisted its environmental initiatives. The use of policies, programs, academic research and partnerships by practitioners to increase support of senior managers, elected officials and decision makers is consistent with the data obtained by Brouwer (2015). Similarly, in our case study the creation of the risk management plan to work with the community reduced the likelihood of the project being rejected or funds being redirected to other goals. This risk management plan can be compared to operating manuals for recreation or community facilities

managed by community volunteers or delegated authorities in municipalities of New South Wales (Dollery et al., 2014). The requirement for the community to be legally formalized in a group is also an accepted protocol for improving decision-making transparency and avoiding actors' disappointment or disempowerment (Barreteau, Bots, & Daniell, 2010; Daniell et al., 2010).

Commonly, researchers apply methods called actor analyses to understand the nature of actors and their communication styles (Titz and Döll 2009). The practitioners involved in our case study project did not apply actor analyses. But they used demographic studies, workshops, surveys and direct interaction to understand the actors' motivations, communication styles, and their vision for the urban space. It is possible that these strategies facilitate communication and develop shared concepts while minimizing conflicts and disciplinary boundaries (Attwater et al. 2005).

In sum, practitioners managed risks and expectations through discussions, priority lists, surveys, examples of previous projects implemented in other cities, joint leadership, and the consistent message that the project was a trial of an organisational change program. According to Ryan (2014), municipalities need to be transparent and clear about what community expectations they can and cannot meet. In this context, it is important that practitioners proactively maintain a clear purpose for the project to avoid the dominance of strong personalities, single interests and divergent objectives (Dewulf et al. 2007; Daniell et al. 2010; Lang et al. 2012).

4.2.6 Conclusion

The main goal of our case study was to understand how a municipality in Sydney, Australia, successfully realised a project delivering multifunctional landscapes, and what role transdisciplinary practice played in that success. For this purpose, we created a tentative explanatory framework comprising enabling conditions, disciplinary dynamics, and strategies applied by practitioners to bring actors together. We observed a range of enabling conditions during the preparation phase: namely, the political institutionalization of environmental concern, local leadership in sustainable management, environmental awareness by a community group, an organisational change program focused on integrative, holistic and multifunctional approaches to a project developed by the municipality, and financial independence from the capital budget, allowing sufficient time and flexibility to work with the community group in the different phases of the project.

Transdisciplinary practice had a role in the planning and design of the project, but not necessarily thereafter as multidisciplinary and monodisciplinary practices were applied in the implementation and maintenance. Transdisciplinary teams were able to communicate and establish a shared vision of the societal problem, set up financial resources to develop this pioneering project for the organisation, and transfer new responsibilities and tasks among the team members. Strategies used by practitioners to facilitate transdisciplinary practises were related to the knowledge of how the municipality works. Practitioners showed data, facts or indicators, established alliances and networks, and adapted to the hierarchical way of working to increase receptivity, trust and confidence in the project. Demographic studies, workshops, surveys, priority lists and discussions were applied to identify interests and manage actors' expectations and risks. Practitioners transferred knowledge and ideas in different communication styles, facilitating dialogue and agreement on goals. In this process, they continuously communicated the trial and organisational learning status of the project, so that staff and community could work more flexibly, and better manage the risks associated with this innovative and pioneering project.

The empirical evidence displayed in our tentative explanatory framework is relevant for academics and practitioners. For academics, the framework contributes to increased knowledge on process management, team dynamics and organisational change. It offers insight into the strategies and diversity of team dynamics that can be established in projects delivering multifunctional landscapes. Practitioners can use the tentative explanatory framework as a guideline to design and implement projects delivering multifunctional landscapes with the active participation of local communities. It highlights the key factors, skills and processes that organisations and practitioners need to be aware of in order to develop these projects. In addition, the framework and the analysis of this study help practitioners to assess their own work and define what did or did not work in a project to support better outcomes in future projects.

Our study shows that the success of projects delivering multifunctional landscapes does not only depend on transdisciplinary practices. Oher disciplinary approaches play a role as well. As a dynamic process, none of the disciplinary dynamics is better than another; all disciplinary approaches fulfil specific needs and complement each other. It seems that a consensus in the planning and design of projects delivering multifunctional landscapes may be sufficient to create outcomes otherwise generated by transdisciplinary practice. If

the level of complexity in decision-making processes is low, implementation and maintenance activities can be developed through monodisciplinary and multidisciplinary approaches, which are common in municipalities. However, when transdisciplinary practices are absent during project implementation and maintenance, there may be the risk of lacking communication and coordination so typical of monodisciplinary and multidisciplinary practices. This lack can lead to dissatisfaction among the local community and practitioners that spent time and resources during project planning and design, and create mistakes in delivering efficient multifunctional landscapes in cities. One solution could be the assessment and oversight of the work of multidisciplinary and monodisciplinary teams by members of transdisciplinary teams involved in the planning and design of the project, to ensure it delivers the intended multifunctional landscapes.

Ultimately, we need more case study analyses of transdisciplinary practice in projects delivering multiple outcomes to draw out lessons for other practitioners, and to verify just what role transdisciplinarity plays in the creation of multifunctional landscapes in our current and future cities.

4.2.7 Acknowledgements

We thank the practitioners involved in our case study project for their willingness to dedicate time and support to our research, and the anonymous reviewers for their useful comments on the previous drafts of this paper. This research was supported by Monash University.

4.2.8 References

References have been moved to a consolidated reference list at the end of the thesis

Chapter 5

Disciplinary dynamics and strategies to enable multifunctional landscapes in Brisbane and Melbourne

5.1 Introduction

In this chapter, empirical evidence for the Brisbane and Melbourne case studies is presented. These two projects were implemented by the municipalities with the participation of consulting firms in certain phases of the projects. The analysis reveals the enabling conditions, followed in greater detail by the disciplinary dynamics and strategies used by practitioners to bring actors together and enable the projects.

5.2 Publication 3 - Toward multifunctional landscapes in Australian cities: what disciplinary dynamics and practitioner strategies inform transdisciplinary practice?

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Abstract

Transdisciplinary practice is considered essential for achieving multifunctional landscapes in cities. But we lack empirical evidence and frameworks that could help us clarify its role and scope. This study seeks to offer empirical evidence by comparing the role of transdisciplinary practice in two projects delivering multifunctional landscapes. What disciplinary dynamics played out in these projects, and what strategies did practitioners use to bring actors together? Using semi-structured interviews, and document analysis, we found different disciplinary dynamics and strategies at play across the project phases. Transdisciplinary practices featured mainly in the initial project phase. During this phase, practitioners applied strategies to highlight the relevance of environmental problems, and to get support from different sectors and audiences. Once practitioners found consensus on common targets and obtained support, decision-making processes became less complex, and time became a priority. At that point, transdisciplinary practice ceased to be relevant, and multidisciplinary, monodisciplinary, and interdisciplinary practices dominated, depending on the expertise required to fulfil project objectives and the need for people to work concurrently to meet specific time frames. Here, practitioners apply strategies, but these are carefully chosen for specific audiences to avoid delays.

We conclude that diverse disciplinary approaches are used to achieve multifunctional landscapes, and that transdisciplinarity is not the only path to success. Contextual factors will determine the disciplinary approaches needed across all phases. Practitioners wishing to use transdisciplinary practices beyond the initial project phase will require flexibility with regard to timing, concrete guidelines and formal institutional commitment to this approach.

Keywords: transdisciplinary practice; municipalities; multifunctional landscapes

5.2.1 Introduction

Rethinking the management of urban spaces to enable multifunctional landscapes is becoming a priority across different sectors. Scientists are interested in creating urban spaces that can deal with climate change and maintain a range of ecosystem services (Pennington 2008). Bureaucrats are aware of the fiscal consequences of climate change in cities, and of the need to redesign urban spaces to effectively manage its economic and social effects (Rijke 2014). Local communities are demanding an activation of urban spaces in order to offer better recreational, health or aesthetic benefits (Brandt et al. 2000). Practitioners from municipalities, who are in charge of the management of an increasing proportion of urban landscapes (World Bank 2011), have been inspired by these diverse sectorial interests to develop projects that might offer multifunctional landscapes.

Transdisciplinary practice is considered crucial to creating multifunctional landscapes in cities, because the integration of formal and informal knowledge achieved in the process generates a holistic perspective of the urban landscape, resulting in more satisfied citizens and a well-functioning natural environment (e.g. Fry 2001; Naveh 2001; Tress et al. 2003). Transdisciplinary practice can be defined as the roles, interactions, processes and experiences of practitioners working in local government with regional agencies, research groups, industry, local community groups, NGOs, or private consultant firms to develop projects on the ground aimed at solving social and environmental problems (Guzmán et al. 2015).

Despite the relevance, the concept is characterized by fuzziness and ambiguity. Various approaches have been introduced for this kind of research such as community-based participatory research, action research or experimental action research among others (Lang et al. 2012; Scholz and Steiner 2015). To avoid pitfalls, this research will use only

the terms ‘transdisciplinarity’, ‘transdisciplinary research’ and ‘transdisciplinary practice’. In this context, a literature review in the topic found that little is known about transdisciplinary practice and its precise role in the delivery of multifunctional outcomes in cities. Research has called for empirical evidence of transdisciplinary processes, and for explanatory frameworks that explain how practitioners define a problem, establish responsibilities, organize activities, integrate knowledge, manage conflicts and negotiations, and evaluate services delivered in local contexts (Ryan-Vincek et al. 1995; Apgar et al. 2009; King et al. 2009).

We respond to this call and suggest that it is necessary to analyse disciplinary dynamics involved in delivering multifunctional landscapes in cities in order to understand the role of transdisciplinary practice in achieving these landscapes (Daniell et al. 2010; Huang and Newell 2003; Stokols et al. 2008). Additionally, it is important to identify the strategies that practitioners use to overcome socio-institutional barriers to transdisciplinary practice and decision-making processes, and that facilitate the change from mono- to multifunctional outcomes in environmental management (Farrelly and Brown 2008; Brouwer 2015)

Our paper contributes an analysis of these aspects – the disciplinary dynamics, and the strategies practitioners used to bring actors together – in the context of two projects that successfully delivered multifunctional landscapes in Brisbane and Melbourne, respectively. By documenting and reviewing the learning-by-doing of the relevant practitioners involved in these projects, we aim to enrich the theory and formalize the practice of transdisciplinarity (Mitchell 2006; Pohl and Hadorn 2008b). Findings of our analysis will help build institutional capacity for transdisciplinary practice, thereby providing the empirical evidence from the practitioners’ perspective identified as lacking in the literature (Apgar et al. 2009; Bock Hong and Reynolds-keefer 2013).

5.2.2 Research approach

Our comparative case study examined the context and features of transdisciplinary practice in two projects delivering multifunctional landscapes. The research followed three main phases: first, selection of cases; second, data collection; and third, case analyses. For the selection of cases, a criteria framework for projects delivering multifunctional landscapes was created, based on urban ecosystem services and green infrastructure indicators at various scales – lot, streetscape and lanes, precinct, and catchment (Ahern 2007; Landscape Institute 2009; Naumann et al. 2011; TEEB - The Economics of

Ecosystems and Biodiversity 2011; Hernández-Morcillo et al. 2013; Gómez-Baggethun and Barton 2013). We assessed seventeen projects in Australia against this criteria framework, allocating ratings to each project. Two additional academics and six practitioners reviewed the evaluation of the projects. From the three projects ranked highest against this framework – a green lane in Sydney, a creek filtration trial system in Brisbane, and an industrial precinct in Melbourne – we chose the Brisbane and Melbourne projects, because they were developed mainly by municipalities, with assistance from consultancy firms. In contrast, the Sydney project was developed by the municipality, with active involvement from a community group. We discuss the analysis of this case in another paper.

Our first case chosen for analysis – the creek filtration system in Brisbane – was created to decrease storm water runoff by allowing water to be distributed over a wider area where aquatic plants and soils remove sediments, nutrients and heavy metals. It suited our study because a fragmented open space was transformed into a network of landscapes, offering new ecological and social benefits such as improved water quality and flow regimes; decreased stormwater runoff; productive vegetation and increased carbon; and improved social amenity and shade (Brisbane City Council 2014). Our second case, the industrial precinct project, involved the redesign of three roads in an industrial area of Melbourne, with the aim to harvest runoff and to treat, store and use 4 megalitres of stormwater to conserve aquatic and terrestrial habitats while irrigating sports grounds and street trees, reducing potable water use, and increasing flood protection and aesthetic amenity (Clearwater 2014).

We collected data through semi-structured interviews with different practitioners involved in the projects, such as senior managers, coordinators, consultants, environmental officers and technical officers. To map the chronological development of the project and reveal the disciplinary dynamics at play over time, we asked practitioners questions about the main project events and the personal experiences, communication and interactions among team members. Semi-structured interviews helped us identify challenges or difficulties in the project, as well as the strategies practitioners used to overcome them in their effort to bring actors together. In total, twenty-two individuals participated in two interview cycles, and we analysed 70 official reports and project minutes.

To analyse the chronological development of our cases, we adopted Olsson et al. (2006) model of the transformation of social-ecological systems, as the phases described therein may yield new insights into the success factors behind ecological and social innovation in cities. According to Olsson et al. (2006), transformation of social-ecological systems involves two phases linked by a window of opportunity: in the preparation phase, organisations prepare for changes, establishing networks and creating visions and strategies that might solve an environmental problem. A short and critical window of opportunity then emerges from the organisation's growing environmental awareness, a favourable political context and availability of solutions for an environmental problem (Kingdon 1995; Olsson et al. 2006). In the transition phase, practitioners deal with new processes and uncertainties in relation to the implementation of a solution for an environmental problem, so they need flexibility to improvise and solve different problems without losing momentum (Olsson et al. 2006).

The disciplinary dynamics applied during these phases can vary; we describe this variation in the following terms: a *monodisciplinary* approach involves teams addressing a problem or producing new knowledge through theories and methods from a single discipline without cross-disciplinary interactions (Hall et al. 2008; van Rijnsoever and Hessels 2011). A *multidisciplinary* approach involves interactions of members from more than two disciplines working in parallel or sequentially on individual tasks in order to address a common problem (Rosenfield 1992; Deady 2012). In contrast, an *interdisciplinary* approach occurs when members from different disciplines work jointly with a common purpose, making complementary and reciprocal contributions (Klein 2008). These professionals have common roles and goals, but practitioners may keep disciplinary boundaries (Choi and Pak 2006; Clarke 1993). Lastly, a *transdisciplinary* approach involves different parts of society and academia cooperating and collaborating to create common frameworks and to address a cognitive and social problem (Rosenfield 1992; Max-Neef 2005).

While we identified the disciplinary dynamics at play during the different social-ecological transformation phases of our two case study projects, we also applied Brouwer's (2015) work on entrepreneurial change for water governance, to identify what strategies practitioners used to bring actors together and thereby enable the projects. Research on strategies that promote transdisciplinary practice is minimal, and Brouwer's work contributes useful concepts such as attention- and support-seeking strategies; linking strategies; relational management strategies and arena strategies that practitioners may

use in the projects. Attention- and support-seeking strategies involve demonstration, rhetorical persuasion and exploitation of “focusing events” (short, uncommon and unexpected events) to explain clearly the environmental problem; to name and frame the problem in different communication styles for diverse audiences; to highlight the immediate and future risks of the problem, promoting desirable solutions; and to increase political attention and financial resources (Birkland 1998; De Bruijn and Ten Heuvelhof 2000).

Simultaneously, practitioners may use three linking strategies called coalition building, issue linking and game linking. Coalition building is used to connect with others and reach shared goals, while issue linking involves adjustments to the projects to facilitate decision-making processes. Game linking means negotiations and collaborations for current or future projects (Koppenjan and Klijn 2004; Taylor et al. 2011; Brouwer 2015). At the same time, practitioners may use networking and trust building as relational management strategies to gather reliable information on how their actions are perceived, identify main issues inside the organisations, and understand rules and behaviours in the networks (Mintrom 2000; Meijerink and Huitema 2010; Brouwer 2015). Moreover, practitioners can use what Brouwer (2015) calls arena strategies such as venue shopping and timing, to search opportune places to explain their ideas and be aware of policy cycles and processes to manipulate them strategically for their preferred actions (Baumgartner and Jones 1991; Meijerink and Huitema 2010).

5.2.3 Results

Disciplinary dynamics identified in the project phases

The historical context of the municipality in Brisbane for a change in urban space management may be said to have started in the 1980s. Prominent Brisbane waterways were affected by pollution, when academic experts, local community groups and practitioners from different municipal departments became aware of the environmental problem and need for action. These transdisciplinary teams analysed what caused the pollution and envisioned solutions to the environmental problem. As result, different actions were developed that support the establishment of the preparation phase. A water initiative was created to improve the water quality of the waterways, and to define the strategic plan and direction of the organisation. Within the municipality, interdisciplinary and multidisciplinary teams formed by planners, biologists and engineers adapted the visions from the transdisciplinary teams into strategic organisational plans and started

searching for funding to implement projects on the ground. In 2011, Brisbane was affected by floods. This unexpected event provided a window of opportunity for the project to deliver multifunctional landscapes. The environmental crisis needed to be managed, and the Lord Mayor decided to invest resources for creek filtration systems across the city, based on visions of the water initiative established by the transdisciplinary teams. The Lord Mayor demanded that the municipality identify eight possible sites to implement these projects across the city. Multidisciplinary teams from different departments of the municipality worked sequentially and in parallel to select the creek filtration system projects based on six selection criteria: simple, cheap, quick, effective, visually attractive and easy to maintain. The transition phase of the project occurred between 2012 and 2014. Planning involved multidisciplinary teams organizing tasks in relation to forest, park or water objectives of the project. The design was developed by four consultancy firms specializing in landscape, civil engineering and water design, supervised by one practitioner from the municipality. In a short period of time, they analysed the project and defined what was viable or not, based on different suggestions and recommendations. Two municipalities departments then implemented and maintained the project. For the implementation, practitioners applied multidisciplinary practices: engineers and construction crews had well-defined roles and clear guidelines for the design. However, they worked with designers to clarify specific features of the design, applying interdisciplinary practices to some degree. The maintenance team applied monodisciplinary practices: they did not share budgets and developed activities without interacting with other departments, applying their specific interests, skills and training.

Similar to the Brisbane case, the historical context of the Melbourne project can be linked to events occurring from the 1960s to the 1990s. The main creeks and bays of this city were affected by water pollution and the local government started to think about ecological health and water management. A transdisciplinary team comprising the municipality's chief executive, known as a water and drainage expert, and members from government authorities and academia collaborated on water management policies and strategies that facilitated the conditions for the preparation phase of the project. In addition, interdisciplinary teams worked together to create a water agenda for the organisation, based on the vision of the transdisciplinary team. This momentum was supported by awards through which engineering associations recognized the municipality. These awards were promoted by the media and contributed to local politicians becoming

increasingly aware of water strategies, thereby promoting a culture change that facilitated innovative projects.

The window of opportunity for the multifunctional project may also relate to the year 2009, when Melbourne was affected by water scarcity while the high siltation levels of one of the main creeks located in the local government affected sporting activities. Environmental awareness grew among different actors, and the political context was conducive to supporting projects that reduced the impact of urban runoff and improved irrigation efficiencies in public spaces through an initiative called “Water for the future”. Transdisciplinary practice played a role in this phase, as practitioners from 14 municipalities put together a proposal to develop different projects. This proposal received technical feedback from various specialists, and was supported by sports associations and water utilities. Practitioners from the municipality involved in this study discussed the proposal with different municipal departments to get everyone on board.

The period from 2009 to 2013 can be considered the transition phase. Project planning involved multidisciplinary practices, as several municipal departments took individual responsibility for the objectives of the project. For instance, one department reported financial activities while others communicated with businesses or sports clubs to explain the project objectives. The design was characterized by monodisciplinary practices executed by engineers who only interacted with other departments to obtain specific information for the design, or to clarify misunderstandings during construction. Similarly, monodisciplinary practices were applied to implement the project. An engineering department was responsible for the construction, and for communicating with the design team if specifications were unclear. In contrast, project maintenance involved a multidisciplinary approach, with one team working on road and drain maintenance, and others in charge of monitoring water quality and maintaining infrastructure.

Overcoming socio-institutional barriers: practitioner strategies for bringing actors together

We found different socio-institutional barriers that hindered transdisciplinary practice and the development of our case study projects. For example, participating organisations perceived the projects as small and low impact compared to other civil engineering projects, leading to what practitioners described as little organisational commitment and a lack of human resources. As a result, the projects did not have permanent managers

coordinating all activities, or guidelines for collaboration; some practitioners lacked required skills; and there were too few mechanisms in place for monitoring and evaluating project progress.

Practitioners applied different strategies to overcome these socio-institutional barriers, and to bring actors together to advance the projects. For example, demonstration strategies (Brouwer 2015) – such as showing data, figures, and other indicators – helped practitioners explain the projects' desired outcomes and feasibility to senior managers and local politicians. Financial data were used as evidence to reduce fear of failure in design, or combat resistance from maintenance crews who might consider these projects irrelevant, expensive or overdesigned. Depending on the audience, practitioners used rhetorical persuasion in plain English, avoiding jargon or very technical language, to explain the objectives of the project, to clarify roles and responsibilities, and to avoid mistakes during project implementation and maintenance. Practitioners exploited so-called focusing events (Brouwer 2015) – such as the unexpected floods in Brisbane, and drought events in Melbourne – to get political attention and mobilize financial resources. Practitioners thereby acquired relevant information for the projects' design, and gained credibility for their implementation.

Coalition building strategies (Brouwer 2015) also played an important role: practitioners created coalitions with actors from government authorities, academia, consultancy firms and local communities to establish common goals and increase support and perceived legitimacy across all project phases. Coalitions were formed through workshops and onsite visits; yet budget and time constraints meant that practitioners had to keep coalitions narrow, especially in the transition phase. Of particular relevance were coalitions formed with maintenance teams, since these could help ensure optimal project outcomes. Next, practitioners used so-called linking strategies (Brouwer 2015) to align project objectives with different programs of the organisation, or with the various actors' interests. In doing so, practitioners ensured that the projects appeared more attractive to a range of audiences, facilitating decision-making processes and richer outcomes. Practitioners applied game linking in time (Brouwer 2015) in the way they drew connections between the current and future projects, to draw out mutual benefits. For instance, they asked others to financially support maintenance activities on the current projects, in return offering technical support for any future projects.

Our study also suggests that practitioners created various formal and informal networks with other practitioners from other municipalities and government entities, academic experts, community groups, sport associations, and/or water utilities companies. Workshops and fieldwork helped establish networks and gain confidence and trust. In these situations, practitioners ensured that everyone could understand the projects' visions and political agenda, and analysed potential problems with their financial support and implementation. New networks could be formed in these settings, since existing networks were focused on other projects and did not have time to play a role in the projects at hand. Overall, practitioners considered implementation and maintenance networks as very valuable to ensure optimal project outcomes.

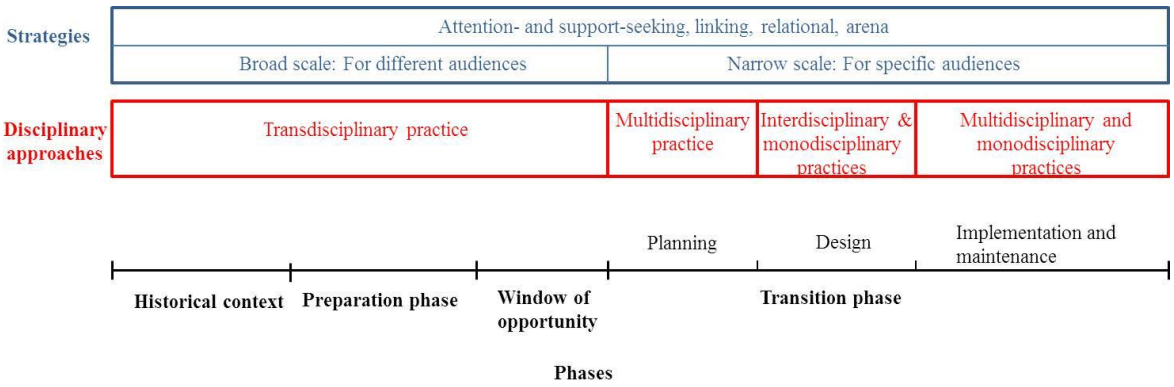
The so-called arena strategy of timing (Brouwer 2015) played a role throughout all project phases. However, we did not find any evidence for the use of venue shopping (Brouwer 2015) as a strategy. Practitioners used timing to identify political cycles and to gather momentum for the projects. During the first year, local politicians were not ready to fully embrace the practitioners' proposals; they needed a year to warm up to the ideas. During this time, practitioners analysed the local politicians' interests and began educating them about their vision. In the second year, local politicians became interested in implementing these ideas, so practitioners promoted the projects, giving technically competent – and therefore politically acceptable – advice. To increase momentum, they emphasized coalitions with science or other elite groups. In the third and final year in office, local politicians were more risk averse, and therefore less likely to support the projects.

5.2.4 Discussion

Our study reveals different disciplinary approaches and strategies (Figure 5-1) at play throughout both projects. Initially, transdisciplinary practice was applied: The historical context facilitated the creation of enabling conditions needed for the preparation phase that took more than ten years and involved cooperation among different actors to deal with environmental challenges linked to the pollution of Melbourne and Brisbane waterways. These environmental imperatives and socio-political contextual factors fostered transdisciplinary practice (Russell et al. 2008; Stokols et al. 2008). Transdisciplinary teams comprising community groups, local politicians, academic experts, consultants and practitioners from municipalities began to identify the causes of environmental problems in these cities, building knowledge and envisioning solutions, thereby shifting from an

isolated and technocratic viewpoint to a participatory process (Wen et al. 2014). Municipalities then adapted the vision created by these transdisciplinary teams to their organisational context, utilizing multidisciplinary and interdisciplinary practices to realize the projects on the ground. According to Jahn et al. (2012) and Resweber (2000), multidisciplinary and interdisciplinary approaches are subsets and integral parts of transdisciplinary practices. In this sense, multidisciplinary and interdisciplinary teams composed of professionals are in charge of analysing the knowledge to develop ideas from the interplay and integration of different actors in transdisciplinary teams.

Figure 5-1 Disciplinary dynamics and actor strategies in projects delivering multifunctional landscapes in cities



Sources: our research findings, modelled on phases by Olsson et al. (2006) and strategies by Brouwer (2015)

Aside from the disciplinary dynamics involved in this phase, practitioners advanced the projects by using such strategies as attention- and support-seeking, as well as linking, arena and relational management strategies. Our findings confirm the important role of these strategies in strengthening arguments, finding common targets, identifying how actions are perceived or affect others, and understanding political cycles (Brouwer 2015). Strategies are applied broadly, meaning practitioners attract different audiences to increase support. Using these strategies can be time-consuming, requires skills, and involves complex and risky decisions for practitioners: they need to gauge when the coalition is big and diverse enough to suit the projects; create networks and build trust with the right people who can support the projects; and think strategically about their actions based on local politicians' number of years in office and position in the electoral cycle (Morgeson et al. 2009; Taylor et al. 2011; Brouwer 2015).

In both the Melbourne and Brisbane project, the window of opportunity arose from environmental crises related to drought and flood. During this short and critical period of time, the political context demanded solutions to these crises and increased environmental awareness among actors (Kingdon 1995; Olsson et al. 2008). Practitioners strategically exploited these crises as focusing events to highlight the relevance of their ideas, and to offer their projects as solutions to the imminent environmental problem. The effectiveness of this strategy is likely to derive from the fact that practitioners were well prepared to give a strong account of the causes of these crises, and that their proposed solutions were clear to local politicians, thereby contributing to immediate action (Birkland 1998). In other words, the strategy was successful because the transdisciplinary teams – composed of scientists, consultants, sports associations and community groups – were able to help practitioners present technically and politically acceptable proposals that fulfilled the requirements of federal initiatives providing funding and local politicians' interests.

We did not identify transdisciplinary practice in the transition phase of our two case study projects. One factor that might have prevented transdisciplinary practice here is time: transdisciplinary practice is time-consuming and poses cognitive, personal and cultural challenges for participants (Ramadier 2004; Tötzer et al. 2011). The transition phase took approximately two years – a rather short period of time for creating conditions conducive to cooperation among practitioners, compared with the ten-year preparation phase. As a result, we think it is not surprising that practitioners during the transition phase did not resort to such strategies as building a broad coalition, which would have encouraged trandisciplinary practice. They also did not link the projects to other ideas or programs, as this could have delayed progress of the projects. Our findings are confirmed by other studies that highlight how difficult it can be to use coalition and issue-linking strategies, because divergent interests among various stakeholders can lead to delay, conflict, complexity, rigidity and stagnation. Practitioners therefore need to identify the right level of coalition and linking – not too narrow and not too broad – to maximize benefits for current or future projects (Axelrod 1984; Brouwer 2015; Roberts 1992). In our case study projects, practitioners used these strategies on a broad scale (for different audiences) during the preparation phase, but on a narrow scale (for specific audiences) during the transition phase. Narrowing their focus to specific audiences allowed them to generate specific benefits for the projects without affecting the overall timeline.

Other factors known to prevent transdisciplinary practice are a lack of concrete guidelines, training and quality standards relating to transdisciplinary practice (Brandt et al. 2013; Wächter 2003; Walter et al. 2007). The municipalities we studied did not have formal guidelines to help their staff learn and apply transdisciplinary practices in their projects. Research suggests that unclear steps and skills required for applying transdisciplinary practice might create tension in roles and responsibilities among project teams, as well as path dependence and dominance of traditional disciplinary approaches in the organisations involved (Bohnet 2010; Edwards et al. 2007). For these reasons, practitioners may limit opportunities for transdisciplinarity, because they resist change and innovation, and are sceptical of new procedures (Cole 2006; Tötzer et al. 2011). Further, they might not see a need for transdisciplinary practice, because the environmental problem appears straight-forward and practitioners have already agreed on an action plan, so cooperation among different actors seems unnecessary (Daniell et al. 2010; Kötter and Balsiger 1999).

These factors might have led to the dominance of multidisciplinary, interdisciplinary and monodisciplinary practices in the transition phase of our two case study projects. Multidisciplinary practices are common in the institutional framework of municipalities that aim to deliver optimal public services (Edwards et al. 2007; Wilson and Pirrie 2000). This disciplinary approach was applied in the planning and implementation of the projects. Our findings, and those of other studies (Kötter and Balsiger 1999; Rosenfield 1992; Wächter 2003), suggest that practitioners can be seen to work in parallel or sequentially to fulfill project objectives, keeping clear disciplinary boundaries and interacting periodically to share their individual outcomes, while the main project coordinators integrate results in a report. An advantage of this multidisciplinary approach might be that practitioners have clear roles and are efficient in delivering outcomes, especially when there are time constraints due to deadlines, or when practitioners need to satisfy local politicians and senior managers' orders in a short time. Wilson and Pirrie (2000) and Rosenfield (1992) explained that multidisciplinary approaches are suitable when there is a need to satisfy clients' needs or solve specific short-term problems. Yet disadvantages might include the lack of feedback opportunities among multidisciplinary teams; the tendency of professionals to claim superiority based on hierarchies; and stereotypes or group rivalry hindering disciplinary collaboration (Bailey 1977; Clarke 1993; Wilson and Pirrie 2000) .

During the design and maintenance of our case study projects, both interdisciplinary and monodisciplinary practices were applied. Pirrie et al. (1998) explain that, even though organisational structures may encourage multidisciplinary practices, teams do not constantly apply them. We suggest this is true of our case study projects too, where we observed interdisciplinary practices in the actions of practitioners from various departments or consultancy firms, who integrated knowledge on different topics and offered special services for the municipalities.

These practitioners commented on their history of collaboration with the municipalities, meaning that the level of trust was high and the team members were familiar with the communication styles of different disciplines, allowing complementary and reciprocal contributions. These findings are consistent with the literature, which describes that members of interdisciplinary teams are able to understand different points of view and share responsibilities due to high levels of trust, tolerance and flexibility (Rosenfield 1992; Clarke 1993; Pirrie et al. 1998; Deady 2012). However, a possible weakness of these interdisciplinary project teams may be the lack of participation by local government practitioners: as a result of the absence of municipal practitioners, the ideas created by these interdisciplinary teams lacked valuable input from the municipality. Further, the breadth of knowledge held by these teams does not necessarily signify depth of knowledge. As Clarke (1993) and Wiecha and Pollard (2004) observe, combining different disciplines does not mean creating shared understanding. It is unclear whether practitioners from these interdisciplinary teams are able to integrate diverse knowledge in short periods of time, and how they can establish new roles and manage rivalry and hierachies to aid knowledge integration (Klein 1990; Rapport et al. 2004)

Similar to the interdisciplinary approach, monodisciplinary practices were used by practitioners from single departments or consultancy firms with the same or very similar professional backgrounds, who perform specific tasks for the organisation. This group of practitioners may communicate well within itself, since group members share similar perspectives and communication styles. The specific knowledge applied in monodisciplinary teams also provides support and opportunities for developing individual skills and commitment to work (Norman and Currow 2005; Plastow and Boyes 2006). However, these practitioners might not be interested in interacting with other departments or actors beyond their own interests and area of specialization (Choi and Pak 2006; Max-Neef 2005; van Rijnsoever and Hessels 2011). This is more likely if a single leader from a

monodisicplinary team makes all final decisions, meaning their perspective might be narrow, or if team members follow professional hierarchies and stereotypes, ignoring others' strengths and weaknesses (Becher 1994; Mackay 1992; Norman and Currow 2005; Pirrie et al. 1998; Wilson and Pirrie 2000)

The empirical evidence generated by our study raises questions about the precise role of transdisciplinary practice in projects aimed at delivering multifunctional landscapes in cities. Our findings offer a number of insights to foster the success of such projects in the future. Ideally, one could argue that transdisciplinary practice should always be applied when different actors work together to integrate disciplines and create new knowledge that generates social and scientific outcomes (Lawrence and Després 2004; Stauffacher et al. 2008). But in our Melbourne and Brisbane projects, transdisciplinary practice may not have reached this level of knowledge integration; it may have related more to the fusion of interests and the creation of consensus. Transdisciplinary practice can be considered weak in our case study projects, because both lacked systemic frameworks to integrate knowledge (Max-Neef 2005). The projects developed transdisciplinary practice in a natural and intuitive way, without any protocols or guidelines to follow. We were intrigued by the breadth of practitioners' transdisciplinary practice, as they skilfully used different communication channels to facilitate dialogue. In addition, practitioners seem to have accepted cognitive, personal, or cultural differences and modified their perspective in order to facilitate a common vision of the complex environmental problem, to embrace imperfect solutions to the problem, and to advance gradually in decision-making processes (Cole 2006; Jacobs and Nienaber 2011; Ramadier 2004).

In order to foster transdisciplinary practice in projects delivering multifunctional landscapes – such as our Melbourne and Brisbane case study projects – a degree of flexibility in project timelines is crucial, as is investment in transdisciplinary training and guidelines as part of institutional capacity building (Djanibekov et al. 2012; Edwards et al. 2007). These factors may contribute to understanding roles and accountability (Bohnet 2010), and may decrease fear of failure and uncertainty about the processes involved. Similarly, the outcomes of the Brisbane and Melbourne projects show how regular meetings, workshops and onsite visits serve as crucial, communicative fora that facilitate transdisciplinary practice. Here, practitioners can clarify their roles and expectations, exchange concerns or interests, diminish misunderstanding and strengthen networks and trust (Dewulf et al. 2007; Olsson et al. 2008; van Herk et al. 2011). Lastly, practitioners should share common

agendas regularly and draw lessons from failure in order to translate individual into organisational learning (Fam et al. 2013; Gonzalez et al. 2009).

5.2.5 Conclusion

We conclude that acute environmental problems can drive transdisciplinary practices in projects delivering multifunctional landscapes in cities. When environmental crises create awareness among different practitioners, the latter begin to cooperate and use different strategies to promote solutions for the problem. The strategies practitioners apply in this initial project phase are broad, since they are aimed at attracting multiple audiences to garner support and to force political actions that favour the projects. We believe that transdisciplinary practices in this phase are spontaneous and organic processes: practitioners are not under time pressure, and they are learning different transdisciplinary skills and strategies that elicit agreement and financial resources for the projects.

But once practitioners reach consensus and sufficient project resources are secured, decision-making becomes less complex, and time is a priority, which puts transdisciplinary practice at risk. To maintain a transdisciplinary approach throughout the transition phase, project timing should remain flexible; practitioners should be adequately trained; and there should be clear guidelines for, and explicit institutional commitment to, transdisciplinarity.

Without these conditions, resistance to change is likely, meaning organisations will be prone to follow traditional approaches (multidisciplinary, monodisciplinary, and sometimes interdisciplinary) to develop projects. There is a high chance that project objectives will require the specialist knowledge generated by monodisciplinary practices, the breadth of knowledge created by interdisciplinary teams, or the efficiency of multidisciplinary teams that are able to solve problems on time. We also note that practitioners apply different strategies in the projects' transition phase, as compared to the preparation phase. During the transition phase, time pressure prevents practitioners from using strategies for multiple audiences, so they apply strategies on a narrow scale instead, planning carefully how and with whom to use them. The primary concern here is that interacting with different actors could delay project activities and therefore progress.

We consider these findings relevant for the development of explanatory frameworks that help us better understand transdisciplinary processes in practice. Our findings provide new insights for academics and practitioners into the possible alternative pathways to creating

multifunctional landscapes in cities, and their advantages and disadvantages. Overall, we show that different disciplinary approaches play a role in projects delivering multifunctional landscapes, and that practitioners need to use various strategies to bring actors together, while changing the scale of these strategies across project phases. In other words, we should not underestimate and undermine the value of all disciplinary approaches; specific contextual factors will call for different combinations of disciplinary approaches and strategies for bringing actors together to participate in the projects. If practitioners planning these types of projects are interested in applying transdisciplinary practices beyond the initial project phase, our findings demonstrate that regular meetings, workshops and onsite visits will provide them with a valuable context for promoting transdisciplinarity. However, we believe that practitioners involved in the transition phase need to make a conscious effort to learn transdisciplinary skills, ensure flexibility in the project's timeline, and secure resources to create guidelines, if they want to see the value of transdisciplinary practice extend into the future.

5.2.6 Acknowledgment

We thank the practitioners who shared their opinions and relevant information for the purpose of this research, and Monash University for its financial support.

5.2.7 References

References have been moved to a consolidated reference list at the end of the thesis

Chapter 6

Processes for delivering multifunctional landscapes in cities

6.1 Introduction

This chapter focuses on the cross-case analysis of the projects in Brisbane, Melbourne and Sydney and the development of a final explanatory framework of the processes that enabled multifunctional landscapes in these three cities. For this purpose, it gives an overview of each case, followed by the description of the explanatory framework. This framework is based on the socio-ecological transformation phases and window of opportunity developed by Olsson et al. (2006). In each phase and window of opportunity, the similarities and differences between the cases are explained in relation to enabling conditions, disciplinary dynamics and strategies.

6.2 Publication 4 - How are actors applying transdisciplinary practice? An explanatory framework of processes that enable multifunctional landscapes in cities

Submitted to Journal Cities

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Abstract

Empirical evidence is needed to confirm the validity of the call for transdisciplinarity in the delivery of multifunctional landscapes in cities. For this reason, this study analysed three projects creating multifunctional landscapes in Australia and developed an explanatory framework of processes (enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring together actors) to enable the projects. Our outcomes show that the call for transdisciplinarity in projects delivering multifunctional landscapes is valid.

Transdiciplinarity was applied in two ways. In the initial phases of the projects transdisciplinarity was used when actors needed to highlight the relevance of environmental problems, bring consensus to visions and obtain financial resources. It was also used in the planning and design of one project that involved a community group. In this case there was formal commitment and training for the application of transdisciplinary practices. However, multidisciplinarity, interdisciplinarity and monodisciplinarity had a role in the three projects as well. Thus, the call for transdisciplinarity needs to specify the phases that require this disciplinarity approach and not neglect the relevance and applicability of other disciplinary approaches to delivering multifunctional landscapes. The framework can be useful for practitioners to understand better how they are developing these projects and for the identification of crucial factors and strategies to enable future projects. Additionally, the explanatory framework this project has developed offers a

diversity of disciplinary alternatives that can be applied to achieve multifunctional landscapes in cities.

Keywords: Transdisciplinary practices, municipalities, multifunctional landscapes

6.2.1 Introduction

Transdisciplinarity, understood as the integration of different actors with formal and informal knowledge to solve complex societal problems, is considered essential to address the mix of legal, economic, social and technical aspects in the delivery of multifunctional landscapes in cities (Fry 2001; Kato and Ahern 2009; Matos Castaño et al. 2015). Despite its relevance, literature on trandisciplinarity is still developing, with much still to be discovered and understood. The term itself is still ambiguous and without consensus regarding its definition. However, different approaches are linked with transdisciplinarity, such as community-based participatory research, action research or experimental action research, among others (Lang et al. 2012; Scholz and Steiner 2015). A literature review of the terms 'transdisciplinarity', 'transdisciplinary research' and 'transdisciplinary practice' showed different research groups active in these fields (Guzmán Ruiz et al. 2015). One group is developing transdisciplinary definitions and analysing similarities to and differences from other disciplines. Other groups are evaluating outcomes of transdisciplinary processes and creating transdisciplinary tools, models and frameworks (e.g., Stokols et al. 2005; Dewulf et al. 2007). Two additional groups of researchers with staff working in public entities are specifically investigating outcomes of transdisciplinary processes developed by practitioners. These investigations include researching the practitioners' experiences, and the roles, attitudes, skills and challenges that practitioners should have in transdisciplinary processes (e.g Mollinga 2009; Daniell et al. 2010). A research gap identified in the transdisciplinary literature is the lack of empirical knowledge and frameworks that show clearly the role of transdisciplinarity in practice. It is unclear how practitioners establish a common vision, define roles, integrate knowledge and deliver different types of services. Therefore, this knowledge is necessary to enrich the theory and methodology, and to facilitate the institutionalisation of transdisciplinarity (Pohl 2008; Apgar et al. 2009).

This study aims to contribute to this growing area of research through providing empirical evidence and developing an explanatory framework that explains the specific role of transdisciplinarity in projects delivering multifunctional landscapes. The empirical evidence is obtained from projects located in Australia, within the urban water sector, and

implemented by municipalities. The explanatory framework focuses on enabling conditions, disciplinary dynamics and strategies applied by actors in three projects delivering multifunctional landscapes in the cities of Brisbane, Melbourne and Sydney. Understanding the enabling conditions and strategies applied by practitioners can go a long way toward filling research gaps in transdisciplinarity such as process management and organisational learning and change (Tötzer et al. 2011; Fam et al. 2013). Identification of disciplinary approaches in the projects can give us insights into team dynamics and knowledge integration by team members (Daniell et al. 2010).

The inputs for the framework are two previous papers. One paper explains the role of transdisciplinarity in the transformation of a Sydney lane into a green multifunctional space. As a result, this study has been able to develop a tentative explanatory framework of the enabling conditions, disciplinary dynamics, and strategies that allowed this transformation. The second paper analyses the disciplinary dynamics and practitioner strategies that inform transdisciplinary practice in two projects – one developed in Brisbane and the other in Melbourne. In these projects a fragmented open space and an industrial area were transformed into a network of landscapes offering new ecological and social benefits. The difference between these papers and the present study is that the present study involves a cross-case analysis and creation of a final explanatory framework based on the empirical evidence from the three projects.

The explanatory framework can be of value to both academics and practitioners. Academics will have at their disposal increased knowledge relating to the research gaps on transdisciplinarity mentioned above, and they will be better able to clarify whether the call for transdisciplinarity in projects delivering multifunctional landscape is valid. Practitioners can use the explanatory framework – which shows a diversity of enabling conditions, disciplinary alternatives and strategies that can be used to create multifunctional landscapes – as a set of design guidelines for projects delivering multifunctional landscapes. The framework will have many uses, as can also be part of retrospective analysis and evaluations to identify failures and areas for improvement in the development of multifunctional landscapes in cities.

6.2.2 Research approach

We have chosen multiple case studies for this current research. To date, little has been known about transdisciplinarity in projects delivering multifunctional landscapes, and

outcomes from multiple cases can be inputs for an explanatory framework for organisations interested in developing such projects within sustainability agendas (Blaikie 1993; Stubbs and Cocklin 2008).

Selection of cases and data collection

In determining the case studies to be included in this research, seventeen leading social and ecological innovation projects implemented by municipalities in Australia were analysed based on a criteria framework for the evaluation of projects delivering multifunctional landscapes. This criteria framework includes green infrastructure and ecosystem services factors (e.g., Ahern 2007; TEEB - The Economics of Ecosystems and Biodiversity 2011; Gómez-Baggethun and Barton 2013). The method for assessing the projects was developed by the authors, and involved rating elements of the projects. The ratings were binary, either 1 if the element was presented in the project or 0 if it was absent. Two additional academics and six practitioners from municipalities reviewed the assessment of the projects. The three projects with the highest scores were chosen for the study – a multifunctional lane in Sydney, a creek filtration system in Brisbane and an industrial precinct in Melbourne.

Data from these projects were collected in the period 2014-2015 from semi-structured interviews and secondary sources. Thirty-seven semi-structured interviews were conducted with actors involved in the projects, such as municipal staff, local politicians, consultants and a local community group. Practitioners answered questions related to the chronological development of the projects, interaction and communication with other actors, primary challenges, and strategies applied in the projects to overcome socio-institutional barriers, thereby enabling the projects. One hundred and sixty-two pieces of secondary data were sourced from official reports, management plans and programs, policies, meeting minutes, official internal communications, newspapers and websites.

Data analysis and interpretation

The data analysis involved four steps. Firstly, the chronological development of the projects was mapped based on the description of social-ecological phases linked to a window of opportunity, according to Olsson et al. (2006). Secondly, conditions that would enable the water project of each case study were identified, drawing on known enabling conditions (Brown and Clarke 2007). These enabling conditions, which are dependent on leadership, are: socio-political capital, bridging organisations, available trusted and reliable science, binding targets, accountability, strategic funding, demonstration projects and

training and market receptivity (Brown and Clarke 2007). Thirdly, disciplinary dynamics involved in the projects were described, based on monodisciplinarity, multidisciplinarity, interdisciplinarity and transdisciplinarity features (e.g., Balsiger 2004; Max-Neef 2005; Choi and Pak 2006). Lastly, strategies used by practitioners to overcome socio-institutional barriers and bring actors together to enable the projects were interpreted using the entrepreneurial change strategies for water governance developed by Brouwer (2015).

'Demonstration', 'rhetorical persuasion' and 'exploitation of short, uncommon and unexpected events' are part of attention- and support-seeking strategies. Linking strategies, used to facilitate decision-making processes and establish collaborations for future projects (De Bruijn and Ten Heuvelhof 2008), are 'coalition building', 'issue linking' and 'game linking'. Relational management strategies are 'networking' and 'trust building', and 'venue shopping' and 'timing' are arena strategies linked to finding the strategic places and times to promote ideas (Baumgartner and Jones 1991).

6.2.3 Results: Insights from empirical evidence

Case study contexts

Brisbane: In 2011, Brisbane was affected by floods. The Lord Mayor decided to invest financial resources for creek filtration systems in the city which would be cheap, simple, cheap, quick, effective, visually attractive and easy to maintain. A creek filtration system is used to manage stormwater runoff. It has multiple functions: it allows the water to spread out through a flat vegetated area, thereby mitigating flooding and decreasing storm water run-off; it improves water quality; and it increases social amenity as citizens enjoy the biodiversity that attracts the filtration systems. Staff from the municipality suggested eight sites for the possible projects, one of which was chosen to be a case study. This project was developed mainly by the municipality with four consultancy firms contributing to the design stage. The project took two years to complete (2012-2014).

Melbourne: Similar to Brisbane, Melbourne was affected by droughts in 2009. Consequently, the government established grants for projects that would reduce the impact of urban runoff and improve irrigation efficiencies in public spaces. The municipality involved in this case study applied with other municipalities for a grant, and the industrial precinct forming the case study was selected for funding. In this project, runoff from factories' roofs and streets is treated through a system comprising pollutant traps, an underground storage system, a raingarden and a storage tank. The treated water is used

for irrigation of nearby public urban spaces, which reduces the discharge of pollutants to, and siltation levels in, a creek located in the industrial area. The project was developed between 2009 and 2013. The municipality was in charge of the project with some consultancy firms contributing to the planning and implementation. Sports associations and factories located in the industrial precinct were aware of the project, but they did not participate in it.

Sydney: In 2010, a building was established in a Sydney lane affected by flooding and illegal activities such as consumption of drugs. By law, the company developing the building was required to surface the lane and provide parking. However, a resident complained to the municipality, seeking a green lane. In the project, buffer strips, a rain tank, permeable paving, solar energy panels, tree planting and street furniture for citizen interaction were implemented. A local community group participated in the planning, design and maintenance of the project, which was developed from 2010 to 2012.

Explanatory framework of processes to enable multifunctional landscapes

This section focuses on describing the explanatory framework prepared for the analysis following phases and windows of opportunity linked with socio-ecological transformations (Olsson et al. 2006). Each phase describes enabling conditions, disciplinary dynamics and strategies to bring actors together (Figure 6-1).

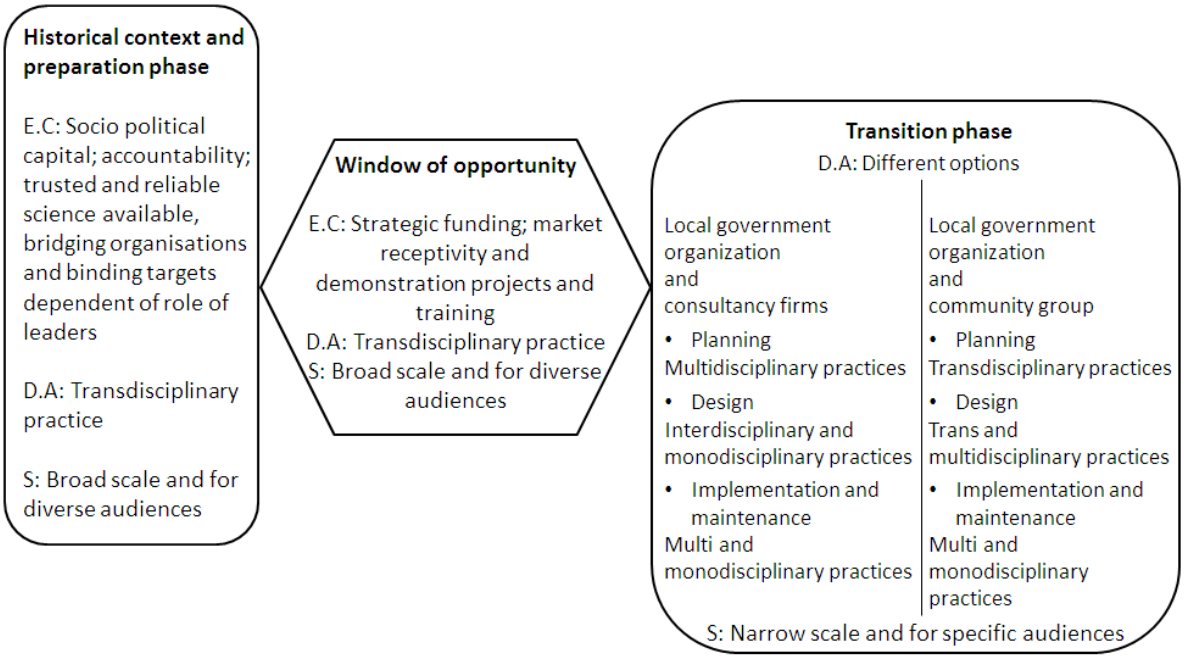
Historical context and preparation phases

The historical context in all cases started when environmental problems triggered the involvement of social-political capital. Environmental problems were affecting emblematic rivers, bays and beaches. These problems generated environmental awareness amongst engineer and marine conservation associations, media, staff from different public entities and community groups, which came together, establishing transdisciplinary teams. These transdisciplinary teams started to understand the causes and effects of the environmental problems and demanded accountability from the government. Thus, environmental problems and social-political capital were drivers for transdisciplinary practices and provided the background for the preparation phases of projects delivering multifunctional landscapes.

Actors applied transdisciplinary skills and developed strategies for different audiences. They created coalitions and networks and used demonstrations and rhetorical strategies to increase support; highlight the seriousness of environmental problems; communicate

ideas clearly, and demand action by the government. These strategies contributed to legislative reforms and changes including the creation of environmental services departments in the municipalities for the management of environmental problems

Figure 6-1 Explanatory framework of processes enabling multifunctional landscapes in cities



Sources: Based on findings of this study and modelled on Olsson et al. (2006); Brown and Clarke (2007); and Brouwer (2015). (E.C refers to enabling conditions; D.A refers to disciplinary approaches and S refers to attention-support; linking, relational and arena strategies)

Within municipalities, leaders and teams emerged, creating programs that favoured the development of projects that would lead to multifunctional landscapes. Emerging leaders included the CEO of the municipality of Melbourne who had broad experience in water management, and staff from environmental services departments in Sydney and Melbourne who had strong environmental values. These leaders used linking strategies to connect their ideas to different organisational programs and policies, thereby increasing support within the municipality and gaining political attention. At the same time, these leaders used timing strategies to think strategically, aligning their actions with different local politicians' ideas and interests. Concurrently, interdisciplinary and multidisciplinary teams in the environmental section of the municipalities focused on developing the ideas earlier drawn up by the transdisciplinary teams through planning exercises involving strategic plans and water initiatives.

These environmental programs were supported by academic experts, bridging organisations and binding targets. The water agendas of the municipalities in all cases involved participation by academics, thus demonstrating a trust in science and reliable scientific knowledge and expertise. Also, bridging organisations were established, such as Healthy Water, an entity to bring together different actors interested in the protection and improvement of urban waterways in Brisbane, and the Cooperative Research Centres for Catchment Hydrology and Freshwater Ecology in Melbourne. The co-operation between academics and municipalities influenced the decisions of municipalities' to include in their programs projects that offer multifunctional landscapes. This co-operation also encouraged the creation of education programs for the local community, thereby increasing the likelihood of transdisciplinary practices, and demonstrating that the establishment of bridging organisations can have a major role in connecting the interests of academics, policy makers and industries. Actors involved in these organisations might now create binding targets that promote multifunctional landscapes in cities as well.

The framework is revealing that preparation phases for projects delivering multifunctional landscapes can be long. In the case of Melbourne, the preparation phase ran from the 1960s until 2009. For Sydney and Brisbane, the preparation phases commenced in the 80s and 90s and continued until 2009-2010 approximately. These findings of the framework are important for practitioners planning to create projects delivering multifunctional landscapes. It is revealing that the initial phases can be long because it is necessary to establish cooperation and trust between actors from different sectors. Moreover, it is relevant to develop transdisciplinary training for the application of strategies to attract multiple audiences, obtain support, and make changes in the legislation to create environmental sections in municipalities.

Windows of opportunity

The windows of opportunity for the projects were associated with environmental crises in all three cases: in the cases of Brisbane and Sydney it was floods that occurred between 2010 and 2011, while in the case of Melbourne it was the droughts of 2009. The outcomes of the study show three types of windows of opportunity for projects delivering multifunctional landscapes:

The first window of opportunity was the immediate action taken by local politicians to mitigate future crises. These politicians´ actions were related to the use of the strategy of

exploitation by focusing events by transdisciplinary teams. In Brisbane this strategy was applied to promote projects that offered multifunctional landscapes. The Lord Mayor interacted with transdisciplinary teams to determine how to mitigate the crisis. As a result, the project received strategic funding. Furthermore, the Brisbane municipality obtained hydrological data that previously were not possible to obtain. This option identifies market receptivity as well. The criteria of the project were simple, cheap, quick, effective, visually attractive and easy to maintain. These factors facilitated the market receptivity of the project and were attractive to local politicians. In this context, within the municipality multidisciplinary teams worked concurrently or sequentially to find possible sites to develop the project.

The second window of opportunity is demonstrated by the case in Sydney. In this case, the community affected by the environmental crisis complained to the municipality and suggested solutions that promoted multifunctional landscapes. The municipality recognised the solution as an opportunity to apply water-sensitive urban design with the participation of a local community group. Additionally, this was an opportunity to test an organisational change program focusing on implementing projects with multiple objectives. The interests of the municipality resulted in the need to demonstrate the benefits and limitations of the organisation program, while increasing training in these types of projects with their multiple objectives. Transdisciplinary practices to obtain strategic funding for the project were undertaken by staff from the municipality, the development company, the leader of the community group and by local politicians.

The third window of opportunity was the availability of government grants to manage the environmental crisis, and this strategic funding encouraged the creation of projects to deliver multifunctional landscapes. This was the case in Melbourne in which a grant was established. The municipality in this case co-operated with other municipalities supported by the water utility company, academic experts, consultants and sports associations. As a group, a proposal involving several projects was presented that would mitigate droughts. Collaboration of academic experts in the application for the grant indicated trust in science and in reliable scientific knowledge and expert opinions. The interest of trial pioneer infrastructures for industrial areas for the first time in Australia indicated an interest in demonstration projects and training. In this regard, within the municipality, interdisciplinary and multidisciplinary teams fulfilled all the requirements for the grant.

These results of the framework indicate that environmental crises are key windows of opportunity to promote projects offering multifunctional landscapes. Furthermore, solutions from communities to solve the crisis, combined with interest from the municipality to work with the communities to establish an organisational program, are also windows of opportunity. To open these windows of opportunity, and increase the likelihood of securing financial resources, practitioners need to be ready to offer a range of technical and politically attractive alternatives to local politicians, and create proposals for grants that are supported by multiple audiences.

Transition phases

The transition phases of both the Brisbane and Sydney projects lasted two years, while in Melbourne it was five years. Findings reveal two main approaches in the transition phases for achieving multifunctional landscapes.

The first approach occurred in the cases of Brisbane and Melbourne. In this approach, multidisciplinarity, monodisciplinarity and interdisciplinarity practices were applied. Factories and communities linked with these projects were aware of the objectives of the projects but were not directly affected by the environmental crisis and were not interested in participating in the activities of the project. In this context, the projects were developed by staff of the municipalities and consultancy firms. Multidisciplinary teams in both cases were responsible for managing the budget, communication with external actors, and building and monitoring the infrastructure implemented in the projects. Monodisciplinary practices were characterised by the staff of the Melbourne municipality providing specialised knowledge for the design and maintenance of the project. Interdisciplinary practices were demonstrated in the design of the Brisbane project by the co-operation of specialised consulting firms in landscape, civil engineering and water design. The teams applying monodisciplinary and interdisciplinary practices managed their budget and focused on specific activities in the projects. Staff used demonstration and rhetorical persuasion strategies to reaffirm funding arrangements, increase confidence, reduce scepticism, clarify roles, avoid mistakes, and keep actors focused on the primary goals and benefits. The strategy of exploitation of focusing events was used to increase credibility in the designs for flood mitigation and promote similar projects. Broad coalition and linking strategies were not applied as actors considered that they would create delays. Workshops and onsite visits were useful to clarify responsibilities and show outcomes while strengthening networks and gaining trust.

The second approach is linked to the Sydney case. The community was directly affected by the environmental crisis. One community group was interested in participating in the project and showed knowledge for the design of the project. Planning and design included transdisciplinary practices while the implementation and maintenance were multidisciplinary and monodisciplinary. Transdisciplinarity was characterised in the training of staff from the municipality to interact with the community group. This interaction included working together in defining common objectives and creating alternatives for the design. As soon as the actors reached an agreement and were satisfied with the design, implementation and maintenance activities – requiring specific skills – were fulfilled by multidisciplinary and monodisciplinary approaches.

Multidisciplinarity is identified in the activities developed by the engineering section to build the infrastructures. The maintenance was monodisciplinary with one section of the municipality given charge of the maintenance of infrastructures, while the community group took charge of the trees. Each group operated from its perspective and undertook responsibilities without any communication or collaboration. Surveys, blogs, priority lists, demographic studies, previous projects and risk management plans implemented in other cities were part of the demonstration strategies used to identify community interests and show the feasibility of the project to senior managers. The municipality staff needed to be able to reduce both risks, and fears of transferring roles to the community in the transition phases. Staff involved in the project used rhetorical strategies as a reminder to other sections of the municipality of the trial status of the project. Support was provided for senior managers so that hierarchical sections of the municipalities could cooperate in the activities of the project, thus also reducing fears and risks. Only a few staff worked as channels of communication transferring knowledge and ideas that facilitate agreements among actors. An example of a linking strategy is identified in the legalisation of the community group. Under the requirements of the municipality, this linking took place to reduce risks of legal demands from the community upon the municipality.

These findings of the framework in regards to the transition phases mean that practitioners can deliver multifunctional landscapes through different disciplinary approaches and strategies for specific audiences. Crucial factors that shape the disciplinary approaches and strategies applied in the projects include: the location of the projects, the education level and interest of the community in participating in the projects, the level of expertise

needed to fulfil the objectives of the projects, timelines, training to work with the community, and political will.

6.2.4 Discussion of results

The framework created in this study attempts to help academics to clarify the role of transdisciplinarity in the delivery of multifunctional landscapes. It is also aimed at increasing knowledge regarding transdisciplinary research gaps such as process management, organisational learning, team dynamics and knowledge integration. At the same time, the framework can be viewed as a guideline for practitioners interested in developing projects delivering multifunctional landscapes, and it can be used as a set of evaluation tools for projects already implemented. For academics and practitioners, the framework illustrates that transdisciplinarity emerges when three enabling conditions are developed in the historical context which facilitates the preparation phase and window of opportunity of the project:

One: When socio-political capital developed due to environmental problems and crises becomes a driver for collaboration among actors from multiple scales, then an opportunity for projects to deliver multifunctional landscapes occurs. The results of this study confirm that environmental imperatives and an engaged population can force governments to take action and facilitate transdisciplinary practice (Lawrence and Després 2004; Russell et al. 2008; Stokols et al. 2008b).

Two: When leaders emerge who are committed to local leadership in sustainable management, and the political institutionalisation of environmental concerns, this leadership facilitates partnerships between governments, industries and communities, and changes in legislations and institutions result (Brown 2008; Roy et al. 2008; Dollery et al. 2011). For instance, in the case of Melbourne the CEO aligned his personal interests and concerns with the values of the municipality and other entities in order to strengthen sustainability agendas (Bansal 2003; Stubbs and Cocklin 2008). Similarly, the leaders from environmental sections in the municipalities promoted alliances with community groups and academics in order to further their objective of institutionalise sustainability and increasing democratic processes (Aulich 2005; Stubbs and Cocklin 2008).

Three: Within the municipalities, when different multidisciplinary and interdisciplinary teams work together or in parallel in the adaptation of the transdisciplinary visions of their leaders to the specific needs of the municipalities, then transdisciplinary collaboration

happens. In this regard, it is possible that municipalities are now beginning to apply transdisciplinarity approaches to set the frameworks for societal changes; while interdisciplinarity and multidisciplinarity, as an integral part of transdisciplinarity, drive the integration of knowledge (Jahn et al. 2012).

The actions of the actors in the three case studies in Brisbane, Sydney and Melbourne lasted approximately twenty years, thus confirming how consuming and demanding transdisciplinarity can be, thus creating implications for the creation of projects focusing on multifunctional landscapes (Palang 2003). Practitioners planning to develop projects delivering multifunctional landscapes might consider it unfeasible to apply transdisciplinarity. However, it is important to consider the characteristics and benefits of this disciplinary approach in the initial phases.

The scale and scope of transdisciplinarity was complex as it included interactions between different actors at the intra-organisational, inter-organisational and intersectoral levels, in order to solve environmental problems at the city level. The long preparation phases of transdisciplinarity contribute to the establishment of relational and arena strategies that increase the efficiency of attention-and-support seeking and linking strategies (Brouwer 2015). In these initial phases staff spend time networking with different actors framing the projects in various communication styles (Koppenjan and Klijn 2004). Also, staff establish a broad scale of coalitions and link their ideas to other people to avoid resistance, thus creating richer outcomes and increasing legitimacy, and social and political support (Meijerink and Huitema 2010; Brouwer 2015).

It is also important to note that in the case studies of this research actors did not follow transdisciplinary guidelines in the preparation phases. At this stage they were learning about transdisciplinary skills spontaneously and without time limitations. The level of transdisciplinary practice in these project phases might be what Max-Neef (2005) called strong transdisciplinarity. Strong transdisciplinarity is a tool and an unfinished project that is constantly being reshaped, and this evidently takes time.

In the transition phases, the framework tells academics that transdisciplinarity is not applied across all project phases. For practitioners, the framework is offering a variety of disciplinary approaches that can deliver multifunctional landscapes in cities and the use of strategies to enable the projects is for specific audiences.

Transdisciplinary was only applied in the planning and design of the project in Sydney, which involved staff from the municipality and a community group interested in participating actively in the project. The interactions for the planning and design of the projects lasted one year approximately. This outcome of the framework is indicating, especially to practitioners, that transdisciplinarity can be applied in short periods of time when right conditions are present. In this project, staff had the knowledge to work with the community and the willingness to learn transdisciplinary skills. The municipality indicated formal commitment and allowed flexibility in time for collaborating with the community group. These outcomes confirm how the involvement of different actors from the beginning of the processes, combined with adequate time and training, facilitate substantially transdisciplinary processes (Antrop and Rogge 2006). Additionally, the level of education and knowledge of design amongst community members was high and contributed to effective interactions with municipal staff in the planning and design of the project. Russell et al. (2008) and Morison and Brown (2011) have shown that a high level of education in the community is important for commitment and participation in political processes related to environmental management.

In contrast, transdisciplinarity was not applied in the transition phases of the projects in Melbourne and Brisbane. This can be attributed to a lack of community ownership and time constraints. The projects were located in an industrial area and in a public park. Consequently, the community was not affected directly as they were in Sydney by the particular environmental problems and crises. Therefore there was a lack of community ownership with the community being more interested in consultation than in active participation in the projects. Additionally, the project timelines were short; the level of design was very specialised, and the level of complexity was low as staff had a clear vision of how to develop the activities of the projects. In these circumstances, multidisciplinarity, interdisciplinarity and monodisciplinarity were applied in the projects.

Multidisciplinarity is the traditional way of working in municipalities and an efficient way to deal with time constraints (Wilson and Pirrie 2000b; Edwards et al. 2007). The level of specialisation for the design of pioneer infrastructure requires specific knowledge and skills that can be satisfied by monodisciplinary and interdisciplinary approaches. Monodisciplinary practices might be promoted because organisations in charge of water issues might consider that expanded goals, from a strategic point of view, devalue the municipalities' raison d'être (Brouwer 2015).

In the transition phase of each project, staff preferred narrow coalitions and issue-linking strategies. Particularly in the case of Brisbane, they avoided broad coalitions and in this way transdisciplinary approaches may be a hinder. Dutch actors involved in the study of Brouwer (2015) were not open to broad coalitions or issue-linking, which can affect the planning and implementation of projects that are a political priority or which have a short time frame. Evidently the timeline of projects and the complexity of problems determines the size and composition of the coalition and linking (Koppenjan and Klijn 2004; Brouwer 2015). Similarly, staff from the municipalities applied carefully rhetorical persuasion. Only a few practitioners worked as channels of communication, transferring knowledge and ideas that facilitated agreements and communication among actors (Mintrom 2000).

The outcomes of this framework for academics more generally indicate that transdisciplinarity in practice can be different to what is indicated by theory. Transdisciplinary teams in the projects might be applying types of knowledge such as that related to 'system', 'target' and 'transformation' through the analysis of environmental problems, definitions of causes, common goals and possible solutions (Pohl and Hadorn 2007). As result, these actors are in a process of understanding others' points of view, this facilitating mutual learning as a core challenge of transdisciplinarity (Becker and Jahn 2006). However, we do not believe that the actors are concerned about transgression of disciplinary boundaries as the main characteristic of transdisciplinarity (Lawrence and Després 2004).

On this point, we think that actors involved in these projects are more interested in the integration of interests in order to reach consensus for common goals, than in the transgression of disciplinary boundaries. Furthermore, the outcomes of this research show that transdisciplinarity is not essential across all project phases, but that other disciplinary approaches are relevant as well. Therefore this study reveals the fuzzy limits and lack of superiority of transdisciplinarity. In this context, we agree with Kötter & Balsiger (1999), Klein (2008) and the Swiss Academies of Arts and Sciences (2013), who suggest that the extent of the use of disciplinary approaches depends on the degree of complexity required to solve a specific problem. Therefore there is no unique set of mutually exclusive categories within the heterogeneity of monodisciplinary, multidisciplinary, interdisciplinary and transdisciplinary.

6.2.5 Concluding remarks

The explanatory framework developed in this study reveals a variety of enabling conditions, disciplinary approaches and strategies applied by practitioners in enabling multifunctional landscapes in cities. It suggests that the call for transdisciplinary practice for the delivery of multifunctional landscapes is valid, but not the only option. Different factors shaped disciplinary dynamics in these projects. These varying factors included time; the complexity level for the development of the objectives; the location of the project; community interest; level of education; training, and formal commitment to interact with different actors. The challenge for practitioners developing these projects is to identify the right conditions to apply to the disciplinary approaches; that is, conditions that will not jeopardise the development of the objectives.

6.2.6 Acknowledgment

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6.2.7 References

References have been moved to a consolidated reference list at the end of the thesis

Chapter 7

Synthesis

7.1 Reflection on the research objective

This research has developed a framework of the processes applied by municipalities to enable three projects delivering multifunctional landscapes in cities. The framework consists of preparation and transition phases linked to a window of opportunity. In the two phases and the window of opportunity, enabling conditions, disciplinary dynamics and strategies were applied by practitioners to bring actors together and enable the projects to deliver multifunctional landscapes.

The framework reveals factors that did not vary between contexts. These factors are common to all projects but use differently in each project, thereby offering various alternatives for the projects. For instance, one aspect of the framework that is common to all projects is socio-political capital associated with environmental problems in the preparation phases. This socio-political capital is a driver for the establishment of transdisciplinary teams interested in understanding causes of environmental problems and finding solutions to them. These teams applied strategies on a broad scale to attract different audiences and increase support for the solution of environmental problems. As a result, with the participation of academics, environmental agendas were established in all municipalities. Similarly, bridging organisations were created to increase communication and interaction among transdisciplinary teams. The windows of opportunity were characterised by environmental crises, and each of the transdisciplinary teams formed in the preparation phases promoted the projects as being able to deliver multifunctional landscapes to solve the crises, and to increase knowledge and training in techniques for water management. In the transition phases, different disciplinary approaches were used in the planning, design, implementation and maintenance of the projects. However, multidisciplinary and monodisciplinary approaches were common in the implementation and maintenance activities of all projects. In regard to strategies, all practitioners used them for specific audiences to avoid delays in the timeline of the projects.

Although the framework reveals factors that did not vary between contexts, one factor that was applied differently in the three projects is strategic funding in regard to being a window of opportunity. Funding opportunities varied according to the release of federal government grants, the decision of local politicians, as well as the interactions of different actors in obtaining financial resources. Also, the disciplinary dynamics applied in the planning and design of the projects was diverse. These dynamics depended on several factors such as time and complexity for the development of the objectives; location of the

project; and the interest of the community in participating in the project. Training and formal commitment of organisations to work within the community influenced the disciplinary dynamics as well

Characteristics of the phases outlined in the framework may have similarities with other phases of frameworks that have been used to explain transdisciplinary processes (**Table 7-1**). For instance, Stokols et al. (2003) created a framework comprising antecedents, processes and outcomes. This was done in order to assess collaborative processes and scientific and public policy results from transdisciplinary research teams and centres, in response to the growing interest and investment of government and private foundations in these centres. Similarly, Hall et al. (2008) developed a framework to assess the effectiveness of health initiatives in fostering collaborative research, and training and improvement, in public health. The framework of the Hall et al. study includes antecedents and factors relating to collaborative readiness; to capacity and products in the near, intermediate and long-term; followed by health impacts. In response to the growing participation of stakeholders in societal decision processes, Stauffacher et al. (2008) evaluate transdisciplinary processes in a project on sustainable landscape development in Switzerland. Their framework explains different techniques and degrees of involvement of stakeholders in the preparation, core, and follow-up phases of the project. Elliott (2011) is interested in integrating water, sanitation, and human health through a transdisciplinary knowledge framework. The framework consists of phases such as knowledge creation, synthesis, translation and mobilisation. Moreover, Hall et al. (2012), in a further study, develop a framework to conceptualise transdisciplinary team-based research in phases called development, conceptualisation, implementation and translation. The objective of the framework is to offer evidence-based models to increase effectiveness and efficiency of transdisciplinary research.

Table 7-1 Different phases of transdisciplinary frameworks

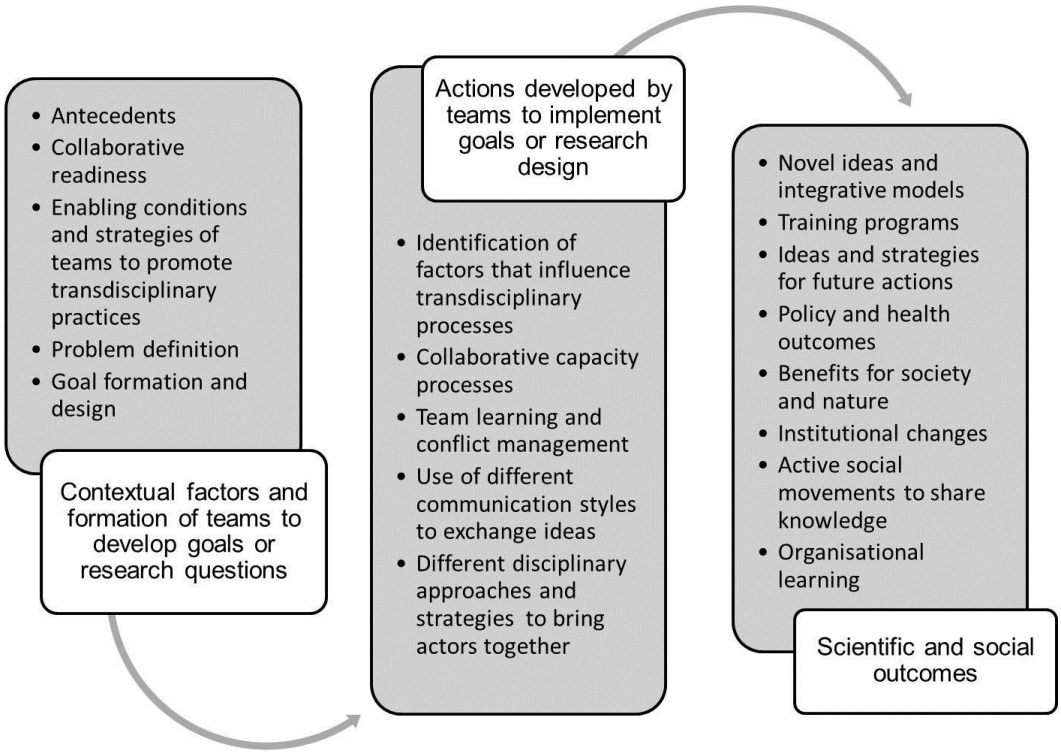
Framework	Transdisciplinary scientific collaboration model Stokols et al. (2003).	Conceptual model for evaluation of collaborative initiatives Hall et al. (2008).	Analytic and dynamic approach to collaboration Stauffacher et al. (2008).	Transdisciplinary knowledge journey Elliott (2011).	Four-phase model of transdisciplinary research Hall et al. (2012).	Explanatory framework developed in this study for enabling projects delivering multifunctional landscapes in cities.
Identification	Antecedents are	Collaborative	Preparation	Knowledge	In the	Preparation

of contextual factors and formation of teams to develop goals or research questions.	linked with intrapersonal, social, physical environmental and organisational conditions.	readiness involves contextual and environmental conditions; intrapersonal and interpersonal factors.	phase includes goal formation, defining a guiding question and facet the case.	creation means activities from a transdisciplinary team to discover new information about a problem. Then knowledge synthesis organises existing knowledge so it is useful for policy, decision makers and researchers.	development phase a team defines a scientific or societal problem of interest. Then, in the conceptualization phase this is leads to the development of research questions or hypotheses, a conceptual model, and a research design.	phases and windows of opportunity characterized by different social and institutional groups enable conditions and strategies promoted by transdisciplinary teams, which in turn enable the projects and solve environmental problems.
Actions developed by teams to implement goals or research design.	Processes encompass behavioural, affective, interpersonal, intellectual and institutional factors that intervene and influence transdisciplinary processes.	Collaborative capacity processes occur among investigators to obtain near intermediate and long-term outcomes.	Core phase includes systems analysis, scenario construction and multi-criteria assessment.	In translation, knowledge creators and brokers adapted their ideas to different communication styles so it is clear for users and receptors.	The implementation phase characterised by the execution of the research design and key processes such as team learning and conflict management.	Transition phases consist of multiple disciplinary approaches and strategies for specific audiences applied in the planning, design, implementation and maintenance of the projects.
Scientific and social outcomes.	Outcomes refer to novel ideas, integrative models, new training programs and institutional changes that support transdisciplinary processes.	Collaborative products, scientific training, policy and health outcomes.	Follow up is linked with the development of orientations and ideas for future actions.	knowledge mobilisation means the creation of an active movement to share knowledge among different receptors	Translation phase involves the use of research findings for the establishment of strategies to solve or ameliorate social problems.	Outcomes of the projects are represented in benefits for society and nature. Moreover, outcomes can be associated with organisational learning to develop these projects.

Despite the several names of the different phases in varying projects, it is possible to find parallels among the phases and distil a common model that consists of three main components or sections (Figure 6-1). In the first component, phases called antecedents, development, knowledge creation and preparation describe contextual factors. These are factors which allow cooperation among different actors for the organisation or formation of

knowledge, and for the establishment of goals or research questions. In a second component or section, there are phases such as processes, collaborative capacity processes, core, translation, implementation and transition. These comprise different activities, degrees of involvement and forms of conflict management by teams in charge of the execution of goals or research design. In the third section, translation, outcomes, collaborative products, knowledge mobilisation and follow up phases reveal scientific and social results developed by the teams involved in the second section. These result in scientific ideas, models and training, health outcomes and benefits to society and nature.

Figure 7-1 Model for design transdisciplinary processes



Differences among frameworks in different projects are associated with the context, objectives and sectors involved in the studies. However, the majority of the frameworks involve scientific collaborations; and techniques or outcomes represented in new concepts, training or integrative models. In contrast, the framework created in this current research specifically focuses on processes and strategies applied by practitioners in solving environmental problems and enabling projects delivering multifunctional landscapes in cities.

The framework developed in this research is a tool for the evaluation and planning of projects delivering multifunctional landscapes. For those who have already implemented a project and want to evaluate their work, the framework reveals enabling conditions, disciplinary dynamics and strategies applied throughout different phases of a project. Practitioners can use these factors and processes as assessment criteria for their own projects. And throughout the framework, practitioners may identify factors and processes that they may not have taken into account or did not know about when implementing their own projects. Consequently, the framework enables practitioners to have a better understanding of their projects and to evaluate their work. In addition, the framework details how three projects delivering multifunctional landscapes were developed. Practitioners can compare enabling conditions, strategies and disciplinary dynamics applied in these three projects, with their own project under evaluation. They can analyse advantages and disadvantages of the actions developed in the three case study projects, generalising from the case studies to the feasibility of applying new factors in future projects.

For practitioners that want to develop a project delivering multifunctional landscapes, the framework shows a variety of options for carrying out the project. Practitioners can therefore be aware of enabling conditions and strategies that bring actors together and facilitate a project. Similarly, practitioners can identify different windows of opportunity for their project. Furthermore, the framework offers different disciplinary dynamics depending on different factors such as the involvement of and level of education of the actors. Other factors that shape disciplinary dynamics are location, time and the objectives of the projects. This means that practitioners can be aware of a variety of requirements, outcomes and implications for each option in the delivery of multifunctional landscapes.

Furthermore, the framework can help practitioners interested in applying transdisciplinary practices in municipalities to explain to other practitioners and decision makers the different characteristics and factors that facilitate or impede transdisciplinarity. The framework can open a dialogue about the benefits and implications of the use of transdisciplinarity in their municipalities. As a result, practitioners can change the vision and expectations of this disciplinary approach to suit their own work. It might be possible that municipalities include transdisciplinary practices in capacity building and organisational learning programs. It might also be possible that organisations discard

transdisciplinary practices and strengthen disciplinary approaches traditionally applied in municipalities.

7.2 Scholarly contribution

The main contribution of this research is an evidence-based response to the call for transdisciplinary processes in the delivery of multifunctional landscapes. Transdisciplinarity might be the favourite choice for delivering multifunctional landscapes in theory. However, this research demonstrates that transdisciplinary practice is not essential at every stage of a project for the successful delivery of multifunctional landscapes. Trandisciplinarity is one disciplinary approach among a diverse array of options. This research recognises that the interaction of different disciplinary approaches may be needed to develop particular projects. Consequently, the call for transdisciplinary processes should be modified, specifying those phases that do need transdisciplinarity, and acknowledging the role of other disciplinary approaches that can also contribute to the successful delivery of multifunctional landscapes.

An in-depth analysis was made of enabling conditions, disciplinary dynamics and strategies applied by practitioners to bring actors together enabling the projects. In this way, this research increases knowledge in transdisciplinary research gaps such in process management, organisational change and learning, team dynamics, knowledge integration and services delivery by practitioners in local contexts. The analysis was developed in municipalities showing the application of transdisciplinarity from practitioners' perspectives in local contexts. It explains key conditions and strategies applied by practitioners to bring actors together and to overcome social and institutional barriers to facilitating transdisciplinary processes. Additionally, it gives information about organisational change and learning, describing how transdisciplinary teams are developed, as well as their roles, characteristics and levels of collaboration. Similarly, this analysis describes features of monodisciplinary, interdisciplinary and multidisciplinary practices by practitioners in municipalities. In this way, it shows the team dynamics and their outcomes in delivery service by these entities. In regard to knowledge integration, this research demonstrates how practitioners focus on the integration of interests and do not necessarily integrate disciplinary methodologies as core elements of transdisciplinarity.

This analysis is displayed in an explanatory framework in an attempt to conceptualise transdisciplinary processes by practitioners, and to facilitate the understanding of transdisciplinarity's role in projects delivering multifunctional landscapes. The framework

may contribute to a debate on transdisciplinarity in practice, thus identifying future areas to investigate. Therefore this study is part of the research group working on transdisciplinary tools, models, or frameworks based on the typology generated in Chapter 2.

The framework developed in this research is a novel framework that explains transdisciplinary processes at a municipal level. To develop this framework, a tentative explanatory framework was created, which shows the characteristics of transdisciplinary processes in a project delivering multifunctional landscapes with the active participation of local communities (the Sydney case). It highlights key factors and processes that municipalities and local community groups need to be aware of to develop these projects together. Then, a final framework was developed, combining the inputs of the tentative framework with transdisciplinary processes from projects developed by municipalities and consultancy firms (the Melbourne and Brisbane cases). This final framework offers a variety of disciplinary dynamics to deliver multifunctional landscapes. In this way, the framework is part of unusual longitudinal comparative studies (Stokols et al. 2005) that explain and compare the characteristics and benefits of the different disciplinary approaches for social purposes.

7.3 Limitations and further research

Transdisciplinarity is the youngest of the disciplinary approaches, and the concept, research and practice of transdisciplinarity is still in its infancy. In this sense, a limitation of this research is a lack of other studies with which to compare the data. It was not possible to find studies related to transdisciplinarity in municipalities, or in its role in multifunctional landscapes, particularly in relation to the urban water sector. Therefore the researcher discussed and compared outcomes with existing literature on transdisciplinarity and other domains such as in co-management, co-governance, co-engineering, management processes, team diversity, social learning and in participatory processes. It was also necessary to review research developed in the health sector, which is the most advanced in transdisciplinary practice. In this sector, it was possible to find studies providing characteristics and experiences of transdisciplinary teams wishing to provide better services. These investigations might be considered outside the context of the current investigation, but in the absence of better-matched studies, these are useful references for understanding transdisciplinarity in the urban water sector.

In this process, the researcher also needed to deal with the ambiguity, lack of consensus and literature dispersed in various knowledge disciplines. The term ‘transdisciplinarity’ is

recognised in Europe and applied in investigations linked with landscape ecology and sustainability research (Scholz and Steiner 2015). In other parts of the world, transdisciplinarity is associated with approaches such as community-based participatory research, action research, experimental action research, 'participatory research', 'public participation', participatory rural appraisal, social learning, mode 2, co-design, co-production, and co-creation or co-construction of knowledge, among others approaches (Roux et al. 2010; Lang et al. 2012; Brandt et al. 2013; Scholz and Steiner 2015). In addition, there is a lack of journals focused on this topic. Under these conditions, the network for Transdisciplinary Research (Swiss Academies of Art and Sciences 2013), that comprises transdisciplinary lecturers and researchers from Switzerland, was also used to find relevant studies for the analysis.

Another limitation is that the research involves three projects delivering multifunctional landscapes in the water sector and developed by municipalities in Australia. Thus, the research is limited to three case studies in a single sector and geographical context. This research does not assess projects developed by other public entities or private organisations. It did not include projects in other sectors, which could give insight into important factors linked with transdisciplinary practice. The small number of case studies may hinder generalisation as a common limitation of case studies as it shows theoretical conclusions to the use of transdisciplinary processes from unique historical events and contextual factors (Lawrence 2002; Stokols 2006; Eisenhardt and Graebner 2007). However, it is important to recognize that the purpose of using only a few case studies is to show heterogeneity within a population and to develop analytical generalisation instead of statistical generalisation (Blaikie 1993; Stake 1995). In this sense, this research is offering a range of heterogeneity in processes, team dynamics and strategies at the level of municipalities, and therefore developing analytical generalisation.

Lastly, the collection of empirical data focused on teams involved in the different projects' phases, in semi-structured interviews with various actors such as senior managers, coordinators, technical officers, consultants and community members. However, the participation of mayors, executives and councillors was not possible, except for one councillor and one executive. Their participation could give invaluable insights into power dynamics, political interests and strategies that facilitated the projects (Goggin et al. 1990; Desmond 2004).

Further research is possible, building on the results of this study. This research analysed three successful projects delivering multifunctional outcomes as an explanatory framework for the enabling conditions, disciplinary dynamics and strategies applied by practitioners. The framework could be tested in projects attempting to deliver multifunctional landscapes in different stages, and different type of organisations, geographical contexts and sectors. For instance, the framework could be tested in failed projects and projects with an average performance (i.e. neither failing nor succeeding fully) to validate the propositions and find new factors and processes that impede projects to deliver successful outcomes.

Municipalities implemented the projects involved in this study. Further research could evaluate projects delivering multifunctional landscapes executed by other public entities, private organisations or a combination of both in the same or different geographical contexts. Furthermore, future research could concentrate on the analysis of projects delivering multiple services in multiple sectors, e.g. comparative analysis of how practitioners deliver multiple services in the water and health sector through transdisciplinarity. The framework of Elliott (2011) focusing on transdisciplinarity in the water and health sectors is a starting point, while Lang et al. (2012) mention commitment and interest in transdisciplinarity in the sector of energy as well. Examination of projects attempting multiple benefits across different sectors could be valuable for comparing and understanding the different roles and the applicability of transdisciplinarity in practice.

In the transdisciplinarity literature, some authors have developed ideal transdisciplinary frameworks to design, conduct and evaluate transdisciplinary research. For instance, Scholz and Steiner (2015) explain that the ideal types of transdisciplinary processes should include the following aspects: (1) type of problem for which transdisciplinary processes may take place (the ontology of transdisciplinarity); (2) type of knowledge produced in a transdisciplinary process and transdisciplinary research (epistemology); (3) processes, techniques, and methods upon which a transdisciplinary process is built (methodology); (4) outcomes and purposes of a transdisciplinary process (functionality); and (5) main organisational traits (organisation). Similarly, Lang et al. (2012) create a conceptual model of an ideal-typical transdisciplinary research process based on insights from different literature and experiences in transdisciplinary projects over ten years. The main phases of the model are the collaborative framing of the problem and building a collaborative research team (Phase A); co-producing solution-oriented and transferable

knowledge through collaborative research (Phase B); and (re)integrating and applying the produced knowledge in both scientific and societal practice (Phase C).

Future research could attempt to apply these ideal transdisciplinary models in transdisciplinary projects developed by practitioners to assess their value and applicability. It would be useful to compare the use of the models by academics and practitioners as well. For example, the use of these ideal models could highlight different challenges and strategies when used by practitioners. Another alternative for further research might be the creation of an ideal transdisciplinary framework based on practitioner´s perspectives. This framework may include ideal factors for short, intermediate and long-term projects, as suggested by practitioners. This ideal transdisciplinary framework could be tested by organisations from public and private sectors interested in applying innovative knowledge, resources and ideas to deliver better services (O'Farrell and Anderson 2010).

7.4 Conclusion

Academics consider trandisciplinarity as essential when transforming urban spaces that offer multifunctional landscapes and might deal with city challenges such as adaptation to climate change and limited urban space. However, this insistence on transdisciplinarity requires empirical data to confirm its validity. For that reason, the aim of this research was to assess the validity of this academic call by evaluating successful projects delivering multifunctional landscapes in the urban water sector in Australia through multiple case studies.

The empirical evidence and its visualisation through an explanatory framework revealed that transdisciplinarity is a valid option as applied in specific phases of projects offering multifunctional landscapes. A spontaneous and organic transdisciplinarity is used in the initial phases of projects. These phases lasted decades as there were no time constraints and transdisciplinary guidelines. Transdisciplinarity in these phases was used to unify interests and reach agreements to enable the projects, not necessarily to produce knowledge that contributes to social and scientific progress. This outcome has an important implication in the vision and definition of success in regards to this disciplinary approach by practitioners. Transdisciplinarity linked with initial phases can be considered time-consuming and inefficient for practitioners desiring tangible and immediate outcomes of transdisciplinarity. However, other practitioners may value the learning process and outcomes that are evident after several years, such as the establishment of coalitions, networks and trust. These transdisciplinary outcomes can be viewed as relevant to

facilitating and preparing the decision-making processes for navigating phases of not only an individual, but of different projects.

In transition phases, practitioners can have a diversity of options for delivering multifunctional landscapes. They can apply transdisciplinarity and this can be an efficient option when the right conditions for transdisciplinary processes come together, such as for formal commitment and training of staff from the municipality. Additionally, the community showed interest and an education level that facilitated transdisciplinary processes in the planning and design of projects.

If these conditions do not apply, other disciplinary approaches more conventionally applied in municipalities can be implemented, such as multidisciplinarity, monodisciplinarity and interdisciplinarity. These different disciplinary approaches can offer successful multifunctional landscapes. For these reasons, the call promoting transdisciplinary as essential in the delivery of multifunctional landscapes should be modified to include specific phases that require transdisciplinarity, and emphasise that other disciplines have a role in delivering multifunctional landscapes as well.

References

Ahern J (2007) Green infrastructure for cities: the spatial dimension. In: Novotny V, Brown P (eds) Cities of the future - towards integrated sustainable water and land- scape management. IWA Publishing, London, pp 267–283

Allan P, Darlison L, Gibbs D (2006) Are councils sustainable ? Final report: findings and recommendations. Independent Inquiry into the Financial Sustainability of N.S.W. Sydney

Anderson S, Allen P, Peckham S, Goodwin N (2008) Asking the right questions: scoping studies in the commissioning of research on the organisation and delivery of health services. Heal Res policy Syst 6:7. doi: 10.1186/1478-4505-6-7

Antrop M (2001) The language of landscape ecologists and planners. Landsc Urban Plan 55:163–173. doi: 10.1016/S0169-2046(01)00151-7

Antrop M, Rogge E (2006) Evaluation of the process of integration in a transdisciplinary landscape study in the Pajottenland (Flanders, Belgium). Landsc Urban Plan 77:382–392. doi: 10.1016/j.landurbplan.2005.04.008

Apgar JM, Argumedo A, Allen W (2009) Building transdisciplinarity for managing complexity: lessons from indigenous practice. Int J Interdiscip Soc Sci 4:225–270.

Apostel L, Berger G, Briggs A, Michaud G (1972) Interdisciplinarity:Problems of teaching and research in Universities. Organization for Economic Co-operation and Development, Paris

Arksey H, O'Malley L (2005) Scoping studies: towards a methodological framework. Int J Soc Res Methodol 8:19–32. doi: 10.1080/1364557032000119616

Armstrong R, Hall BJ, Doyle J, Waters E (2011) "Scoping the scope" of a cochrane review. J Public Health (Bangkok) 33:147–150. doi: 10.1093/pubmed/fdr015

Asmussen KJ, Creswell JW (1995) Campus response to a student gunman. J Higher Educ 66:575.

Attwater R, Booth S, Guthrie A (2005) The role of contestable concepts in transdisciplinary management of water in the landscape. Syst Res Behav Sci 22:185–192.

Aulich C (2005) Australia: still a story of Cinderella. In: Denters B, Rose E (eds)

Comparing Local Governance: Trends and Developments. Palgrave Macmillan, Hampshire, England, pp 193–210

Axelrod R (1984) The evolution of corporation. Basic Books, New York

Bailey F. (1977) Morality and expediency: folklore of academic politics. Blackwell, Oxford

Balsiger PW (2004) Supradisciplinary research practices: history, objectives and rationale. Futures 36:407–421. doi: 10.1016/j.futures.2003.10.002

Bammer G (2005) Integration and implementation sciences: Building a new specialization. Ecol Soc 10:6.

Bansal P (2003) From issues to actions: The importance of individual concerns and organizational values in responding to natural environmental issues 510-527. Organ Sci 14:510–527.

Barreteau O, Bots PWG, Daniell KA (2010) A framework for clarifying “participation” in participatory research to prevent its rejection for the wrong reasons. Ecol Soc 15:1–5.

Barton JR (2013) Climate change adaptive capacity in Santiago de Chile: Creating a governance regime for sustainability planning. Int J Urban Reg Res 37:1916–1933. doi: 10.1111/1468-2427.12033

Bass B, Avolio B (1994) Improving organizational effectiveness through transformational leadership. SAGE Publications, Thousand Oak,CA

Battilana J, Leca B, Boxenbaum E (2009) How actors change institutions: towards a theory of institutional entrepreneurship. Acad Manag Ann 3:65–107.

Baumgartner FR, Jones BD (1991) Agenda dynamics and policy subsystems. J Polit 53:1044–1074.

Becher T (1994) The significance of disciplinary differences. Stud High Educ 19:151–161.

Becker E, Jahn T (eds) (2006) Soziale okologie: grundzüge einerWissenschaft von den gesellschaftlichen naturverhältnissen. Campus, Frankfurt/New York

Bell A, Corfield M, Davies J, Richardson N (2010) Collaborative transdisciplinary intervention in early years - putting theory into practice. Child Care Health Dev

36:142–8. doi: 10.1111/j.1365-2214.2009.01027.x

Berger P., Luckman T (1967) The social construction of reality: a treatise in the sociology of knowledge. Anchor Books, Garden City

Bettini Y (2013) Adapting institutions: processes and instruments for urban water transitions. Monash University

Birkland TA (1998) Focusing events, mobilization, and agenda setting. J Public Policy 18:53–74.

Blaikie NWH (1993) Approaches to social enquiry. Polity Press, Blackwell, Cambridge

Bock Hong S, Reynolds-keefer L (2013) Transdisciplinary team building: strategies in creating early childhood educator and health care teams. Int J Early Child Spec Educ 5:30–44.

Bohnet IC (2010) Integrating social and ecological knowledge for planning sustainable land- and sea-scapes: experiences from the Great Barrier Reef region, Australia. Landsc Ecol 25:1201–1218.

Bohnet IC, Roberts B, Harding E, Haug KJ (2011) A typology of graziers to inform a more targeted approach for developing natural resource management policies and agricultural extension programs. Land use policy 28:629–637. doi: 10.1016/j.landusepol.2010.12.003

Bowen HP, Wiersema MF (1999) Matching method to paradigm in strategy research: limitations of cross-sectional analysis and some methodological alternatives. Strateg Manag 20:625–636.

Boxelaar L (2004) Diversity and convergence in platforms for change: building social capability for land management. University of Melbourne

Bracken LJ, Bulkeley HA, Whitman G (2014) Transdisciplinary research: understanding the stakeholder perspective. J Environ Plan Manag 1–18. doi: 10.1080/09640568.2014.921596

Brandt J, Tress B, Tress G (2000) Multifunctional landscapes: interdisciplinary approaches to landscape research and management. In: Multifunctional landscapes. Centre for

Landscape Research, Roskilde, Denmark,

Brandt P, Ernst A, Gralla F, et al (2013) A review of transdisciplinary research in sustainability science. Ecol Econ 92:1–15. doi: 10.1016/j.ecolecon.2013.04.008

Brisbane City Council (2014) Creek filtration systems fact sheet. Brisbane

Brouwer S (2015) Policy entrepreneurs in water governance, strategies for change, Springer. Springer International Publishing Switzerland, London

Brown R (2003) Institutionalisation of Integrated Urban Stormwater Management : Reform across Metropolitan Sydney. University of New South Wales

Brown R (2008) Local institutional development and organizational change for advancing sustainable urban water futures. Environ Manage 41:221–233. doi: 10.1007/s00267-007-9046-6

Brown R, Farrelly M (2009) Delivering sustainable urban water management: a review of the hurdles we face. Water Sci Technol 59:839–846.

Brown R, Farrelly MA, Loorbach DA (2013) Actors working the institutions in sustainability transitions: The case of Melbourne's stormwater management. Glob Environ Chang 23:701–718. doi: 10.1016/j.gloenvcha.2013.02.013

Brown R, Mouritz M, Taylor A (2005) Institutional capacity and policy. In: Wong THF (ed) Australian Runoff Quality: A Guide to Water Sensitive Urban Design. Engineers, Australia, Melbourne, Australia, pp 5:1–5:20

Brown R, Ryan R, McManus R (2001) An Australian case study: Why a transdisciplinary framework is essential for integrated urban stormwater planning. In: Proceedings of frontiers in urban water management: Deadlock or hope? Marseille, France, pp 251–259

Brown RR, Clarke JM (2007) Transition to water sensitive urban design: the story of Melbourne. Melbourne

Brown RR, Keath N, Wong THF (2009) Urban water management in cities: historical, current and future regimes. Water Sci Technol 59:847–55. doi: 10.2166/wst.2009.029

Brugnach M, Ingram H (2012) Ambiguity: the challenge of knowing and deciding together.

Environ Sci Policy 15:60–71. doi: 10.1016/j.envsci.2011.10.005

Bunch MJ, Morrison KE, Parkes MW, Venema HD (2011) Promoting health and well-being by managing for social–ecological resilience: the potential of integrating ecohealth and water resources management approaches. Ecol Soc 16:6.

Carpenter J (1995) Interprofessional education for medical and nursing students: evaluation of a programme. Med Educ 29:265–72.

Chapman L, Ware J (1999) Challenging traditional roles and perceptions: Using a transdisciplinary approach in an inclusive mainstream school. Support Learn 14:104–109. doi: 10.1111/1467-9604.00113

Choi BCK, Pak AWP (2006) Multidisciplinarity, interdisciplinarity and transdisciplinarity in health research, services, education and policy: 1. Definitions, objectives, and evidence of effectiveness. Clin Invest Med 29:351–64.

Clarke P (1993) A typology of multidisciplinary education in gerontology and geriatrics: are we really doing what we say we are? J Interprofessional Care 7:217–227.

Clearwater (2014) Mordialloc industrial precinct. Melbourne

Cole A (2006) Motueka Catchment futures, transdisciplinarity, a local sustainability problématique and the Achilles-heel of Western science. In: 5 th Australasian conference on social and environmental accounting research. Wellington, NZ,

Council of Europe (2000) European Landscape Convention and Explana- tory Report.

Creswell JW (2003) Research design: qualitative, quantitative, and mixed methods approaches. SAGE

Creswell JW (2012) Qualitative inquiry and research design: choosing among five approaches. SAGE Publications, Inc, Los Angeles

Crotty M (1998) The foundation of social research: meaning and perspective in the research process. Sage, London

Daniell K., White I, Ferrand N, et al (2010) Co-engineering participatory water management processes: theory and insights from Australian and Bulgarian interventions. Ecol Soc 15:11.

Danler S, Langellotto-Rhodaback G (2005) Ecological design of urban landscapes: economic, social, and ecological benefits. Oregon State Univ. 17.

De Bruijn H, Ten Heuvelhof E (2008) Management in networks: on multi-actor decision making. Routledge, London and New York

De Bruijn H, Ten Heuvelhof E (2000) Networks and decision making. Lemma, Utrech

De Jong C, Cappy S, Finckh M, Funk D (2008) A transdisciplinary analysis of water problems in the mountainous karst areas of Morocco. Eng Geol 99:228–238. doi: 10.1016/j.enggeo.2007.11.021

Deady R (2012) Studying multidisciplinary teams in the Irish Republic: the conceptual wrangle. Perspect Psychiatr Care 48:176–82. doi: 10.1111/j.1744-6163.2011.00326.x

Desmond M (2004) Methodological challenges posed in studying an elite in the field. Area 36:262–269.

Després C, Brais N, Avellan S (2004) Collaborative planning for retrofitting suburbs: transdisciplinarity and intersubjectivity in action. Futures 36:471–486. doi: 10.1016/j.futures.2003.10.004

Després C, Vachon G, Fortin A (2011) Implementing transdisciplinarity: architecture and urban Planning at work. In: Doucet I, Janssens N (eds) Transdisciplinary knowledge production in architecture and Urbanism. Towards hybrids modes of inquiry. Springer, New York, pp 33–49

Dewulf A, Greet F, Pahl-Wostl C, Taillieu T (2007) A framing approach to cross-disciplinary research collaboration: experiences from a large-scale research project on adaptive water management. Ecol Soc 12:14.

Djanibekov N, Hornidge A-K, Ul-Hassan M (2012) From joint experimentation to laissez-faire: transdisciplinary innovation research for the institutional strengthening of a water users association in Khorezm, Uzbekistan. J Agric Educ Ext 18:409–423. doi: 10.1080/1389224X.2012.691785

Döll C, Döll P, Bots P (2013) Semi-quantitative actor-based modelling as a tool to assess the drivers of change and physical variables in participatory integrated assessments. Environ Model Softw 46:21–32. doi: 10.1016/j.envsoft.2013.01.016

Dollery B, Crase L, Grant BJ (2011) The local capacity, local community and local governance dimensions of sustainability in Australian local government. Commonw J Local Gov. doi: 10.5130/cjlg.v0i8/9.2423

Dollery B, Kortt MA, Crase L (2014) Community council cooperation: the lake Macquarie city council co-governance delegation model. Int J Public Adm 37:747–755. doi: 10.1080/01900692.2014.903274

Dollery B, Moppett W, Crase L (2006) Spontaneous structural reform in Australian local government: the case of the Gilgandra co-operative model in New South Wales. Aust Geogr 37:395–409. doi: 10.1080/00049180600954807

Edelenbos J, Van Buuren A, Klijn E. (2013) Connective capacities of network managers. Public Manag Rev 15:131–159.

Edelenbos J, van Buuren A, van Schie N (2011) Co-producing knowledge: joint knowledge production between experts, bureaucrats and stakeholders in Dutch water management projects. Environ Sci Policy 14:675–684. doi: 10.1016/j.envsci.2011.04.004

Edwards P, Lamshed S, Francey M (2007) Organisational change: transdisciplinarity in urban stormwater quality management programs. In: Rainwater and Urban Design. Engineers Australia, pp 216–223

Eisenhardt KM, Graebner ME (2007) Building Theories from Case Study Research. Opportunities and challenges. Acad Manag Rev 50:25–32. doi: 10.5465/AMR.1989.4308385

Elliott SJ (2011) The transdisciplinary knowledge journey: a suggested framework for research at the water-health nexus. Curr Opin Environ Sustain 3:527–530. doi: 10.1016/j.cosust.2011.10.005

Elzinga A (2008) Participation. In: Hadorn GH, Hoffmann-Riem H, Biber-Klemm S, et al. (eds) Handbook of transdisciplinary research. Springer Netherlands, Dordrecht, pp 345–359

Enengel B, Muhar A, Penker M, et al (2012) Co-production of knowledge in transdisciplinary doctoral theses on landscape development—An analysis of actor

roles and knowledge types in different research phases. Landsc Urban Plan 105:106–117. doi: 10.1016/j.landurbplan.2011.12.004

Eshuis J, Stuiver M (2005) Learning in context through conflict and alignment: farmers and scientists in search of sustainable agriculture. Agric Human Values 22:137–148.

European Commission (2002) Environment 2010: our future, our choice. The sixth environmental action programme.

Fam D, Mitchell C, Meeks T, Abeysuriya K (2013) Facilitating organisational learning to support decision making and planning for sustainability in the water sector. Water Policy 15:1094–1108.

Farrelly M., Brown R. (2008) Professional perceptions on institutional drivers and barriers to advancing diverse water options in Australia. In: Proc. 11th Int. Conf. Urban Drainage. Edinburgh, Scotland,

Flinterman J, Teclemariam-Mesbah, R Broerse J, Bunders J (2001) Transdisciplinary: the new challenge for bio- medical research. Bull Sci 21:253–266.

Forester J (1999) The deliberative practitioner: Encouraging participatory planning processes. MIT Press, London

Fratini CF, Elle M, Jensen MB, Mikkelsen PS (2012a) A conceptual framework for addressing complexity and unfolding transition dynamics when developing sustainable adaptation strategies in urban water management. Water Sci Technol 66:2393–401. doi: 10.2166/wst.2012.442

Fratini CF, Geldof GD, Kluck J, Mikkelsen PS (2012b) Three points approach (3PA) for urban flood risk management: A tool to support climate change adaptation through transdisciplinarity and multifunctionality. Urban Water J 9:317–331. doi: 10.1080/1573062x.2012.668913

Fry G (2001) Multifunctional landscapes - towards transdisciplinary research. Landsc Urban Plan 57:159–168.

Futter M, Keskitalo ECH, Ellison D, et al (2011) Forests, forestry and the water framework directive in Sweden: A Trans-disciplinary commentary. Forests 2:261–282. doi: 10.3390/f2010261

Gibbons M, Limoges C, Nowotny H, et al (1994) The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies. SAGE, London

Goggin ML, Bowman, A. O. M., Lester JP, O'Toole, L. J. J (1990) Implementation Theory and Practice: Toward a Third Generation. Scott, Foresman/Little, Brown Higher Education

Gómez-Baggethun E, Barton DN (2013) Classifying and valuing ecosystem services for urban planning. Ecol Econ 86:235–245. doi: 10.1016/j.ecolecon.2012.08.019

Gonzalez C, Clemente A, Nielsen KA, et al (2009) Human–Nature relationship in mediterranean streams: integrating different types of knowledge to improve water management. Ecol Soc 14:35.

Gratton L, Voight A, Erickson TJ (2007) Bridging faultlines in diverse teams. MIT Sloan Manag Rev 48:22.

Groot R De, Fisher B, Christie M, et al (2010) Integrating the ecological and economic dimensions in biodiversity and ecosystem service valuation.

Guzmán Ruiz A, Dobbie M, Brown R (2015) Insights and future directions of transdisciplinary practice in the urban water sector. J Environ Stud Sci. doi: 10.1007/s13412-015-0351-8

Haasnoot M, Middelkoop H, van Beek E, van Deursen WPA (2011) A method to develop sustainable water management strategies for an uncertain future. Sustain Dev 19:369–381. doi: 10.1002/sd.438

Häberli R, Grossenbacher-Mansuy (1998) Transdisziplinarität zwischen förderung und überforderung. Erkenntnisse aus dem SPP Umwelt. GAIA 7:196–213.

Hall KL, Stokols D, Moser RP, et al (2008) The collaboration readiness of transdisciplinary research teams and centers findings from the national cancer institute's TREC year-one evaluation study. Am J Prev Med 35:S161–72. doi: 10.1016/j.amepre.2008.03.035

Hall KL, Vogel AL, Stipelman B, et al (2012) A four-phase model of transdisciplinary team-based research: goals, team processes, and strategies. Transl Behav Med 2:415–430. doi: 10.1007/s13142-012-0167-y

Harding R, Hendriks CM, Faruqi M (2009) Environmental Decision-making: Exploring Complexity and Context. Federation Press, Sydney

Henderson C, Parke G, Spinks S, Breen P (2012) A Landscape Design Process for Bioretention Systems. http://www.gemsevents.com.au/stormwater2012/Resources/Website PDF/Henderson and Parke/A Landscape Design Process for Bioretention Systems 20121015 [Read-Only].pdf. Accessed 14 Jun 2013

Hernández-Morcillo M, Plieninger T, Bieling C (2013) An empirical review of cultural ecosystem service indicators. Ecol Indic 29:434–444. doi: 10.1016/j.ecolind.2013.01.013

Herndon S, Kreps GL (1993) Qualitative research : applications in organizational communication. Hampton Press ; Speech Communication Association, Cresskill, N.J. : Annandale, Va

Hirsch Hadorn G, Bradley D, Pohl C, et al (2006) Implications of transdisciplinarity for sustainability research. Ecol Econ 60:119–128. doi: 10.1016/j.ecolecon.2005.12.002

Hirsch Hadorn G, Hoffmann-Riem H, Biber-Klemm S, et al (eds) (2008) Handbook of Transdisciplinary. Springer, Bern, Switzerland

Huang JC, Newell S (2003) Knowledge integration processes and dynamics within the context of cross-functional projects. Int J Proj Manag 21:167–176. doi: 10.1016/S0263-7863(02)00091-1

Huili Gong J, Zhang, Demin Zhou Xiaojuan L, Yun P (2010) Hydroinformatics and ecohydrology tools for ecologically sustainable development in northern China. In: Hydrocomplexity: New Tools for Solving Wicked Water Problems Kovacs Colloquium. pp 129–136

Iglesias A, Buono F (2009) Towards sustainability of water policies in Mediterranean countries: evaluation approaches in the SWAP project. Curr Opin Environ Sustain 1:133–140. doi: 10.1016/j.cosust.2009.10.012

Irwin A, Simmons P, Walker G (1999) Faulty environments and risk reasoning: the local understanding of industrial hazards. Environ Plan A 31:1311–1326.

Ison R (2008) Methodological challenges of trans-disciplinary research: some systemic reflections. Natures Sci Sociétés 16:241–251. doi: 10.1051/nss:2008052

Jackson PM, Stainsby L (2000) Managing public sector networked organisations. Public Money Manag 20:11–16.

Jacobs I, Nienaber S (2011) Waters without borders : transboundary water governance and the role of the " transdisciplinary individual " in Southern Africa. In: Water Research Commission 40-Year Celebration Conference. Kempton Park, pp 665–678

Jahn T (2012) Transdisciplinarity as a research practice to approach sustainability challenges – A social-ecological perspective. In: Frankfurt am Main Leuphana Sustainability Summit. Lüneburg, p 10

Jahn T (2008) Transdisziplinarität in der Forschungspraxis. In: Bergmann M, Schramm E (eds) Transdisziplinäre Forschung Integrative Forschungsprozesse verstehen und bewerten. Campus Verlag, Frankfurt/New York, pp 21–37

Jahn T, Bergmann M, Keil F (2012) Transdisciplinarity: between mainstreaming and marginalization. Ecol Econ 79:1–10. doi: http://dx.doi.org/10.1016/j.ecolecon.2012.04.017

James P, Tzoulas K, Adams MD, et al (2009) Towards an integrated understanding of green space in the European built environment. Urban For Urban Green 8:65–75. doi: 10.1016/j.ufug.2009.02.001

Kato S, Ahern J (2009) Multifunctional Landscapes as a basis for sustainable landscape development. J Japanese Inst Landsc Archit 72:799–804. doi: 10.5632/jila.72.799

Kato S, Ahern J (2008) "Learning by doing": Adaptive planning as a strategy to address uncertainty in planning. J Environ Plan Manag 51:543–559.

Katzenbach JR, Smith DK (2001) The discipline of teams: A mindbook-workbook for delivering small group Performance. John Wiley & Sons, New York

King G, Strachan D, Tucker M, et al (2009) The application of a transdisciplinary model for early intervention services. Infants Young Child Vol. 22:211–223.

Kingdon JW (1995) Agendas, alternatives, and public policies. Harper Collins New York,

New York

Kingsford RT, Biggs HC, Pollard SR (2011) Strategic adaptive management in freshwater protected areas and their rivers. Biol Conserv 144:1194–1203. doi: 10.1016/j.biocon.2010.09.022

Klein J, Grossenbacher-Mansuy W, Rudolf H, et al (eds) (2001) Transdisciplinarity: Joint problem solving among science, technology, and Society: An effective way for managing complexity. Springer, Basel, Switzerland

Klein JT (2008) Evaluation of interdisciplinary and transdisciplinary research: a literature review. Am J Prev Med 35:S116–23. doi: 10.1016/j.amepre.2008.05.010

Klein JT (1990) Interdisciplinarity: history, theory, and practice. Detroit, Wayne State. University Press.

Kloot L, Martin J (2007) Public sector change, organisational culture and financial information: A study of local government. Aust J Public Adm 66:485–497.

Koppenjan J, Klijn E. (2004) Managing uncertainties in networks: a network approach to problem solving and decision making. Routledge, London, New York

Kötter R, Balsiger PW (1999) Interdisciplinarity and transdisciplinarity: a constant challenge to the sciences. Issues Integr Stud 87–120.

Kueffer C, Hadorn GH, Pohl C (2007) Towards a publication culture in transdisciplinary research. Gaia 16:22–26.

Kviberg K (2010) Value and price, a transdisciplinary approach to ecologically sustainable urban water management. University of Auckland

Landscape Institute (2009) Green infrastructure: connected and multifunctional landscapes. London

Lang D, Wiek A, Bergmann M, et al (2012) Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustain Sci 7:25–43. doi: 10.1007/s11625-011-0149-x

Lawrence AT (2002) The drivers of stakeholder engagement: reflections on the case of Royal Dutch/Shell. J Corp Citizsh 6:71–85.

Lawrence P, Shaw R, Lane L, Rowan E (2000) Participatory multiple objective decision making processes: emerging approaches with new challenges. In: Proceedings of the American Society for civil engineers (ASCE): Watershed management symposium. Collins CO, USA,

Lawrence RJ, Després C (2004) Futures of transdisciplinarity. Futures 36:397–405. doi: 10.1016/j.futures.2003.10.005

Leedy PD, Ormrod JE (2013) Practical research: planning and design. Pearson, Sydney, Australia

Levac D, Colquhoun H, O'Brien KK (2010) Scoping studies: Advancing the methodology. Implement Sci 5:69. doi: 10.1186/1748-5908-5-69

Lincoln YS, Guba EG (1985) Naturalistic Inquiry [Hardcover]. SAGE Publications; 1st edition

Ludwig R, Mauser W, Niemeyer S, et al (2003) Web-based modelling of energy, water and matter fluxes to support decision making in mesoscale catchments—the integrative perspective of GLOWA-Danube. Phys Chem Earth 28:621–634. doi: 10.1016/S1474-7065(03)00108-6

Lundy L, Wade R (2011) Integrating sciences to sustain urban ecosystem services. Prog Phys Geogr 35:653–669. doi: 10.1177/0309133311422464

Lynch AH, Griggs D, Joachim L, Walker J (2012) The role of the Yorta Yorta people in clarifying the common interest in sustainable management of the Murray–Darling Basin, Australia. Policy Sci 46:109–123.

Lyons (2005) Inquiry into Local Government Consultation paper and Interim Report. London

Mackay L (1992) Working and co-operating in hospital practice. J Interprof Care 6:127–131.

Marrickville LC (2013) Marrickville matters. Marrickv. Counc. 29:16.

Matos Castaño J, Hartmann T, Dewulf GPMR, van Huffelen-de Kort IAT (2015) "What is going on and what should we do?" Divergent frames in multifunctional projects. Eng

Proj Organ J 1–13. doi: 10.1080/21573727.2014.997712

Max-Neef M (2005) Foundations of transdisciplinarity. Ecol Econ 53:5–16. doi: 10.1016/j.ecolecon.2005.01.014

Meijerink S, Huitema D (2010) Policy entrepreneurs and change strategies: lessons from sixteen case studies of water transitions around the globe.

Miles MB, Huberman AM (1994) Qualitative data analysis, Second. SAGE, London

Mintrom M (2000) Policy entrepreneurs and school choice. Georgetown University Press, Washington, D.C

Mitchell VG (2006) Applying integrated urban water management concepts: a review of Australian experience. Environ Manage 37:589–605. doi: 10.1007/s00267-004-0252-1

Mobjörk M (2010) Consulting versus participatory transdisciplinarity: a refined classification of transdisciplinary research. Futures 42:866–873. doi: 10.1016/j.futures.2010.03.003

Mollinga PP (2009) Towards the transdisciplinary engineer: incorporating ecology, equity and democracy concerns into water professionals' attitudes, skills and knowledge. Irrig Drain 58:S195–S204. doi: 10.1002/ird.510

Mollinga PP (2010) Transdisciplinary method for water pollution and human health research. Bonn: ZEF

Morgeson FP, DeRue DS, Karam EP (2009) Leadership in teams: a functional approach to understanding leadership structures and processes. J Manage XX:1–39.

Morison PJ (2009) Management of urban stormwater: advancing program design and evaluation. Monash University

Morison PJ, Brown RR (2011) Understanding the nature of publics and local policy commitment to water sensitive urban design. Landsc Urban Plan 99:83–92. doi: 10.1016/j.landurbplan.2010.08.019

Mouritz M (2000) Water sensitive urban design—where to now? In: Proceedings of the Water Sensitive Urban Design Workshop. Melbourne, Australia,

Munasinghe M (2001) Exploring the linkages between climate change and sustainable development: A challenge for transdisciplinary research. Conserv Ecol 5:14.

Nader L (1980) The vertical slice: Hierarchies and children. In: Britan GM, Cohen R (eds) Hierarchy and society : anthropological perspectives on bureaucracy, Institute. Philadelphia,

NAS/NAE/IOM (2005) Facilitating Interdisciplinary Research. The National Academies Press, Washington D.C

Naumann S, Davis M, Kaphengst T, et al (2011) Design , implementation and cost elements of Green Infrastructure projects.

Naveh Z (2001) Ten major premises for a holistic conception of multifunctional landscapes. Landsc Urban Plan 57:269–284. doi: 10.1016/S0169-2046(01)00209-2

Nicolescu B (2002) Manifesto of transdisciplinarity. New York

Nicolescu B (2006) Transdisciplinarity - past, present and future. In: Haverkor B, Reijntjes C (eds) Moving Worldviews - Reshaping sciences, policies and practices for endogenous sustainable development,. Compas Editions, Leusden, Netherlands, pp 142–166

Nienaber S, Jacobs I (2010) The adventure of working together: promoting transdisciplinarity between young water scientists. Water Wheel 9:40–41.

Norman R, Currow D (eds) (2005) Supportive care for the urology patient. Oxford University Press, Oxford New York

O'Farrell PJ, Anderson PM (2010) Sustainable multifunctional landscapes: a review to implementation. Curr Opin Environ Sustain 2:59–65. doi: 10.1016/j.cosust.2010.02.005

Olsson P, Folke C, Hughes T. (2008) Navigating the transition to ecosystem based management of the great barrier reef, Australia. Proc Natl Acad Sci U S A 105:94.

Olsson P, Gunderson LH, Carpenter SR, et al (2006) Shooting the rapids: navigating transitions to adaptive governance of social-ecological systems. Ecol Soc 11:18.

Pahl-Wostl C, Hare M (2004) Processes of social learning in integrated resources

management. J Community Appl Soc Psychol 14:193–206.

Palang H (2003) How does an elephant look like? Some experiences and some more fears about interdisciplinary landscape research. In: Tress B, Tress G, van der Valk A, Fry G (eds) Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations. Alterra Green World Research, Delta Series, pp 55–58

Palmen MJ (2011) An exploration of transdisciplinary ontology as a foundation for sustainable development practice. University of Cambridge

Patterson J, Lukasiewicz A, Wallis PJ, et al (2013) Tapping fresh currents: Fostering early-career researchers in transdisciplinary water governance research. Water Altern 6:293–312.

Pawson R (2002) Evidence-based policy: In search of a method. Evaluation 8:157–181.

Payton RW, Barr JJF, Martin A, et al (2003) Contrasting approaches to integrating indigenous knowledge about soils and scientific soil survey in East Africa and Bangladesh. Geoderma 111:355–386. doi: 10.1016/S0016-7061(02)00272-0

Pennington D (2008) Cross-disciplinary collaboration and learning. Ecol Soc 13:8.

Petts J, Owens S, Bulkeley H (2008) Crossing boundaries: interdisciplinarity in the context of urban environments. Geoforum 39:593–601. doi: 10.1016/j.geoforum.2006.02.008

Pillora S, Blackburn N, Artist S (2009) Barriers and drivers to sustainability in local government. Sydney, Australia

Pini B, Haslam Mckenzie FM (2007) Access and local government research: methodological reflections. Local Environ 12:31–42.

Pirrie A, Wilson V, Elsegood J, et al (1998) Evaluating multidisciplinary education in health care. Scottish Council for Research in Education, Edinburgh

Plastow NA, Boyes C (2006) Unidisciplinary CPD in a multidisciplinary world: experiences from practice.

Pohl C (2008) From science to policy through transdisciplinary research. Environ Sci Policy 11:46–53.

Pohl C, Hadorn GH (2008a) Core Terms in Transdisciplinary Research. In: Hadorn GH, Hoffmann-Riem H, Biber-Klemm S, et al. (eds) Handbook of transdisciplinary research. pp 427–432

Pohl C, Hadorn GH (2007) Principles for designing transdisciplinary research: proposed by the Swiss Academies of Arts and Sciences. Academies Swiss of Arts and Sciences, Munich, Germany

Pohl C, Hadorn GH (2008b) Methodological challenges of transdisciplinary research. Natures Sci Sociétés 2:111–121.

Potschin M, Haines-Young R (2006) 'Rio+10? sustainable science and landscape ecology. Landsc Urban Plan 75:162–175.

Ramadier T (2004) Transdisciplinarity and its challenges: the case of urban studies. Futures 36:423–439. doi: 10.1016/j.futures.2003.10.009

Rapport MJK, McWilliam RA, Smith BJ (2004) Practices across disciplines in early intervention: the research base. Infants Young Child 17:32–44.

Renner R, Schneider F, Hohenwallner D, et al (2013) Meeting the challenges of transdisciplinary knowledge production for sustainable water governance. Mt Res Dev 33:234–247. doi: 10.1659/MRD-JOURNAL-D-13-00002.1

Resweber JP (2000) Le pari de la transdisciplinarité: vers l'intégration des savoirs. L'Harmattan, Paris

Rijke J (2014) Delivering change. Towards fit for purpose governance of adaptation to flooding and drought. Unesco-IHE Institute for Water Education, Delft University of Technology

Roberts NC (1992) Public entrepreneurship and innovation. Rev Policy Res 11:55–74.

Rodenburg CA, Nijkamp P (2004) Multifunctional Land Use in the City: A Typological Overview. Built Environ 30:274–288. doi: 10.2148/benv.30.4.274.57152

Rosenfield PL (1992) The potential of transdisciplinary research for sustaining and extending linkages between the health and social sciences. Soc Sci Med 35:1343–1357. doi: 10.1016/0277-9536(92)90038-R

Rossman G, Rallis S. (1998) Learning in the field: An introduction to qualitative research. Sage, Thousand Oak,CA

Rouse MJ, Daellenbach US (1999) Rethinking research methods for the resource-based perspective: isolating sources of sustainable competitive advantage. Strateg Manag J 20:487–494.

Roux DJ, Stirzaker RJ, Breen CM, et al (2010) Framework for participative reflection on the accomplishment of transdisciplinary research programs. Environ Sci Policy 13:733–741. doi: 10.1016/j.envsci.2010.08.002

Roy A., Wenger S., Fletcher T., et al (2008) Impediments and solutions to sustainable, watershed-scale urban stormwater management: lessons from Australia and the United States. Environ Manage 42:344–359.

Russell AW, Wickson F, Carew AL (2008) Transdisciplinarity: context, contradictions and capacity. Futures 40:460–472. doi: 10.1016/j.futures.2007.10.005

Ryan R (2014) Innovative Citizen Involvement for Creating Public Value in Local Government. J African Asian Local Gov Stud 3:35–51.

Ryan-Vincek S, Tuesday-Heathfield L, Lamorey S (1995) From theory to practice: a pilot study of team members' perspectives on transdisciplinary service delivery. Infant-Toddler Interv Transdiscipl J 5:153–175.

Schatzman L, Strauss A. (1973) Field research: strategies for a natural sociology. Prentice Hall, Englewood Cliffs

Scholz R (1995) Zur theorie der fallstudie. In: Scholz R, Koller T, Mieg H, Schmidlin C (eds) Perspektive "'Grosses Moos'" Wege zu einer nachhaltigen Landwirtschaft. UNS- Fallstudie, pp 39–46

Scholz RW (2015) Transdisciplinarity as a method of science-practice collaboration: Definition(s), prerequisites and challenges in the start-up phase. In: 1st JPI Climate Joint Call Kick-off meeting. Brussels,

Scholz RW, Lang DJ, Wiek A, et al (2006) Transdisciplinary case studies as a means of sustainability learning: Historical framework and theory. Int J Sustain High Educ 7:226–251.

Scholz RW, Marks D (2001) Learning about Transdisciplinarity: Where are we? Where have we been? Where should we go? In: Klein JT, Grossenbacher-Mansuy W, Häberli R, et al. (eds) Transdisciplinarity: Joint Problem Solving among Science, Technology, and Society. Basel: Birkhäuser Verlag AG, pp 236–252

Scholz RW, Mieg H., Oswald J. (2000) Transdisciplinarity in groundwater management – towards mutual learning of science and society. Water Air Soil Pollut 477–487.

Scholz RW, Steiner G (2015) The real type and ideal type of transdisciplinary processes: part I—theoretical foundations. Sustain Sci 10:527–544. doi: 10.1007/s11625-015-0326-4

Scholz RW, Tieje O (2002) Embedded Case Study Methods: Integrating Quantitative and Qualitative Knowledge. SAGE

Schummer J (2004) Interdisciplinary issues in nanoscale research. In: Baird D, Nordmann A, Schumman J (eds) Discovering the nanoscale. IOS Press, Amsterdam, pp 9–20

Sevenant M, Antrop M (2010) Transdisciplinary landscape planning: does the public have aspirations? Experiences from a case study in Ghent (Flanders, Belgium). Land use policy 27:373–386. doi: 10.1016/j.landusepol.2009.05.005

Silverman D (2005) Doing qualitative research: a practical handbook. SAGE Publications, London

Stake RE (1995) The Art of Case Study Research. SAGE, Thousand Oaks

Stauffacher M, Flüeler T, Krütli P, Scholz RW (2008) Analytic and dynamic approach to collaboration: a transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. Syst Pract Action Res 21:409–422. doi: 10.1007/s11213-008-9107-7

Stoecker R (1991) Evaluating and rethinking the case study. Sociol Rev 39:88–112.

Stokols D (2006) Toward a science of transdisciplinary action research. Am J Community Psychol 38:63–77. doi: 10.1007/s10464-006-9060-5

Stokols D (1998) Barriers to transdisciplinarity research in youth tabacco use prevention.

Stokols D, Fuqua J, Gress J, et al (2003) Evaluating transdisciplinary science. Nicotine

Tob Res 5 Suppl 1:S21–39. doi: 10.1080/14622200310001625555

Stokols D, Hall KL, Taylor BK, Moser RP (2008a) The science of team science: overview of the field and introduction to the supplement. Am J Prev Med 35:S77–89. doi: 10.1016/j.amepre.2008.05.002

Stokols D, Harvey R, Gress J, et al (2005) In vivo studies of transdisciplinary scientific collaboration lessons learned and implications for active living research. Am J Prev Med 28:202–213. doi: 10.1016/j.amepre.2004.10.016

Stokols D, Misra S, Moser RP, et al (2008b) The ecology of team science: understanding contextual influences on transdisciplinary collaboration. Am J Prev Med 35:S96–115. doi: 10.1016/j.amepre.2008.05.003

Stubbs W, Cocklin C (2008) Conceptualizing a “Sustainability Business Model.” Organ Environ 21:103–127. doi: 10.1177/1086026608318042

Suddaby R, Greenwood R (2005) Rhetorical strategies of legitimacy. Adm Sci Q 50:35–67.

Swiss Academies of Art and Sciences (2013) Td-net network for transdisciplinary Research. http://www.transdisciplinarity.ch/e/Transdisciplinarity/TRdefinitions.

Taylor A (2010) Building leadership capacity to drive sustainable water management: The evaluation of a customised program. Water Sci Technol 61:27972–807.

Taylor A, Cocklin C, Brown R, Wilson-Evered E (2011) An investigation of champion-driven leadership processes. Leadersh Q 22:412–433. doi: 10.1016/j.leaqua.2011.02.014

TEEB - The Economics of Ecosystems and Biodiversity (2011) TEEB Manual for Cities: Ecosystem Services in Urban Management.

Tejada-Guibert J., Maksimovic C (2003) Urban water issues – An international perspective. In: Lawford R., Fort D., Hartmann H., Eden.S (eds) Water: Science, Policy, and Management: Challenges and Opportunities. American Geophysical Union, Washington D.C, pp 43–77

Thornton P, Ocasio W, Lounsbury M (2012) The institutional logics perspective: A new approach to culture, structure and process. Oxford University Press, Oxford

Titz A, Döll P (2009) Actor modelling and its contribution to the development of integrative strategies for management of pharmaceuticals in drinking water. Soc Sci Med 68:672–81. doi: 10.1016/j.socscimed.2008.11.031

Tötzer T, Sedlacek S, Knoflacher M (2011) Designing the future: a reflection of a transdisciplinary case study in Austria. Futures 43:840–852. doi: 10.1016/j.futures.2011.05.026

Tress B, Tress G (2001) Capitalising on multiplicity: a transdisciplinary systems approach to landscape research. Landsc Urban Plan 57:143–157. doi: 10.1016/S0169-2046(01)00200-6

Tress B, Tress G, H D, D'Hauteserre A (2001) Bridging human and natural sciences in landscape research. Landsc Urban Plan 57:137–141.

Tress B, Tress G, van der walk A, Fry G (eds) (2003) Interdisciplinary and transdisciplinary landscape studies: potential and limitations. Delta Series 2, Wageningen

Uhrwing M (2003) MISTRA and interdisciplinarity – Experiences and expectations. In: Tress B, Tress G, van der Valk A, Fry G (eds) Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations, Delta Prog. Wageningen, pp 28–32

US Army Corps Multipurpose planning Module M1: Multi-purpose Plan Formulation – Policies and Constraints.

van Herk S, Zevenbergen C, Rijke J, Ashley R (2011) Collaborative research to support transition towards integrating flood risk management in urban development. J Flood Risk Manag 4:306–317. doi: 10.1111/j.1753-318X.2011.01113.x

van Mansfeld M (2003) The need for knowledge brokers. In: Tress B, Tress G, van der Valk A, Fry G (eds) Interdisciplinary and Transdisciplinary Landscape Studies: Potential and Limitations. Delta Series 2, Wageningen, The Netherlands, pp 33–39

van Rijnsoever FJ, Hessels LK (2011) Factors associated with disciplinary and interdisciplinary research collaboration. Res Policy 40:463–472. doi: 10.1016/j.respol.2010.11.001

Wächter M (2003) The "social-ecological research" Program. In: Tress B, Tress G, van der Valk A, Fry G (eds) Interdisciplinary and Transdisciplinary Landscape Studies:

Potential and Limitations. Wageningen, Alterra Green World Research, Delta, pp 19–27

Walter AI, Helgenberger S, Wiek A, Scholz RW (2007) Measuring societal effects of transdisciplinary research projects: design and application of an evaluation method. Eval Program Plann 30:325–38. doi: 10.1016/j.evalprogplan.2007.08.002

Wen B, van der Zouwen M, Horlings E, et al (2014) Transitions in urban water management and patterns of international, interdisciplinary and intersectoral collaboration in urban water science. Environ Innov Soc Transitions. doi: 10.1016/j.eist.2014.03.002

Wickson F, Carew A., Russell AW (2006) Transdisciplinary research: characteristics, quandaries and quality. Futures 38:1046–1059. doi: 10.1016/j.futures.2006.02.011

Wiecha J, Pollard T (2004) The interdisciplinary eHealth team: chronic care for the future. J Med Internet Res 6:e22. doi: 10.2196/jmir.6.3.e22

Wiek A, Walter AI (2009) A transdisciplinary approach for formalized integrated planning and decision-making in complex systems. Eur J Oper Res 197:360–370. doi: 10.1016/j.ejor.2008.06.013

Williams P (2012) Collaboration in public policy and practice: Perspectives on boundary spanners. Policy Press, Bristol

Wilson V, Pirrie A (2000a) Multidisciplinary teamworking: beyond the barriers? a review of the issues. Edinburgh

Wilson V, Pirrie A (2000b) Multidisciplinary teamworking indicators of good practice. Spotlight 77 1–4.

Wolcott H. (1994) Transforming Qualitative Data: Description, Analysis, and Interpretation [Paperback]. SAGE Publications, Inc

Wong T, Brown RR (2009) The water sensitive city: principles for practice. Water Sci Technol 60:673–82. doi: 10.2166/wst.2009.436

Wong T, Deletic A, Brown RR (2011) An inter-disciplinary research program for building water sensitive cities. In: 12th International Conference on Urban Drainage,. Porto

Alegre, Brazil, pp 11–16

World Bank (2011) Decentralisation: what, why, and where. http://www1.worldbank.org/publicsector/decentralization/what.htm. Accessed 12 Mar 2014

Yin RK (2009) Case Study Research: Design and Methods. SAGE Publications, Thousand Oaks

Zalewski M (2014) Ecohydrology, biotechnology and engineering for cost efficiency in reaching the sustainability of biogeosphere. Ecohydrol Hydrobiol 14:14–20. doi: 10.1016/j.ecohyd.2014.01.006

Zalewski M, Harper D, Wagner I (2009) Ecohydrology – why demonstration projects throughout the world? Ecohydrol Hydrobiol 9:3–11. doi: 10.2478/v10104-009-0043-7

Appendix A Online Resource 1 Information matrix and analytical framework

Insights and future directions of transdisciplinary practice in the urban water sector

Journal of Environmental Studies and Sciences

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Group of transdisciplinary research in the water sector

Subgroup	Title	Aim of study	Methodology	Year	Author´s affiliations
Definitions, principles, concepts or differences with other disciplines	The role of contestable concepts in transdisciplinary management of water in the landscape	Emphazise in contestable concepts around transdisciplinary dialogues	Case studies	2005	Researchers
	Transdisciplinarity in groundwater management - Towards mutual learning of science and society	Describe principles of transdisciplinarity in projects on groundwater and soil management	Participatory methods	2000	Researchers
	Transdisciplinary method for water pollution and human health research	Design principles and basic tools for inter- and transdisciplinary research are discussed in the context of 'water pollution and human health' research initiative	Literature review	2010	Researchers
Tools, models or frameworks	Web-based modelling of energy, water and matter fluxes to support decision making in mesoscale catchments-the integrative perspective of GLOWA-Danube	Identify, examine and develop new techniques for the integration of natural and socio-economic sciences and integrated decision support system to investigate the sustainability of future water use on a catchment	Computational methods, interfaces, software development	2003	Researchers
	Semi-quantitative actor-based modelling as a tool to assess the drivers of change and physical variables in participatory integrated assessments	Develop a semi-quantitative approach for actor-based modelling. This approach includes actions of societal actors based on their problem perceptions and effects on physical system variables	DANA software	2013	Researchers
	Strategic Adaptive Management in freshwater protected areas and their rivers	Outline stages of an strategic adaptative management process for aquatic protected areas and implement the stages in South Africa	Case studies	2011	Researchers and practitioners

		and Australia			
	Participatory multiple objective decision making processes: Emerging Approaches with New Challenges	Description of multi-stakeholder, participatory decision making approach to evaluate water infrastructure in Australia	Working gruops, software tool	2000	Researchers
	The transdisciplinary knowledge journey: a suggested framework for research at the water-health nexus	Outline the water-health crisis and review the importance of the knowledge journey with respect to linking evidence with action	Literature review	2011	Researchers
Outcomes and experiences of transdisciplinary processes	Human-nature relationship in mediterranean streams: Integrating different types of knowledge to improve water management	Present studies of human–nature relationship in Mediterranean streams emphasizing on interdisciplinary and transdisciplinary integration	Case study, value survey and analysis of discourse; biomonitoring and integrity biotic indexes	2009	Researchers
	Motueka Catchment futures, transdisciplinarity, a local sustainability problématique and the Achilles-heel of Western science	Evaluate catchment futures model using comparative classical Western and transdisciplinary epistemologies	Input-output economy-environment model and a system-dynamic population model	2006	Researchers
Outcomes and experiences of transdisciplinary processes	A Framing Approach to Cross-disciplinary Research Collaboration: Experiences from a Large-scale Research Project on Adaptive Water Management	Outline a framing approach to cross-disciplinary research emphasizing on different frames that researchers use to to make sense of the issues they want to research jointly in large-scale project	Multiple qualitative methods	2007	Researchers
	Integrating social and ecological knowledge for planning sustainable land- and sea-scapes: Experiences from the Great Barrier Reef region, Australia	Analyze tools, processes and outcomes of a water quality improvement plan in order to achieve knowledge integration for planning sustainable land-and sea-scapes	Interviews, workshops	2010	Researchers
	Towards sustainability of water policies in Mediterranean countries: evaluation approaches in the SWAP project	Review, discuss and outline challenges of several evaluation approaches and tools for water policy evaluation. Discuss a framework to evaluate the sustainability of water policy based on transdisciplinary participation	Case studies	2009	Researchers
	Actor modelling and its contribution to the development of integrative strategies for management of pharmaceuticals in drinking water	Develop an integrative strategy by the participation of key actors in the problem field “pharmaceuticals in drinking water.”Describe and apply a novel modelling method for identifying	Dana software	2008	Researchers

		an integrative risk management strategy			
	A transdisciplinary analysis of water problems in the mountainous karst areas of Morocco	Understand and predict characteristics and availability of water under changing climatic and agricultural conditions	Measuring and mapping techniques	2008	Researchers
	Meeting the challenges of transdisciplinary knowledge production for sustainable water governance	Identify strategies for addressing challenges related to transdisciplinary knowledge production in water governance research projects	Workshops and interviews	2013	Researchers
Broad transdisciplinary scope	A method to develop sustainable water management strategies for an uncertain future	Describe a method for the development of sustainable water management strategies under uncertainty including physical, socio-economic and social systems	Hypothetical case	2011	Researchers
	Promoting health and well-being by managing for social-scological resilience: The potential of integrating ecohealth and water resources management approaches	Present ideas from complexity science to conceptualize environment and health relationships including watersheds as units for management of such relationships and discuss the potential of managing for human health and well-being based on understanding social– ecological resilience	Literature review	2011	Researchers
	Forests, forestry and the water framework directive in Sweden: A trans-disciplinary commentary	Present a transdisciplinary overview of the water framework directive and its implications for forests and forestry in Sweden	Workshops	2011	Researchers
	Learning by doing': Adaptive planning as a strategy to address uncertainty in planning	Identify uncertainties in landscape planning. Address the uncertainty by an adaptive planning method applied in the context of water resource planning	Literature review and adaptive planning method	2008	Researchers
Narrow transdisciplinary scope	Hydroinformatics and ecohydrology tools for ecologically sustainable development in northern China	Review of current conditions and problems of ecohydrology in China and develop of a transdisciplinary ecohydrological framework for future research	Literature review	2010	Researchers
	Ecohydrology - Why demonstration projects throughout the world?	Analysis of demostration projects on ecohydrology and recent advances	Literature review	2009	Researchers

	From Joint Experimentation to Laissez-faire: Transdisciplinary Innovation Research for the Institutional Strengthening of a Water Users Association in Khorezm, Uzbekistan	Evaluate a participatory action and innovation research experience in which different actors came together to test and adapt a social mobilization and institutional strengthening approach according to the local context	Joint experimentation	2012	Researchers
Narrow transdisciplinary scope	Tapping fresh currents: Fostering early-career researchers in transdisciplinary water governance research	Investigate practical experiences and challenges faced by a diverse group of for early-career researchers engaging in water governance research	Auto-ethnographic inquiry	2013	Researchers
	A typology of graziers to inform a more targeted approach for developing natural resource management policies and agricultural extension programs	Develop a typology of graziers in a basin and explore its potential for supporting natural resource management policies and agricultural extension programs	Case study	2010	Researchers
	Ecohydrology, biotechnology and engineering for cost efficiency in reaching the sustainability of biogeosphere	Show examples of how ecohydrology as a fundamental pillar for integration of different environmental sciences might increase efficiency and reduce the costs of sustainable environmental management	Literature review	2014	Researchers
Group of transdisciplinary research in the urban water sector					
Subgroup	**Title**	**Aim of study**	**Methodology**	**Year**	**Author´s affiliations**
Definitions, principles, concepts or differences with other disciplines	Transdisciplinarity and its challenges: the case of urban studies	Analysis of concepts of transdisciplinarity, representation and perception of urban space base on studies on Canadian suburbs	Literature review	2004	Researchers
Tools, models or frameworks	A conceptual framework for addressing complexity and unfolding transition dynamics when developing sustainable adaptation strategies in urban water management	Introduces a conceptual framework to facilitate the integration of different disciplinary approaches and epistemologies into both urban water management research and practice	Literature review and observations	2012	Researchers
	Three Points Approach (3PA) for urban flood risk management: A tool to support climate change adaptation through transdisciplinarity and multifunctionality	An approach to improve communication between stakeholders and facilitate decision making processes	Interviews	2012	Researchers and practitioners
	Towards an integrated understanding of green space in the European built environment	Create an integrated framework for multidisciplinary and interdisciplinary research on urban green space and catalogue of key research questions in	Delphi technique, email-mediated discussions and symposium	2009	Researchers

		this field			
Outcomes and experiences of transdisciplinary processes	Designing the future—A reflection of a transdisciplinary case study in Austria	Present a transdisciplinary case study to build sustainable structures and regional networks in Steyr (Austria)	Interviews, photo elicitation, workshops and scenario building	2011	Researchers and regional stakeholders
	Transitions in urban water management and patterns of international, interdisciplinary and intersectoral collaboration in urban water science	Explore cross- boundary interactions in professional networks and changes in the knowledge production towards more collaborative patterns in urban water science	Professional interaction networks; scientific output,social network and bibliometric techniques	2013	Researchers
	Collaborative planning for retrofitting suburbs: transdisciplinarity and intersubjectivityin action	Present a transdisciplinary research program and collaborative planning process for the future of Quebec (Canada)	Empirical research, action research	2004	Researchers
	Implementing transdisciplinarity: Architecture and urban planning at work	Illustrate how an Interdisciplinary Research Group on Suburbs bypass the rigidity of academic disciplinary training and narrow the gap between research and practice	Literature review, face-to-face interviews, focus groups and survey	2011	Researchers
Broad transdisciplinary scope	Integrating sciences to sustain urban ecosystem services	Review of ecosystem services associated with water and create a framework for discussion	Case study	2011	Researchers
	Value and price: A transdisciplinary approach to urban water management	Examine and map people´s awareness, perceptions, attitudes and preferences	A system-based contingent valuation method	2010	Researchers
Narrow transdisciplinary scope	Climate change adaptive capacity in Santiago de Chile: Creating a governance regime for sustainability planning	Explore the governance challenges of adaptation in Santiago (Chile) in order to forge a more integrated adaptation response	Literature review	2013	Researcher
Narrow transdisciplinary scope	An Australian case study: Why a transdisciplinary framework is essential for integrated urban stormwater planning	Identify the implementation variables for building institutional capacity	Case study	2001	Researchers
Group of transdisciplinary practice in the water sector					
Subgroup	**Title**	**Aim of study**	**Methodology**	**Year**	**Author´s affiliations**

Outcomes and experiences of transdisciplinary processes	Co-engineering Participatory Water Management Processes: Theory and Insights from Australian and Bulgarian Interventions	Investigate co-engineering aspects of participatory water management through two interventions: a participatory risk- management process in Australia, and a participatory modeling process in Bulgaria	Literature review, intervention research	2010	Researchers and practitioners
Roles and skills that practitioners should have in transdisciplinary processes	Towards the transdisciplinary engineer: Incorporating ecology, equity and democracy concerns into water professionals' attitudes, skills and knowledge	Use transdisciplinary frameworks to define attitudes and skills of water professionals to address challenges to the agricultural water sector	Literature review	2009	Researchers
	Waters without borders : Transboundary water governance and the role of the ' transdisciplinary individual ' in Southern Africa	Interrogate cross-cutting role of water and need for transdisciplinary responses to regional socio-economic development in Southern Africa region. Examine the role of the individual and the internalisation of transdisciplinarity as a mindset beyond collective models	Literature review	2011	Researchers
	The role of the Yorta Yorta people in clarifying the common interest in sustainable management of the Murray–Darling Basin, Australia	Address whether the interests of indigenous can encompass and contribute to the common interest of the wider community in a basin	Triangulation strategy	2013	Researchers and practitioners
Group of transdisciplinary practice in the urban water sector					
Subgroup	**Title**	**Aim of study**	**Methodology**	**Year**	**Author´s affiliations**
Outcomes and experiences of transdisciplinary processes	Organisational change: Transdisciplinarity in urban stormwater quality management programs	Show examples of how the urban stormwater quality management (USQM) industry has adopted transdisciplinary theory	Case study, literature review	2007	Practitioners
	Facilitating organisational learning to support decision making and planning for sustainability in the water sector	Investigate the process of organisational learning in decision making and planning for sustainability in the water sector	Interviews, workshops	2013	Researchers and practitioners

Appendix B Criteria framework for projects delivering multifunctional landscapes

Criteria		Hargreaves mall	Williamstown high school bay view campus	Docklands Park	Royal park wetlands stormwater harvesting	Darling Gardens	Napier Park	Gum Scrub Creek Officer	Little stringybark Creek	Stormwater Management and Harvesting Banyule	Starlight reserve	Dobson Park and Tim Neville Arboretum	Boronia retardin Basin, Wetland and Master Plan	Sydney Park Stormwater Harvesting	Wildford Lane	Kays Avenue	Creek Filtration system	Mordialloc Industrial Precinct
Stage	In design															1		
	Under construction												1					
	Implemented	1	1	1	1	1		1		1	1	1		1	1		1	1
Scale and spatial elements	Streetscape and lanes	1				1									1	1		
	Precinct	1	1				1			1		1	1					1
	Creeks		1	1	1			1	1	1	1	1	1	1			1	1
	Wetlands		1	1	1			1		1	1	1	1	1			1	1
	Park			1			1	1		1	1	1	1	1			1	1
	Sportfield		1		1					1		1		1				1
	Forests						1	1			1					1	1	1
	Community gardens		1												1			
	Raingardens					1	1	1	1	1					1		1	1
	Rain tank									1					1			1
	Green building		1												1			
	Cultural heritage			1							1					1		
	Public art	1		1							1		1		1			
	Cycle ways	1		1	1			1						1	1			
	Porous pavements	1													1	1		1
	Trails	1	1	1	1			1			1	1	1	1	1	1	1	
Gradient of multifunctionality	Mono or single purpose project					1												
	Single purpose project with added benefits	1		1	1					1		1	1	1				
	Multiple purpose project		1					1			1				1	1	1	1
General objectives of the projects	Water quality/supply/ harvesting	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Climate regulation		1		1		1			1				1	1		1	1
	Biodiversity conservation or restoration		1		1		1	1	1	1	1			1		1	1	1
	Improve health of citizens	1	1	1	1	1	1	1		1	1	1	1	1	1	1	1	1
	Improve social interactions	1		1		1								1	1		1	
	Aesthetic	1	1	1		1								1	1	1	1	
Urban ecosystem services	Food supply														1			
	Water flow regulation/runo ff mitigation	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	Urban temperature				1		1		1	1				1	1		1	1
	Climate regulation				1		1		1	1				1	1		1	1
	Air purification				1													
	Noise regulation																	
	Waste		1						1									

Criteria		Hargreaves mall	Williamstown high school bay view campus	Docklands Park	Royal park wetlands stormwater harvesting	Darling Gardens	Napier Park	Gum Scrub Creek Officer	Little stringybark Creek	Stormwater Management and Harvesting Banyule	Starlight reserve	Dobson Park and Tim Neville Arboretum	Boronia retardin Basin, Wetland and Master Plan	Sydney Park Stormwater Harvesting	Wildford Lane	Kays Avenue	Creek Filtration system	Mordialloc Industrial Precinct
	treatment																	
	Pollination		1		1		1	1			1						1	1
	Animal sighting		1		1		1			1	1			1			1	1
	Attract wildlife diversity to the landscape		1		1			1		1	1			1	1	1	1	1
	Recreation and cognitive development	1	1	1	1			1			1	1	1	1	1	1	1	
	Tourism			1										1				
	Aesthetic appreciation		1	1	1	1	1	1			1	1	1	1	1	1	1	1
	Spiritual experience				1		1	1			1			1	1		1	1
Total		**13**	**20**	**16**	**20**	**9**	**15**	**17**	**8**	**17**	**18**	**12**	**12**	**22**	**24**	**14**	**23**	**10**

Appendix C Interview questionnaire

This interview is part of our research entitled: Towards understanding disciplinary processes and dynamics in the design of multifunctional projects. Before commencing this interview, it is a Monash University requirement that you read the following explanatory statement and consent form attached to this interview guide. The interview might take approximately 30-45 minutes. You are encouraged to speak freely and if you want to elaborate on a question in greater depth you are more than welcome to do so.

Once again, thank you for your assistance.

Yours Sincerely,

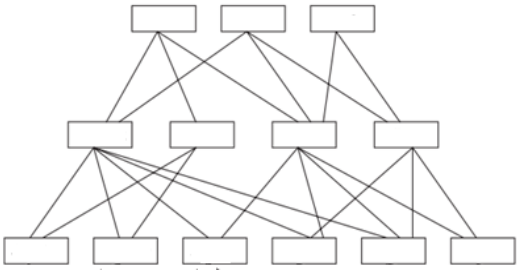
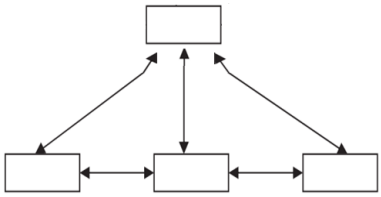
Ana Guzmán Ruiz, Professor Rebekah Brown and Doctor Meredith Dobbie

Profile of the interviewee
Name:
Date of the interview:
• **Professional profile**
What is your background?
• **Position in the organisation**
What is the department or division in which you work?
What is your position in this department?
• **Role in the organisation**

Could you please explain to me briefly what your main roles in the organisation
How long have you been working in the organisation?
Chronological development, key events and organizing processes that lead to the projects
What was your role in this project? Did this role change over time?
Could you explain briefly how did this project emerge?
What are the main key events of this project?

Could you describe how was the decision making process through the project?
Team dynamics
How many people were involved in the team? Did the team change over time?
Could you please tell me how was your experience working in this team?
How often did you communicate with other team members?

How did you describe the team?

a) Transdiciplinary teams	b)Multidisciplinary teams
	
c)Monodisciplinary teams	d) Interdisciplinary teams
	
Why?	

Did you have any issues or problems interacting as a team? What did you do?

Overall, how effectively did you think that this team work in this project?

Strategies employed by individuals to bring actors together and enable the projects
What do you think were the factors that allowed the development of this project?
What were the main limitations of the project?
How did you think that these limitations were managed?
Additional information
Is there anything more you would like to add?
Is there anything else I should have asked you in relation to this project?

If you would like to find out more information about this research or the outcomes of this interview, please do not hesitate to contact:

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