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Assessing the impact of transdisciplinary research: The usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact

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Abstract

There is a call for more transdisciplinary (TD) research, from academia, society, and funding agencies. Consequently, the field of TD research is searching for ways of proving the value and providing evidence to support the effectiveness of such research. The main challenge for evaluating TD research is attribution, that is how to link societal change to the TD research process. However, little attention has been paid to the relationship between the quality of the research process and the effects and impacts that are being evaluated. Building upon earlier attempts at evaluating TD research, this article tests three key aspects of effective sustainability research: its relevance, credibility, and legitimacy. To explore the link between the quality of process and societal effects, we analyze and compare outputs, outcomes, and impact of five TD projects. Overall, our analysis shows that while relevance, credibility, and legitimacy gave important insights regarding the links between process and impacts, they are not adequate for evaluating TD research impact. Process qualities such as practitioner motivation and perceived importance of the project, together with breadth of perspectives, the openness/flexibility of participants, and in-depth exchanges of expertise and knowledge, contributed to producing internally relevant, credible, and legitimate results. However, we also saw a need to develop the relevance, credibility, and legitimacy framework, in relation to the external dynamics of the project process, heterogeneous stakeholder groups, and the credibility of practice-based knowledge, which together with institutional factors and the political context significantly shape the possibility of impact.

Key words: societal impact; evaluation; sustainability; transdisciplinary research

1. Introduction

Different types of participatory and transdisciplinary (TD) research have been receiving increased attention as viable approaches to solving or contributing to solving current sustainability challenges in a variety of areas including natural resource management, urban and development studies, strategic regional planning, and responsible innovation (Walter et al. 2007; Pohl et al 2010; Watson 2014; Wickson and Carew 2014; Polk 2015a). All of these examples share a methodological focus on societal problem-solving through in-depth interactions between researchers and stakeholders, also referred to as TD research, participatory sustainability research, or transformative sustainability science (Robinson and Tansey 2006; Talwar et al. 2011; Wiek et al. 2014). In this article, we will use the term TD research to refer to problem-solving research where scientific knowledge is combined with values, knowledge, and know-how from practitioner-based practice through in-depth inclusive processes. A great deal of the literature on TD research has focused on developing and testing methods and frameworks for participation (Pohl and Hirsch Hadorn 2007; Bergmann et al. 2012; Lang et al. 2012; Polk 2015b). However, as the field develops, there is growing interest in questioning the assumptions regarding how societal impact from TD research can be identified and assessed, as well as

how, and to what extent, different types of participation contribute to sustainability and/or other types of societal impact (Walter et al 2007; Polk 2014; Wiek et al. 2014; Hellström 2015; Westberg and Polk 2016). A number of TD studies have concluded that the development of TD approaches is limited by the lack of quality criteria for assessment, which in turn affects its methodological and theoretical development as well as its ability to attract funds and educate future researchers and practitioners (Bergmann et al. 2005; Feller 2006; Carew and Wickson 2010; Jahn and Keil 2015; Belcher et al. 2016). If the quality of TD research includes impact on the problem under scrutiny, then the link between the research process, its products, and contributions to transformational change needs to be better understood.

This article focuses on how to evaluate and develop the quality of TD research, particularly the link between the research process and its societal impact. Historically, TD research has been evaluated either with the same methods as disciplinary research or 'against its extra-academic objectives', what Wiek et al. 2014 refer to as 'societal effects', that are of practical interest to society. Numerous studies have developed criteria and methods for evaluation that focus on design, process, and/or impact (Walter et al 2007; Wiek et al 2012; Wiek et al. 2014; Belcher et al. 2016). More recent studies focus on outlining both effect categories, such as increasing capacity, building of networks, and structural change, and participatory features, such as process qualities. They also include compilations of criterion based on extensive literature reviews of the current state of the art (Klein 2008; Wiek et al. 2014; Belcher et al. 2016). In his 2013 literature survey, Bornmann concludes that there are still no comparable metrics that can capture societal impact and that the case study approach is so far the most apt for assessing the complexity of societal impact, despite its high cost and lack of comparability (Bornmann 2013; see also Koier and Horlings 2015).

One of the widely cited characteristics of TD research is the collaboration between societal stakeholders and researchers and the assumption that this collaboration results in more socially robust results, actionable knowledge, or sustainable outcomes (Wickson et al. 2006; Pohl and Hirsch Hadorn 2007; Wiek et al. 2012; Bornmann 2013; Polk 2014; de Jong et al. 2016). While a lot of attention has been given to methods for TD research, less attention has been paid to the relationship between the quality of TD research processes, especially regarding stakeholder participation, and its influence on the impacts and outcomes that are being evaluated (Pohl and Hirsch Hadorn 2007). Wiek et al. (2014: 119) note a lack of empirical evidence on 'the specific benefits and the critical participatory components' that are favorable to sustainability research. Blackstock et al. (2007: 729), as well as others, have called for an unpacking of 'the assumed relationship between participatory research for sustainability science and the transition to sustainability' (Polk 2014; Westberg and Polk 2016).

In a recent approach, Belcher et al. (2016) develop the conceptualization by Cash et al. (2002) of four key aspects of effective sustainability research, namely: salience (or relevance), credibility, legitimacy, and effectiveness. Belcher et al. consider these four principles as 'necessary attributes for research to successfully produce transferable, useful information that can cross boundaries between disciplines, across scales, and between science and society' (Belcher et al. 2016: 8). The overall aim of this article is to build upon such approaches to increase our understanding of the relationship between the quality of TD research process (their participatory features) and their societal effects. Based on criteria suggested in Cash et al. (2002) (and applied in Belcher et al. 2016), this article takes its point of departure in the difficulty of having research results affect policy and practice, particularly due to contextual constraints (Cash et al. 2003: 8089). It will test if such approaches, which were largely developed from within the science–policy discourse, can be applied to evaluating the contributions of a TD approach to societal impact.

Our overall interest is to identify ways of working throughout the research process that will increase the potential for societal impacts. Previous studies seem to assume that stakeholders can implement usable results once they understand their relevance, and find them credible and legitimate (Cash et al. 2002; Polk 2014; Belcher et al. 2016). In a recent study, de Jong et al. show the link between certain participatory features and types of impact but conclude that more than half of the variance in impact remains to be explained (de Jong et al. 2016). Bornmann concludes that lack of impact should not be interpreted as 'uselessness' but must be understood in terms of conditions, context, and efforts of the involved institutions (Godin and Doré 2005). Cash et al. (2002) problematize such assumptions by adding the element of boundaries to explore contextual and institutional factors in the application of knowledge in decision-making organizations. We see a need to further explore the link between internal and external project dynamics and external effects by assessing the quality of participatory research processes and their results in specific situated contexts. To do so, this article builds on an empirical investigation and comparison of five TD research projects conducted at Mistra Urban Futures[1], a TD center for sustainable urban development located in Gothenburg, Sweden. Interviews with project participants are analyzed in relation to interviews made with coordinators of Mistra Urban Futures partner organizations regarding how the practitioner representatives value the project results.

In the following we will review the literature regarding the evaluation of TD research and the links between collaborative processes and impact. Thereafter we will lay out our analytical framework, developed from this review, before we present our results.

2. Evaluating TD research and assessing the links between participatory processes and societal outcomes

The quality of TD research is difficult to define as criteria from a range of disciplines and practice-based needs are involved (Carew and Wickson 2010; Belcher et al. 2016). A particular challenge is, on the one hand, to find standardized quality measures and, on the other, to encourage the innovative character of the field (Wickson and Carew 2014; Belcher et al. 2016). Emerging literature on evaluation in TD research has developed a range of quality criteria focusing on input and support, as well as process, output, outcomes, and impact (Defila and Di Giulio 1999; Bergmann et al. 2005; Wickson et al. 2006; Klein 2008; Carew and Wickson 2010; Roux et al. 2010; de Jong et al. 2011; Spaapen and Van Drooge 2011; Wiek et al. 2014). Studies on TD evaluation continually emphasize the importance of the contextual and emergent characteristics of TD research that cannot be limited by the implementation of predefined quality criteria or scientific standards (Walter et al. 2007; Bornmann 2013; Hellström 2015; Koier and Horlings 2015; Belcher et al. 2016).

TD approaches, it is argued, require different quality measures because of their normative, problem-solving character that aim to

integrate different types of knowledge, which are relevant, reflective, and negotiated (Klein 2008; Wiek et al. 2014). Much TD evaluation research therefore focuses on a broader quality assessment that includes relevance and societal effects. Disciplinary assessment, with its focus on methodological rigor, originality, and scientific excellence, assessed through peer review and bibliometric measures, is considered insufficient to capture such values. Instead suggestions vary from a combination of assessing disciplinary and societal effects to a radical departure from disciplinary orientation 'in favor of external, emergent, context-dependent quality criteria that are defined and enacted collaboratively by a community of peers' (Belcher et al. 2016: 7). Bornmann and Haunschild (2017) as well as Koier and Horlings (2015), for example, have explored the use of alt-metrics but have found them insufficient to capture the complexity of TD research, nor do they measure transformational change.

Participatory features of sustainability research have been positively linked to usable products, enhanced capacity, network effects, and transformational change (Walter et al. 2007; Talwar et al. 2011; Lang et al. 2012; Polk 2014; de Jong et al 2016), as well as with scientific values such as a broader empirical base and methodological reflection (Hegger and Dieperink 2015). A number of studies look specifically at the links between the participation of societal actors in the research process and the societal impact of the results. Following Wiek et al. (2014) we define usable products as *outputs*, enhanced capacity and network effects as *outcomes*, and transformational change, such as structural changes, as societal *impact*. Wiek et al. further distinguish the first two (outputs and outcomes) as *first-order* or *intermediate* effects that can be expected within the project period from the third (impact) as *second-order* or *indirect* effects that may be significantly delayed and more difficult to attribute to the project. TD approaches are built on the assumption that the intermediate or direct effects of participatory research contribute indirectly to transformational societal change, since the latter is difficult to measure, as it is often significantly delayed as well as hard to attribute to specific research (Walter et al. 2007; Polk 2014; Wiek et al. 2014).

Spaapen and Van Drooge (2011) introduce the term 'productive interactions' to better understand social impact and deal with attribution problems in their analysis of social impact assessment. Productive interactions are defined as 'exchanges between researchers and stakeholders in which knowledge is produced and valued that is both scientifically robust and socially relevant' (Spaapen and Van Drooge 2011: 212). Spaapen and van Drooge focus on the interactions that occur between different stakeholder groups including: direct (face-to-face in meetings), indirect (through various outputs such as reports and articles), and financial (through contracts, co-financing and in-kind contributions). These interactions are seen as 'productive' when they contribute to knowledge being applied that results in behavioral change. They suggest using both quantitative (to map the interactions) and qualitiative indicators (such as stakeholder narratives) to identify the potentially productive interactions and impacts. Moreover, Spaapen and van Drooge conclude that it is 'not the productive interaction per se that is important, but the role they play in the process of realizing social impact' (p. 218). Productive interactions are thus an intermediate step in reaching social impact.

Using Spaapen and van Drooges work, among others, de Jong et al (2016) made a statistical analysis of two major TD research programs in The Netherlands, which focused on both the research process, their impacts, and the links between them. Based on researcher self-reporting on a questionnaire, they showed a moderate to fairly strong effect of informal TD interaction, consulting TD, and participating TD on social impact. Their results confirm that different approaches to TD have different societal benefits. However, they also found that formally including societal stakeholders resulted in negative effects, while informal TD interactions showed the most positive societal effects (de Jong et al 2016: 1406). Their study, however, has some noteworthy limitations: they only interviewed scientists, they defined productive interactions as communication events, not as behavioral changes, and they had a significant drop-off rate, both overall and within the individual independent variables. All of these limitations can impact the reliability of the results. They also state that much variance in the results remains unexplained in their study and that further research is needed that includes a societal actor perspective (de Jong et al 2016: 1407). Both Spaapen and Van Drooge (2011) and de Jong et al (2016) conclude that it is necessary to include narratives and perspectives of societal stakeholders in research on societal impacts.

Through a literature review, Wiek et al. extract key participatory research features, which they divide into two categories: (1) the nature of the participatory process and (2) the quality of the participatory research process (Wiek et al. 2014: 124). The first includes number, type and sequence of events, stakeholder motivation, stakeholder roles in events, and perceived importance of events. The second includes representation of opinions and perspectives, fulfillment of critical participatory roles, adequate level of interaction, consideration and processing of stakeholder input, mapping out and resolving disagreement and conflict, and diversity in participatory activities (Wiek et al. 2014: 124). They developed a methodological scheme to test the links between these participatory features and project results using mixed methods (document analysis, participant survey), complemented with interview material. Their results, however, were inconclusive due to lack of adequate data, such as high drop-off rates, difficulty in identifying respondents, and memory distortion. They conclude that future research needs to focus on the links between participation and social impact in ways that can address such methodological challenges, such as formative and context-sensitive evaluations.

Cash et al. (2002) also base their framework on a literature review and consultative workshops with stakeholders in research projects, as well as comparative case research. While they do not explicitly look at TD projects, they do focus on how science and technology can be harnessed for sustainability. The projects they base their discussion on involve actors from both science and practice, and how they can contribute to sustainability, which makes their work relevant when discussing the links between process and impact in TD research. Cash et al. link knowledge production processes to the production of salient, credible, and legitimate results, characteristics they consider essential for the research produced to have an impact (Cash et al. 2002). More importantly, they explore the institutional challenges of the knowledge—impact link through a discussion of boundary management. They show the importance of communication, translation, and mediation between science and decision-making, particularly when it comes to the different ways that knowledge producing processes are considered salient, credible, and legitimate by different stakeholders. Their analysis resulted in a number of process related aspects needed for producing salient, credible, and legitimate results across boundaries. These include taking boundary management seriously (through attention to communication, translation, and mediation), dual accountability (anchoring boundary managers in both science and policy

spheres), and the use of boundary 'objects' (jointly designing and producing project outputs) (Cash et al. 2003: 8089).

Roux et al. (2010) suggest a framework for co-reflection that can also function as a type of boundary management. They focus on the characteristics of TD research and the resultant expectations and needs of involved funders, researchers, and social actors. They outline commitments that need to be made by funders, providers of research (academia), and users of research (non-scientific actors) to create the social learning and joint accountability from all parties that is required to achieve impact. They conclude that there needs to be explicit mechanisms for funders, researchers, and end users to share accountability for the TD process.

This is achieved through participatory co-reflection regarding expectations, responsibility, and needs, where the co-reflection process supports social learning and 'reciprocal relationships between research partners' (funders, researchers, and end users) (Roux et al. 2010: 740). Co-reflection in itself constitutes a tool to broaden accountability 'beyond the contractual agreement that accompanies most research projects and programs' (Roux et al. 2010: 737), as it provides opportunity to take into consideration the different expectations, values, culture, language, and reward structures of the main participating groups, as well as the different emphasis they place on relevance, rigor, and efficiency, that is their accountability to their home organizations/constituencies. Funders, researchers, and end users of the research need to be jointly accountable for the process, to fulfill the institutional, research, and end user needs of the TD process (Roux et al. 2010).

These studies all show the practical and methodological challenges in understanding the links between participatory research and its societal impact. They give us important clues on process elements that are crucial to achieve impact. Reflecting on the literature from the point of departure of our empirical material raises an additional set of issues that we want to address in this article. Although most studies emphasize the importance of contextualization of evaluations, there are few investigations of differences between disciplines when it comes to the relationship between process and impact, though this is noted: 'Future research should investigate how researchers in other fields and problem areas produce societal impact. Comparative studies are needed because the sectoral background of societal actors matters' (de Jong et al. 2011: 1407). Furthermore, there is little discussion of the fact that different studies look at different types of non-scientific stakeholders, ranging from citizens to decision makers. Even more importantly, few studies distinguish between actors within stakeholder organizations and groups. There are also examples of studies that base evaluations on researcher input (de Jong et al 2016). The results from our evaluation of five TD research projects show an internal–external dynamic between projects and the project context. To capture this dynamic, we needed to look more closely at how project processes and impacts are attributed value from within different positions in the project and surrounding practitioner organizations, and how their attribution of value was related to participatory features. This later point distinguishes between what happens internally inside the project and what happens outside, primarily in the organizations of the stakeholders, but also in society at large, where the external dimension is crucial for contributing to societal change.

As mentioned, at the core of the relationship between process and impact lies the need to attribute effects (Wiek et al. 2014; Hellström 2015). The action-value attribution framework, developed by Hellström (2015), addresses both the problem of identifying effects and attributing them to process from different situated perspectives within the problem complex. It does so by letting the participants (both researchers and societal stakeholders) in the research process themselves critically reflect upon what activities and results they can attribute to the project, how they value them, and if and how they have led to any identifiable societal impact (Hellström 2015). This framework is based upon the participants' 'theory-in-use' of how they understand the problem complex and have participated in designing the project to address that specific problem (Argyris and Schön 1996). Given the multiple roles of the project participants (in the project and in their home universities and governmental agencies), this approach allows us to capture both internal and external valuation of the project process and impacts. In the following we explain how we have used the action-value attribution framework in our analysis of the empirical material to further explore the process-impact link.

3. Methodology

Our analysis is based on an empirical investigation of five TD projects. Interviews were conducted with project leaders, project participants as well as the coordinators of the Center partners, representing four governmental agencies, which comprise all of the administrative and decision-making levels in the region, and three academic organizations. In total, we interviewed 21 project participants, 15 of which were project leaders. In total, 10 individual interviews were carried out, five with researchers and five with practitioners. Three pair interviews were conducted with six practitioners. There was also one focus group with five participants, a mix of researchers and practitioners. We also conducted 15 interviews with current and previous partner coordinators for the Center. The interviews were between 45 min and 2 h, and were recorded and transcribed.

In accordance with the action-value attribution framework, the project interviews focused on four main topics. First, the project processes are assessed by their understanding and enactment of TD collaboration or what we refer to as the co-production of knowledge.[2] This includes the involvement of participants, the integration of different knowledge sources, and their links to context. The quality of the project process is judged by the degree of involvement in and the sharing of responsibility for project formulation, execution, and implementation, as well as the learning that occurred in the processes. Second, the project participants assess the outcomes, in particular from their specific practice-based setting, where practitioners both identify and attribute value to specific project results, outputs, and impact. Third, information was also gathered regarding the internal (Center related) and external conditions and factors that support or hinder the successful enactment of the projects. Fourth, a number of success factors were identified for both successful TD processes and production of usable results. The partner coordinators interviews focused on mapping out the value given to TD co-production for the participating agencies, and the actions and activities that are necessary for attaining such values. The coordinator interviews were used to triangulate the results because they are in a position to assess the contribution of projects to the broader organizations, their receptive capacity/willingness, and external factors that shape impact.

To explore the process-impact link, we analyzed the material in terms of how the enactment of the TD process contributed to and shaped the perception of relevance, credibility, and legitimacy of the results, as well as how the perception of those qualities related to

impact. In so doing we had to open up the categories of relevance, credibility, and legitimacy to make them relevant for understanding what happened at the interface between science and practice as well as between different actors within stakeholder organizations and groups, that is through different forms of boundary management. The perceptions of the qualities of relevance, credibility, and legitimacy were gauged through an analysis of the interview transcripts and project documentation. It is important to note that relevance, credibility, and legitimacy are closely connected in that all of these qualities share attention to how different types of knowledge and expertise are valued and used in a process. Relevance and legitimacy, for example, cannot be achieved without credibility within and between groups. While they are impossible to separate completely in the analysis each will focus on the following aspects that are developed from the literature (Cash et al. 2002; Belcher et al. 2016).

In Cash et al. relevance, or salience, 'deals with the needs of decision-makers' (Cash et al 2003: 8086). In our projects, the term 'decision-makers' encompasses a diverse and heterogenous group of civil servants that have an impact on decision-making including different city officials, planners, administrators, and policy-makers. In our analysis, the quality of *relevance* was therefore assessed via different degrees of sensitivity the project context. *Credibility* is usually defined in scientific standards (Cash et al. 2003: 8086; Belcher et al 2016: 8). However, in our TD processes, credibility also includes the importance of how science judges, evaluates, and integrates non-scientific input and expertise into the project process, as well as how practitioners evaluate the appropriateness of different types of scientific expertise for the project goals. In the literature, legitimacy is referred to as 'fair and unbiased' processes and results (Cash et al 2003: 8086). In our TD projects, legitimacy is seen through the extent to which different actors, both researcher and practice-based, take responsibility for ensuring or creating such 'fair and unbiased' processes and impacts.

In the interviews we looked both for how the participants value the internal process and how the projects were received by external actors, both their own organizations and others. We also looked for how the coordinators in the partner organizations perceive relevance, credibility, and legitimacy in relation to their institutional and political context.

4. Results

This section starts by summarizing the five projects and continues with analyzing and discussing the relevance, credibility, and legitimacy of the processes and their links to the project results.

4.1 Project descriptions

4.1.1 *Project 1: Business in Sustainable Urban Development*

Sustainable urban development increasingly embodies complex challenges for political and administrative actors, where cities and regions need to generate financial resources at the same time that businesses are interested in meeting their monetary goals through partnerships with public agencies. As the business community has specific goals and motivations, public agencies are forced to balance between protecting democratic values and transparency, and promoting business engagement. To explore such topics, TD projects were developed between VGR, the regional political actor in Western Sweden, and the *School of Business, Economics and Law* around the theme of *business-driven sustainable urban development*. Researchers with both a problem-driven focus and long-term relationships with public agencies in the area initiated Business in Sustainable Urban Development (BISUD), a project which ran from 2012 to 2016. Through a focus on building interdisciplinary and TD knowledge around private/public actor collaboration and developing business models that concurrently promote both business innovations and sustainable urban development, this project engaged a variety of business actors, disciplines, and public agencies.

The BISUD project was made up of a number of sub-projects from different cities across Sweden. Researchers from a variety of scientific areas (business administration, organization and management, law, and innovation systems analysis) worked together with practitioners and business representatives to analyze and merge the logic of business interests with the mandates and responsibilities of public actors. Project topics focused on, for example, economic sustainability in building and management of co-operative apartments, how cities can work with the private sector to reduce ecological impact, the profitability of energy efficiency measures in housing companies, and how business models can promote the electrification of trucking infrastructure. This project, through a variety of workshops and project groups, produced different tools and forums for sustainable urban development including an investment calculation tool, a consortium model for public–private companies, an innovation platform, and input to climate policies for the city. Overall, the competences and approaches represented in the project were highly sought after by the participating municipalities. The results were also well received in the participating agencies. Part of the project is continuing in an ongoing innovation platform for the City of Gothenburg.

4.1.2 *Project 2: Cities as Value Networks*

Following the trend of other cities, Gothenburg started to grow in the 1980s, after a period of decline, with effects on the city and capital accumulation. Real estate prices have gone up rapidly because of shifts in property form, with effects on demographics. The research project *Cities as Value Networks* (CAVN) sets out to investigate cities' attraction of capital and people and the drivers behind. It explores how inhabitants, visitors, and entrepreneurs value elements of urban environments, and how their experienced values shape economic values. The ambition was to make a very abstract idea of city values more concrete through studies of specific geographical sites and an analysis of how people make choices and what the choices are.

The project was initiated in 2012 by the main researcher on recommendation from Mistra Urban Futures. The project was developed by researchers with extensive experience of TD in close cooperation with representatives from the City of Gothenburg and neighboring municipalities Tjörn and Mölndal, the local tenant association, and the private property owners association. Initial workshops were held with representatives from the different sites where the idea was developed. However, due to unstable funding, the project took a different turn. From being a multisite qualitative research project, mainly based on interview material, it became a thorough analysis of time series of demographic data. The involvement and commitment by a senior administrator from the City Executive Office, who became co-leader of the project, were especially significant to the development of the project. The involvement of the City Executive Office provided access to important statistical data that made it possible to ask new and innovative

questions and carry out advanced analysis with the help of the right competence.

The output includes a popular scientific book and academic articles as well as extensive media output that has sparked a vivid debate. The project developed a tool for visualizing the demographic changes and increasing inequality and segregation. The tool was met with appreciation but was canceled due to lack of funding. An important outcome is the greater appreciation for learning among involved administrators and an improved sense of social relevance. However, there is a disappointment among project participants that high officials and politicians have shown limited interest in the results and methods. Further outcomes are the possibility to use statistics in innovative ways and to explore ideas that had been lingering in the administration. Such outcomes were made possible by producing legitimate space for working with other issues from other perspectives.

4.1.3 *Project 3: Well-being in Sustainable Cities*

In the sustainability debate two opposing perspectives are often presented. It is assumed that sustainability can be achieved with technical development and thereby requires no life style changes, or it is assumed that lifestyle changes are necessary and that they will involve sacrifices. The *WISE* project (*Well-being in Sustainable Cities*) is exploring the idea that some of the lifestyle changes necessary to achieve sustainability can increase well-being, and that a greater focus on well-being can help drive development toward a sustainable society. The project was conceived by representatives from the City of Gothenburg, VGR, the Swedish Transport Administration, and Chalmers University of Technology, based on previous research. Project leadership was shared between one researcher and one representative from public administration, and most of the team had worked together previously.

The project was initiated with a major workshop, prepared by researchers, where a range of ideas were developed and the main research questions formulated. The main themes were identified and project leadership divided between practice and academia. The initial workshop is considered to have been crucial for the relevance for practice and for relating the project to ongoing policy processes. The project is divided in five sub-projects. In the sub-projects there have been different arrangements with single project leaders from either academia or practice. The sub-projects have different forms depending on how they relate to ongoing processes in politics or public administration and how much research is involved. Throughout the project period, the sub-projects have held workshops with external participants and high attendance to discuss preliminary results. Participants experience a broad interest from their home organizations as well as from public administration in general, mainly because of the issues that are being researched. The project has been well funded.

All the channels of the participating organizations have been used for dissemination of results. The main outputs have been the Gothenburg climate strategy, the Swedish Transport Association's testing of new models for traffic planning, and a digital game to be used in high schools where you compete for low carbon emissions. Additional reports and papers have been published. In terms of outcomes, participants note new methods, new types of data collection, ambitious networks, and learning. Although difficult to attribute, they see impact primarily on how climate change and consumption are being addressed by a range of authorities in the region as well as on the national level.

4.1.4 *Project 4: Knowledge about and Approaches to Fair and Socially Sustainable Cities*

The realization that Gothenburg is one of the most segregated cities in Europe and that inequality is increasing is of concern to the City of Gothenburg and to the Association of Local Authorities, VGR, and the county government. In 2011, as partner organizations of Mistra Urban Futures, these organizations initiated a research project with the purpose of investigating how the city can work for social sustainability. The research project was called KAIROS (Knowledge about and Approaches to Fair and Socially Sustainable Cities). A working group developed the project plan after three workshops with 60–80 participants, primarily civil servants. A researcher who had been involved in similar work in another city was invited to lead the project, and he invited a civil servant in the city to co-lead the project.

The project work started with a number of research circles that defined three sub-projects. Due to an unstable funding situation at the Center, funding was cut short and the participants had to look for additional resources and possible synergies with other projects. SKL (the Swedish Association of Local Authorities and Regions) added funding and VGR funded two sub-projects. The interests of these organizations had effects on the focus of the project and design of the sub-projects. There was still insufficient funding for replacing a second researcher who had left the project, with the effect that there was an imbalance between researchers and practitioners in the project. The project had a reference group consisting of representatives from the partners of Mistra Urban Futures. However the reference group did not function ideally and was only used sparsely.

In terms of output the project has produced a set of desk-studies to increase theoretical grounding and integrate previous research around social sustainability. Project participants have disseminated and discussed project results at several workshops and external conferences. In a final report, the project presents eight mental shifts or changes of perspectives that are considered required to deal with the obstacles and power structures that prevent a just and socially sustainable development. The final report was presented at a conference and workshop with 400 participants from public administration and civil society. In terms of impact, the project and its results have, for example, contributed to some main perspectives in the social sustainability work in Norra Hisingen, a Gothenburg city district. KAIROS has also had effects on models for dealing with social unrest in county governments in Stockholm, Skåne, and Västra Götaland. Overall, there has been a perception among project participants of insufficient grounding and dissemination on all levels to really have an impact on approaches to social sustainability. Obstacles have been lack of prioritization at the political level as well as the constraints of administrative organizations and hierarchy.

4.1.5 *Project 5: Urban Station Communities: the way to resource efficient travel*

From 2003 to 2006, local and regional politicians from the 13 municipalities in the Göteborg metropolitan area in Western Sweden participated in extensive dialogue processes where they debated, discussed and operationalized long-term political goals and visions for the region. This process resulted in a number of overarching local and regional political goals called: *Sustainable growth: Goals and strategies focusing on regional structure*. Along with the *Vision for Västra Götaland*, the strategic policy from VGR, these

two documents can be seen as embodying the visionary goals for the region and the ways forward for achieving these goals. One of the cornerstones of both the vision and goals is the role of transport infrastructure in creating growth, a cohesive region and overall sustainable development.

Within this context, *Urban Station Communities* (USC) was initiated in 2012 by the Göteborg Region Association of Local Authorities (GR), who together with the Swedish Transport Administration (TV) wanted to see what types of knowledge, cooperation, and support were needed to promote sustainable growth around the train lines leading into Gothenburg, so-called *USC*. This project has attracted much interest from all of the administrative and regulatory agencies in the region. Seven focus areas and potential sub-projects were identified in several workshops where 80–100 of civil servants, business representatives, politicians, and researchers participated. Projects and activities were initiated within specific focus areas. USC is led by two practitioners and one researcher who have worked extensively with a number of researchers within the different sub-projects and activities.

One of the project results, which was written by the project leaders, is the report *Co-creation in urban station communities —findings from working seminars involving the collaboration of transdisciplinary agents, 2015–2016*. This report gives an overview of the different activities in the USC knowledge process. The most important outcome of the project is a new forum for dialogue and collaboration across sector and administrative borders, including new ways of working together among the municipalities, as well as between and among the regional and national agencies. This new way of working together has created new conditions, structures, contacts, and networks where trust and mutual understanding have been established between a diverse group of civil servants, politicians, and researchers. The concept *USC* is now used nationally, and has been integrated in ongoing municipal planning processes.

4.2 Assessing the qualities of relevance, credibility, and legitimacy in the five cases

There are clear differences in how the different participants in the projects experienced relevance, credibility, and legitimacy, both internally in the project groups and externally in relation to the different parts of their respective home organizations. Given this diversity, this presentation of results will focus on both an overall approximation of the nature and quality of the participatory processes, as well as give specific examples of how these elements played out in the projects. As can be seen in the project descriptions, the five cases represent a diversity of ways in which practitioners and researchers worked together around current sustainability challenges. TD was enacted in a number of different ways including: joint leadership and project ownership, more traditional forms of research with high and low practitioner and researcher involvement, and projects where practitioners were the main initiators and drivers of the projects. This diversity of involvement of practitioners and researchers in project ownership and activities gives us a unique opportunity to compare different types of interactions between practitioners and researchers in project initiation, design and implementation and how they are correlated to both the relevance, credibility, and legitimacy of the projects and to the ability of the projects to contribute to societal change.

The positions from which relevance, credibility, and legitimacy are assessed vary greatly in TD projects. Cash et al. (2002), for example, emphasize the importance of taking into consideration the different meanings that these three qualities have to different groups, divided by various boundaries. As they explain, the crucial location for effective knowledge is at the interface or border between 'communities of experts and communities of decision-makers'; managing these borders includes understanding how these qualities are experienced by different groups (Cash et al. 2003: 8086). We concur with this point. However, their reasoning implies somewhat homogenous groups where relevance, credibility, and legitimacy are experienced according to similar criteria. Our empirical data show that all three are experienced and assessed differently, not only at the borders between scientific and practice-based participants but also within organizations and mandates. They vary between individuals, professional positions, and decisions-making levels, and unsurprisingly, between political and ideological positions. The diversity of what is considered relevant, credible, and legitimate knowledge and processes are due to the specific organizational complexity and political nature of the project topics and the positioning of the respondents in this complexity. While often simplified as 'decision-makers', 'practitioners', 'users', or stakeholders', these groups are highly heterogeneous. The variety of ways that knowledge and processes are valued and interpreted within and between public organizations is profound and contributes greatly to the complexity of each research context.

This diversity is also apparent from within and outside of the project processes themselves, resulting in internal and external valuations of the project relevance, credibility, and legitimacy. What is relevant, credible, and legitimate to a highly anchored and grounded TD project group may not be so to the organizations within which it is anchored. Since all of the projects are about sustainable urban development (harnessing business interests, mapping urban values, climate change adaptation, social sustainability, and creating viable and sustainable communities), they are enmeshed in institutional cultures and policy processes, which determine the contours within which such attributes are assessed. In the following discussion of the results, we will therefore distinguish between the TD project group, their main home organization and the wider societal context where change occurs.

4.3 Relevance, credibility, and legitimacy

From the interviews we learn that internal *relevance* of results was achieved in two main ways. The first includes initiation by problem-driven highly informed research based on long-term relationships and collaboration with practitioners in the city and regional offices. The research topics evolved through years of close dialogue with practitioners, combined with openness to changing conditions and needs. The three projects in this category each started with a workshop that gathered both practitioners and researchers to decide together on the different focus areas for the project. However, they developed differently in terms of degrees of collaboration. The WISE project, though initiated by researchers, was based upon joint problem formulations, resulting in a project where practitioners felt equally entitled to the process and worked proactively in formulating the research focus and questions. The BISUD project interacted more sporadically with practitioners, who were mainly from the business community, while CAVN mainly interacted with one key civil servant throughout the project due to funding cuts. All of the researcher-initiated projects had a high degree of in-depth participation in the beginning of the process which resulted in a high degree of relevance for the project group.

Second, the project on social sustainability (KAIROS) and USC was initiated by practitioners from the City, Region, and governmental agencies. In these projects, practitioners acted proactively, taking the lead in both identifying the research topics that were based upon specific challenges from their practice-based experiences, as well as selecting individuals from certain disciplines and agencies that they judged were crucial for addressing the complexity of the issues under study. Both projects had a lesser degree of researcher participation; in the case of KAIROS this was a result of funding cuts. These projects, initiated from practitioner defined issues, thus had a high degree of relevance for the involved practitioners and organizations but were considered lacking in terms of academic breadth.

These two ways of achieving relevance while initiated from different groups had two commonalities. *First*, they were based on long-term relationships with the problem context. This includes both researchers who focused on problem-driven research approaches and had long-term relationships with public agencies, as well as practitioners themselves, who with years of experience identified knowledge gaps on issues that had not responded to previous strategies and implementation plans. In each case, relevance required long-term, in-depth experience with the problem *in situ* to grasp the complexity of the substantive issues within their respective political and administrative settings. Participants in one of the projects testify that some efforts at collaboration in sub-projects failed due to an inability to find common ground between the invited researchers and the practitioners about the research problem. This was mainly due to communication difficulties where the researchers were considered unresponsive and unable to translate their work to create a shared understanding, with the result that these researchers were replaced. Participants in all of the projects emphasize that the motivation and openness of researchers is essential for achieving relevance.

Practitioner participation, grounded motivation, informed research approaches, and openness to multiple approaches and perspectives were important for achieving internal relevance in projects. However, they were not sufficient for creating external relevance. The dynamic nature of the problem settings also required additional attention to build and maintain external perceptions of relevance during the project period, especially with regard to the home institutions. Thus, a *second* trait appeared in the interviews and was confirmed by the coordinators of the partner organizations, namely, that maintaining relevance requires attention throughout the project, a continual re-anchoring of the project goals, collaboration, and preliminary results in different parts of the problem context. This second trait of iteration, through openness and flexibility, was achieved, for example, through regular project and steering group meetings, through presenting preliminary results to interest groups and adapting the project process to the input that was received, and by continual micro-adjustments of the support that was offered (USC; BISUD; WISE). USC and WISE, in particular, planned for such processes at the early stages of their projects, and actively interacted with ongoing processes in their respective administrations. Two projects had a somewhat different experience. KAIROS had a strong internal learning process but experienced limited interest from its reference group and to some extent from politicians and their home organizations, despite extensive exchanges with both. Bureaucratic procedures as well as current issues that were exhausting their home organizations were identified as possible obstacles to receptiveness and successful anchoring. CAVN engaged in little outreach activities after the initial workshops and experienced difficulties in anchoring their work in the home organization of the key civil servant in the project. This was partly due to what was experienced as high-level administrator gatekeeping in relation to the political level.

Reflecting on the relevance of the projects, several of the coordinators of the partner organizations further emphasized that relevance for the partner organizations lies not only in the ability of results produced being able to solve problems but in the capacity that is being built in their organizations and the possibilities of breaking silos within and between organizations. The processes were therefore also valued because of such relationship-building and networking qualities, and not only because of the results they produced.

As noted above, *credibility* is used in the literature to refer to scientific credibility (Cash et al. 2002, 2003; Belcher et al. 2016). This definition is not sufficient for the projects analyzed here where project ownership, design, and leadership are shared by researchers and practitioners alike. In such TD projects, credibility is determined from the perspective of both scientific standards and practice-based criteria and needs. The most important component of credibility in these projects was mutual respect and exchange between participants with different approaches, positions, and sources of knowledge. The ability of researchers to be open, change perspectives, and make their knowledge and theoretical perspectives accessible and relevant to problem-solving was highly valued by practitioners in the projects. The participants in KAIROS (both practitioners and researcher) considered it a problem that there was only one researcher in the project. Although there was high alignment with his/her theoretical perspective, the participants thought it would have been valuable, and increased credibility, if its dominant position could have been problematized and developed in interaction with other theoretical perspectives.

Despite a general perception that experience-based knowledge was valued in the knowledge-producing process, a concern was raised by a few participants regarding the discursive power of scientific knowledge and the exclusionary effects of, for example, semi-academic seminars. Openness and motivation among researchers were regarded as crucial but did not guarantee the status of experience-based knowledge. Maintaining practice-based credibility required constant vigilance on the part of practitioners (WISE, KAIROS). Participants in the KAIROS project, with its particularly high ambition with regard to co-creation of knowledge, also expressed a concern that experience-based knowledge was not sufficiently taken into consideration when writing was confined to researchers.

Scientific credibility played an important role for practitioners also in another regard. One of the most important mechanisms identified in the interviews is the creation of a working space that is outside of the normal, formal, and informal processes of the participating organizations. In all the projects, this 'unaligned' space created opportunities for analyzing actual problems and creating new, cross-sector, interdisciplinary knowledge exchange, and interactions that are otherwise not available within the confines of the organizations or between organizations. These interactions are importantly not necessarily between researchers and practitioners, as much TD research emphasizes. They are equally important within and between the public agencies and organizations, and in negotiating the boundaries between organizations. The ability of such processes to create an unaligned space that creates its' own relevance,

credibility, and legitimacy is the foundation upon which this space creates wider relevance, credibility, and legitimacy within the problem context, especially regarding the home organizations of the participating practitioners. This space contributes to creating new understandings of the challenges as well as new approaches to formulating, understanding, and dealing with, for example, climate change transitions, increasingly segregated suburbs, and the collaboration needed to create livable USC. Yet, as indicated by the analysis of relevance and legitimacy, the unaligned space must at the same time be sufficiently anchored in the wider context. Here the projects point at the challenge for TD projects on sustainability to potentially destabilize the status quo while being dependent on participation that is guaranteed within existing governance structures. Several coordinators from the partner organizations noted the importance of the projects as a neutral ground that allows for challenging conventions and testing new ideas. They emphasize the importance of how the perceived neutrality of the projects let them deal with politically contentious issues, and argue that their possibility of doing so should be strengthened. This unaligned space also enables more free thinking, as well as testing and challenging 'business as usual'. It creates spaces for urban experiment for both research and practice.

The possibility of using this neutral space is highly connected to whether practitioners in the projects are relieved of some of their ordinary tasks, that is that time is invested by the home organizations in the projects, a problem addressed particularly by the projects whose funding was cut (KAIROS and CAVN). Lack of time for practitioner participants is considered a challenge to full appreciation of practitioner knowledge in projects, and thereby to internal project credibility. Participants in the KAIROS project also highlighted the importance for a social sustainability project to really involve ordinary people and foreground the inductive elements in the research process to fully confront the participants' perspectives with people's reality.

The value attributed to scientific credibility by *external* actors is further significant for its potential for impact. Practitioners used the involvement of researchers in their projects to increase the status (credibility) of their work externally and in relation to their home organizations. This was especially the case regarding researchers from the local technical university. In one project the high status connected to a local technical university gave credibility to the practitioners, and indirectly to the project and uptake of the project results as well (WISE). Mutual respect for different perspectives and knowledge was, in all of the projects, a crucial cornerstone of the overall experienced credibility.

The *legitimacy* of the projects was judged by how the project leadership and organization allowed and promoted multiple entitlements to and responsibility for processes and activities throughout the project. Again, this not only refers to practitioner involvement but also includes the degree of researcher involvement in the knowledge producing processes that were led by practitioners. The results from our interviews show that legitimacy can be reached in a variety of ways, through a variety of project organizations and approaches to what the participating researchers and practitioners call TD research or co-production. All of the project participants related to the TD, co-production approach. However, the degree of in-depth collaboration differed in the different project groups as well as in the phases of the projects. In some projects and sub-projects, in-depth collaboration was limited to a few individuals with long-term experience with the problem area who were highly committed to the processes. This led to a high degree of legitimacy between a limited number of individuals (CAVN, BISUD). In another project, for example, the participants called their method 'cooperation' not co-production (WISE). This project and sub-projects had a high degree of entitlement and commitment to the processes by all of the participating practitioners and researchers. The participants experienced these projects as highly legitimate when they actively integrated expertise, knowledge, and know-how from a variety of different sources of knowledge.

An interesting effect of TD research is how it changed expectations for involved practitioners. For some practitioners, working in tight collaboration with researchers throughout a project is a unique experience. For example, practitioners from one of the sub-projects tried to work with researchers from another university. They noted that these new researchers wanted to work in a more traditional consulting role, to do their job themselves, and present their results at the end of the process. The involved civil servants had other expectations due to their experiences in a TD project (WISE). They wanted to meet with these researchers throughout the project for in-depth dialogue and learning. Their experiences and understanding of TD research changed the expectations they had on research collaboration. What they considered a suitable process for producing legitimate results, and even consulting, included equal entitlement to and responsibility for the entire process.

Legitimacy was thus judged in terms of how well the project design was able to actually engage a variety and breadth of expertise and perspectives throughout the project process. In the interviews, this was seen in terms of how different groups, including both researchers and practitioners, were entitled to the process, and consequently how this entitlement resulted in commitment, responsibility, and accountability to the process and its results. Joint leadership and ownership require mutual commitment, including temporal and financial investments. Adequate time to collaborate and reflect upon the process was raised in all of the interviews, as crucial for the success of the projects. As different actor groups invest in a process, both with time and money, they also share responsibility for the project itself, as well as for the project outcomes. This type of legitimacy through in-depth TD engagement therefore includes a positioning regarding commitment and responsibility. This engaged participation became personally important to many of the project participants. They built up trust and relationships within the project groups, across sectors and decision and administrative levels. However, in several of the projects some practitioners had very little time to participate actively. This had consequences for their possibility to invest in the projects.

When it comes to *external* legitimacy a distinction between the five projects can be made based on the interviews. Here it is clear how the three traits are tightly coupled to one another. Two projects, WISE and USC, with researchers from mainly technical universities evoked responses to processes that were ongoing at the highest level of the administration. It can be argued that the technical character of the research through its high credibility provided additional external legitimacy to the project. Highly credible processes create more respect thereby increasing engagement. In addition, the fact that these projects were responding to preexisting and ongoing processes, goals, and strategies, where mind shifts had already been made, increased their external relevance. Finally, these two projects worked with implementation throughout the project period. Two other projects, KAIROS and CAVN, led by social science researchers, responded to current challenges but were not directly

connected to ongoing policy processes. Social science research on social sustainability, due to uncertainty and scientific disagreement, runs a greater risk of being questioned (Clark et al. 2002, in Cash et al 2002: 5). Moreover, while the two former projects contributed to strengthening mind shifts that had already been made, the latter two proposed mind shifts as a result of their research, more importantly they propose mind shifts that challenge prevailing governance systems. Their results were thus less grounded externally in their relevance and credibility, and consequently, the legitimacy of the results was weaker in the respective public institutions. Finally, CAVN and KAIROS had intensive internal learning processes but paid less attention to implementation during the project period. These factors seem to be significant for external legitimacy. BISUD, finally, mainly worked with applied research and knowledge that was in demand by business actors and the city. Here, one of the project leaders points out the challenge of gaining legitimacy within academia for their research. Coordinators from the partner organizations further emphasize the importance of securing interest and commitment from the strategic level, as well as for projects to communicate with the strategic level in the administration to create a sense of purpose and legitimacy even in periods when usable results are delayed.

4.3.1 *Discussion: Linking the relevance, credibility, and legitimacy of TD processes to the effectiveness of their results*

Overall, our study shows that while the relationship between the traits of relevance, credibility, and legitimacy on knowledge systems and their societal impact is theoretically convincing (Cash et al. 2002), it has limited applicability in TD research. While designing the analysis around these terms gave many interesting reflections, the overall benefit was in understanding how poorly the accepted definitions of such traits mirrored or could be applied to a TD context. These definitions, which were modified in our analysis, do not mirror the empirical complexity of the TD cases that we studied here. This brings us back to the point brought up by way of introduction, namely, that the relevance, credibility, and legitimacy framework were developed within the science–policy discourse. The need for modifying the definitions for the TD example highlights the heterogeneity of the participants and their organizations. It gives us important insights into how TD processes both bridge and remain anchored in the contexts of their respective participants and organizations. It also gives insight into the implications this complex and somewhat paradoxical situation has for the ability of such processes to contribute to societal change. Overall, TD research functions as a different type of boundary management between academia and stakeholder organizations than science–policy approaches, and has different challenges and needs.

All of the five projects studied here, irrespective of formal participatory features, produced usable and important research results from processes that were considered relevant, credible, and legitimate by the project participants. But, as one project participant commented, 'you can lead a horse to water, but you can't make him drink'. Relevance, credibility, and legitimacy are necessary qualities of TD research processes. However, because of the context situatedness and dependence of TD research, the realization of these qualities within projects is not adequate for ensuring the effectiveness of project results. Our study shows that there are no clear mechanisms that link participatory features to impact; there is instead a complex web of relationships, institutional cultures, and political agendas that require that we open up the categories to see how they are conceived of by different actors internal as well as external to the project. Because of such context situatedness and dependency, relevance, credibility, and legitimacy need to be understood as attributed both internally in projects, as well as externally in implementing organizations. The focus on the role of boundaries between science and policy needs to be widened to include the boundaries that exist between various actors within organizations, and across mindsets, professional positions, sectors, and decision-making levels. Our study emphasizes that such institutional and political issues are crucial when trying to understand the impact of TD research. Certain research problems that are more politically contested, where mind shifts are required, need to focus more on intermediary and organizationally related effects (such as capacity-building and networks) than impact in their evaluations. They also need to pay more attention to ways of strengthening such effects, such as working with politics productively rather than excluding politics from the process. In the following we will discuss these conclusions more thoroughly.

We found no direct link between participatory features such as the number of meetings, breadth of participating organizations, disciplines and stakeholders, and the quality of the interactions. While meetings and breadth of participants are important, they are not sufficient criteria for productive interactions. High-quality collaboration includes aspects, such as practitioner motivation and engagement, mutual perception of the importance of the project, breadth of perspectives, as well as openness and flexibility of the participants and the processes (to go where needed), and in-depth exchanges of expertise and knowledge both within and between the different involved organizations (Wiek et al. 2014).

Our study highlighted two specific commonalities in the projects with regard to creating *relevance*, through what Nowotny et al. 2001 call 'strong contextualization'. This includes, first, the ability to capture long-term, in-depth experience with the problem to grasp its complexity, where participants are particularly skilled in crossing boundaries between organizations and perspectives. And second, a continuous re-anchoring of the project's relevance through openness, flexibility, and adaptation is needed to maintain relevance throughout the project process.

Our study further questions scientific *credibility* as a sufficient trait of TD research processes. One of our results is that credibility, in the TD projects studied here, is reciprocal. Project participants highlight the importance of sufficiently incorporating and valuing experience-based knowledge, and problematized the discursive power of scientific knowledge. Researchers express the importance of how confrontation with experience-based knowledge changes the way they ask questions and expands the range of perspectives from which they view a research problem that improves the quality of the research, and thereby its credibility. Practitioners highlight the credibility that the scientific analysis of their practice-based expertise and know-how provides. We could argue that this wider definition of credibility occurs when practitioners are equally entitled to the process, when their practice-based needs are equally important as the scientific needs of the researchers. Scientific knowledge is then also judged by its ability to conceptualize and make sense of practice-based knowledge. As Cash et al. note, limiting credibility to scientific criteria results in clear trade-offs between relevance, credibility, and legitimacy (Cash et al. 2003: 8086). However, a more inclusive, reciprocal definition of credibility shows that such trade-offs are not equally evident or even predictable.

Most importantly, our cases indicate that internal and external dynamics of the project process, together with institutional factors and the political context, significantly shape the possibility of impact. While Cash et al. (2002) identify boundaries between research and policy, between disciplines, scales, and knowledges, our study points at the importance of understanding the internal–external project boundary. Internal relevance, credibility, and legitimacy do not necessarily translate into external relevance, credibility, and legitimacy. A key to understanding this dynamic is to unpack the practitioner positions and roles. Project participants become not just boundary managers, but they continuously navigate and negotiate their own positions and the boundaries they maneuver. Both researchers and practitioners in the projects define themselves as different from others in their home organizations. The researchers are defined by their interest in problem-solving and their openness and ability to co-produce knowledge, in contrast to strictly academic careers. The practitioners often emphasize how they have been changed through the research process and how it will affect them as they return to their home organizations. How the boundaries are navigated shapes the possibility for impact? How practitioners in particular navigate boundaries is shaped by institutions and politics, which in turn shape the possibility of impact?

One of the results of our study is that managing boundaries within the policy and administrative spheres is crucial for the production and uptake of new knowledge. It was here that significant foundations for societal change were established, regarding for example, the creation of mutual understanding and trust between diverse sectors and decision-making and administrative bodies. Cash et al. also note the need for 'boundary organizations' and their mediating roles between experts (scientists) and decision makers (Cash et al. 2003: 8089). From our results, managing boundaries within the different functional spheres within urban planning are equally, if not more crucial to the ability of knowledge production processes to contribute to societal change. Belcher et al. also define relevance, credibility, and legitimacy in terms of the content of the research, not in terms of the involvement of stakeholders, except under legitimacy (referring to effective collaboration, genuine, and explicit inclusion) (Belcher et al. 2016: 9–10). This suggests that researchers take more responsibility for the relevance and credibility of the project, and/or that the involvement of practitioners is taken care of under legitimacy. As noted above, our analysis showed that practitioner perspectives on and responsibility for relevance and credibility are equally important as the scientific in the TD processes studied here.

All of the projects studied were highly informed by ongoing administrative and political issues and processes in the city and region. All had some degree of high quality of relevance, credibility, and legitimacy, internally and some degree of external relevance, credibility, and legitimacy. However, even the projects with high internal relevance, credibility, and legitimacy were not necessarily taken on board by their home organizations. There are a number of reasons for this. One included institutional barriers to impact. In certain types of bureaucracy, there is little room for innovation and learning due to structures, regulations, monitoring, reporting of results, etc. Home organizations are also often caught up in current issues, with no time for incorporating new perspectives and results. Roux et al. (2010) highlight the need for co-reflection and TD learning between researchers, funders, and end users to broaden accountability for knowledge production and uptake. However, they do not distinguish between actors within stakeholder organizations and groups. Our study shows that it matters who in the administration participates in the projects. Our projects note that low-level administrators can think freely but have limited influence. High-level administrators have more power but can also be more constrained in their thinking. Hierarchies and gatekeepers prevent receptivity in organizations and decision-making. There is a need for commitment by the strategic level—but also by those who will actually do the implementation. While project process cannot fully control such institutional factors, they can improve the possibilities for impact through broad outreach and implementation during the project phase.

Mindsets and mind shifts in politics also influenced the uptake of project results. This study shows that projects where a mind shift had already occurred in political and administrative organizations had more impact. These areas are also considered less politically controversial. In other projects, they were timely in the sense that there was a perceived problem to deal with. However, the necessary mind shift had not yet been made. Some of the new ideas and understanding were not welcomed by all of the partner organizations. For another, the highly contested and politicized nature of the research topic, social sustainability, had limited political support despite the fact that the issue is a political priority and the public bodies themselves initiated and formulated the project.

Given such context complexity and dependency, building or enhancing capacity becomes an important effect category. Capacity building involves individuals but needs to be scaled up to include organizational learning that goes beyond the specific project. Capacity is built as information is exchanged, and learning is encouraged and developed (Blackstock et al. 2007; Wiek 2007; Robinson 2008; Lang et al. 2012). However, our study also shows that such learning often stops at the project level because of various institutional and political reasons. Such barriers have clear effects on whether results will have an impact. As Molas-Gallart et al. state (Molas-Gallart, et al. 1999), there may be a lack of impact 'not because of any shortcomings in a set of research results or the dissemination strategy used, but because potential users are unwilling or unable to exploit the opportunities presented to them' (in Meagher et al. 2008: 165). As our study shows, there are specific quality aspects surrounding and external to the research process that are crucial for achieving impact. These external factors are detrimental to impact and can only, to a limited extent, be compensated for in internal processes. This should not be taken to mean that TD projects should not be pursued. Spaapen and Van Drooge (2011) describe different modes of organizing and maintaining 'productive interactions'. When strategic-level commitment and interest is weak, productive interactions that contribute to building networks and capacity contribute to social impact in the long-term. In line with their results, our study shows that projects need to work explicitly to safeguard strategic-level commitment, through continuous and broad outreach, to promote high-level support. They also need to carry out continuous implementation as part of knowledge production, to increase intermediary effects like capacity building and networks that, in turn, increase the potential for long-term impact.

Finally, this study confirms that TD projects provide an unaligned space that allow the participants to step out of their ordinary roles and think outside of their organizational boxes (Polk 2014). The function of the project as an unaligned space increases the need for continual anchoring of the project in the home organizations to widen the possibility of understanding their practical relevance. Our conclusions suggest that we need to reevaluate the process-impact link in terms of how internal and external dynamics affect the

diversity of meanings of relevance, credibility, and legitimacy that are experienced and played out in a specific political context. Given the attribution difficulties in linking participatory processes, project outputs, and outcomes to societal impact, understanding this complexity is crucial for any evaluation of TD projects. Otherwise we run the risk of missing barriers to impact, and overlooking outcomes, which can lead to impact in the future.

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Notes

1. Mistra Urban Futures is co-owned, financed, and led by seven partner organizations including: the City of Gothenburg, the Göteborg Region Association of Local Authorities, Västra Götalands Region (VGR), the County Administration Board, the University of Gothenburg, Chalmers Technical University, and the Swedish Environmental Research Institute. For more information, please see the web pages at mistraurbanfutures.org.
2. Co-production refers to knowledge production processes where practitioners and researchers jointly formulate the research problem and project design, as well as generate, apply, and evaluate the results that are produced (Polk 2015a, 2015b).

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