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Understanding and Creating Societal Impact of Sustainability Transitions Research through “Real-world Laboratories”

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Abstract

Questions regarding the societal impact of research, how to reach impact and what is needed to stabilize the effects are rising from various sides. Societal impact is seen as part of a social contract that exists between science and society. This entails that research must address pressing social issues which in turn implies a number of core challenges such as gathering evidence or the creation of actionable knowledge. The transdisciplinary research approach “real-world laboratory” is discussed as possible way to address and to overcome some of the challenges. A “real-world laboratory” currently being established in the city of Wuppertal serves as case study, linking conceptual and empirical investigations.

Keywords: societal impact assessment, real-world laboratories, transformative research

Introduction

Questions regarding the societal impact of (sustainability) research, how to reach impact and what is needed to stabilize the effects are rising from various sides: the research community (e.g. CfP IST 2015), funding programmes (e.g. EU Horizon 2020) and institutional stakeholders (WBGU Special Report 2014).

Core challenges associated with the societal impact of research can be differentiated into two areas: (1) with regard to understanding and measuring societal impact. This includes aspects such as time lag, developmental nature of impact, attribution, knowledge creep and gathering evidence (Penfield et al., 2014, p. 25-27). And (2) with regard to actually creating societal impact, e.g. via influencing policymaking, the creation of actionable knowledge or concrete experiments. Challenges of the second type include aspects of legitimacy, knowledge transfer as well as robustness to (social) context and other.

In this paper the transdisciplinary research approach “real-world laboratory” is presented, its particularities are outlined and possibilities to address and overcome some of the above-mentioned challenges with regard to the impact of this research setting are discussed. We aim to explore the following research question: *How to understand and assess the societal impact created by real-world laboratories?* When referring to the creation of societal impact, we suppose real-world laboratories help to produce actionable knowledge und robust solutions e.g. through the involvement of stakeholders and their participation in joint experimentation. When referring to understanding societal impact, we assume that real-world laboratories due to their quasi-experimental set up constitute proper setting for studying and understanding societal impacts.

To pursue our aim, we first present the current state of the debate on the new transdisciplinary research approach, the real-world laboratory. We then present and discuss assessment tools for research impact, outlining some of the particular challenges of assessing the impact of (transdisciplinary) research. Finally, a real-world laboratory currently being established in the city of Wuppertal serves as case to examine avenues of understanding societal impact in the field of sustainability transitions research.

Real-world Laboratory – Conceptualizing a new research setting

The term and concept „real-world laboratory“ (German: “Reallabor”) is getting quite popular in German-speaking regions in the last years (Wagner and Grunwald, 2015; Schneidewind, 2015). Similar trends can be seen in the international sustainability research community with a variety of potentially related concepts such as Living Labs (e.g. Bergvall-Kåreborn et al.,

2009; Geibler et al., 2014), urban transition labs (e.g. Nevens et al., 2013; Wiek et al. 2015), sustainability experiments (Berkhout et al., 2010; Bai et al. 2010; Wieczorek et al., 2015) or transition experiments (Van den Bosch and Rotsmans, 2008; Van den Bosch, 2010).

In the German discourse there currently exists only a broad (working) definition of “real-world laboratories” defining them as:

“societal context in which researchers carry out interventions in the sense of ‘real-life experiments’ in order to learn about social dynamics and processes and transfer the scientific concept of the ‘laboratory’ into the analysis of societal and political processes” (WBGU 2014, p. 88).

As such this term is quite similar to the concept of urban transition labs as defined by Nevens et al. (2013):

“[...] **facilitated** sites for creating (social) innovation and within which social change agents can initiate or inflict urban sustainability transitions. [...] the locus within the city where (global) persistent problems are translated to the specific characteristics of the city and where multiple transitions interact across domains simultaneously (e.g. energy, mobility, food, ecosystems). It is a **hybrid, flexible and transdisciplinary platform that provides space and time for learning**, reflection and development of alternative solutions that are not self-evident in a regime context...”

While urban transition labs frequently do use transition management as guiding framework and specifically focus on the urban context, real-world laboratories are currently more open in terms of methodology and fields of application. Real-world laboratories are set up in urban districts, whole cities, regions (e.g. rural area, biosphere reserve, national park), university campuses, industry sectors and value chains or regional mobility systems (De Flander et al., 2014). With regard to methodology, real-world laboratories use a transdisciplinary approach, similar to urban transition labs or transition experiments, but are by now not focussing on particular methods or approaches.

With methods and fields of applications being rather open, a conceptualisation of real-world laboratories can be done by using core criteria (De Flander et al., 2014; Wagner und Grunwald, 2015; Schneidewind, 2015) such as:

- aim to create social acceptable and robust knowledge
- knowledge shall be co-produced
- knowledge integration and mutual learning
- contribute to solving real-world (sustainability) problems
- apply solutions in the laboratory-setting and experimenting for innovative, applicable and adapted solutions

- real-world interventions guided by scientists
- aim for self-perpetuating solutions
- developing transferable solutions for other contexts
- transdisciplinary cooperation between science and society (economy, politics, administration, and civil society stakeholders)

Besides those already established criteria, the understanding of the concept, the goals it shall reach and ways how to reach these – by simultaneously high impact expectations – is still “under construction”. It becomes obvious that real-world laboratories include numerous elements that relate to the generation of impacts as well as the possibilities to understand and assess these impacts. These include the transdisciplinary nature of the undertaking, the aim for generating real-world change, the cyclical nature of learning as well as the high complexity of the research setting. In the following we discuss on how to understand societal impact of research and present and discuss traditional models to capture and assess these impacts – as well as their applicability to the case of real-world laboratories.

Societal Impact of Research – Definitions, Assessment Frameworks and respective Challenges

Societal impact can be defined as an „effect on, change or benefit to the economy, society, culture, public policy or services, health, the environment or quality of life, beyond academia“ (Research Excellence Framework 2015) or „change of behaviour, attitude, opinions, based on research outcome“ (De Jong et al., 2014, p. 92). It is seen as a “part of a social contract that exists between science and society which entails that research must address pressing social issues“ (Donovan and Hanney, 2011, p. 176) and encompasses the products, uses and benefits of research (in and for society). Within the “Social Impact Theory“ (e.g. Vanclay, 2002) societal impact is defined as „cognitive or physical consequences of a program“ (similar Weiss, 1998, p. 8). From these definitions it becomes clear, that societal impacts of research can be understood quite differently – e.g. differing with regard to the level of aggregation (from impacts on individuals to the society) and with regard to how immediately impacts are arising in relation to the actual research process.

To capture the process of research having impact, so called logic models are widely used (see figure 1) dividing the process into inputs, (processes), outputs, outcomes and impact. Application examples are the payback framework (Buxton, 2011; Donovan and Hanney, 2011), which is explained in the next section, or the methodological scheme for capturing societal effects of participatory sustainability research (Wiek et al. 2014).



**Figure 1. Process model of societal impact development
(adapted from Penfield et al., 2014)**

The category of Input encompasses the research framework, conceptual models and methods (for example transdisciplinary research) and includes for example the quantity, frequency and type of participatory workshops or dialogues and further research-stakeholder interactions. **Output** captures the products of the research process, such as articles, reports or innovation-patents. **Outcome** encompasses the direct and short-term results of the research process such as for example enhanced cognitive skills and knowledge (system, target and transformative knowledge) and network effects. **Impact** describes the long-term effects of research such as structural changes, changed (e.g. political, individual) decision-making and actions.

What are challenges associated with assessing and understanding societal impact? Penfield et al. (2014) differentiate the following problems:

- *Time lag*: meaning that the time between research and impact varies strongly;
- *Developmental nature of impact*: impact is not static, it will develop and change over time, and this development may be an increase or decrease in the current degree of impact. Impact can be temporary or long-lasting. The point at which assessment takes place will therefore influence the degree and significance of that impact.
- *Attribution*: Impact is derived not only from research but from findings, good fortune, and complex networks interacting and translating knowledge and research. The way research creates societal impact is complex and involves amongst other aspects a variety of processes, individuals, and organizations. Therefore, attributing the contribution made by a specific individual, piece of research, funding, strategy, or organization to an impact is often not a straight forward task.
- *Gathering evidence*: Gathering evidence of the links between research and impact is not only a challenge where that evidence is lacking. The introduction of impact assessments with the requirement to collect evidence retrospectively poses difficulties because evidence, measurements, and baselines have, in many cases, not been collected and may no longer be available. Looking forward, we could reduce this problem in the future, identifying, capturing, and storing the evidence in such a

way that it can be used in the decades to come is a difficulty that we will need to tackle. Through the introduction of impact assessments we could be able to reduce this problem in the future, identifying, capturing, and storing the evidence.

When it comes to analysing and assessing the impact of real-world experiments, these challenges potentially maximize, due to the increasing complexity of the research setting, as well as the blurriness of boundaries between different sciences as well as between science and society that takes place in the setting (transdisciplinarity). Furthermore it is questionable, to what extent a simple, linear logic model is suitable to capture the rather cyclic and entangled process of a real-world laboratory.

Besides challenges that arise when it comes to understanding and measuring impacts, numerous challenges arise when it comes to the actual creation of societal impacts. To name just a few, these include for example to influence policymaking or to create actionable knowledge. In fact, the difficulties of generating impact often correlate with the difficulties of measuring and understanding these impacts – the more it is difficult to know what the actual impact of a research is, the more it is difficult to generate this desired impact.

In the following section we present two established models for societal impact assessment that may be suitable for overcoming mentioned difficulties. This is true due to the frameworks applying different foci and using circular logics.

Societal Impact Assessment-Frameworks

Different frameworks to assess the societal impact of research exist. Key examples are the “SIAMPI-Approach” (Spaapen and van Drooge, 2011) and the “Payback-Framework” (Donovan and Hanney, 2011)¹

1. “Social Impact Assessment Methods for research and funding instruments through the study of Productive Interactions” (SIAMPI)-Approach

Bridging processes and impacts without assessing the whole system is a task of the SIAMPI approach, which focuses on productive interactions between science and society as a prerequisite and proxy for impact. It is based on the conception of Evaluating Research in Context (ERiC) (2010), part of the Standard Evaluation Protocol used by all Dutch universities and academic research organisations (Spaapen et al., 2007).

¹ A third popular scheme is the “Research Excellence-Framework” (REF) (HEFCE 2015), which applies a linear logic and therefore is not presented in depth here. Others examples include CERIF oriented solutions to simplify the data collection (Wolf et al., 2014) as well as the measurement of societal impact via tools like Altmetric work, measuring the attention that academic papers receive online (Bornmann and Marx 2014, p. 2013).

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, p. 212). To focus on productive interactions means to concentrate on how the exchange between scientist and stakeholder contributes to create societal impact. The exchanges are mediated through direct (face-to-face communication), indirect (by publications, project reports, exhibitions etc.) or financial interactions (by financing a research project).

An interaction is *productive* if stakeholders change their attitudes, opinions, and behaviour based on the research outcomes. Stakeholders are „all actors involved in the process that leads to societal impacts“ (De Jong et al. 2014, S. 92). This assessment framework was applied in the field of information and communication technologies (ICT) (De Jong et al. 2014, S. 92), healthcare (Spaapen and van Drooge, 2011) and social sciences and humanities (Molas-Gallart und Tang, 2011). To capture the productive interactions, survey methods such as questionnaires, interviews and document analysis are used, resulting in case studies or network diagrams.

2. Payback-Modell

The Payback Framework is possibly the most widely used and adapted model for impact assessment (Wooding et al., 2007; Nason et al., 2007). It was developed at Brunel University, UK, to examine the ‘impact’ or ‘payback’ of health services research (Buxton and Hanney, 1996). It systematically links research with associated benefits (Scoble et al., 2010; Hanney and Gonzalez-Block, 2011).

The framework has two components: a logic model, of how to assess the benefits, representing the complete research process, and a series of categories to classify the paybacks (benefits) from research. The *logic model* consists of seven stages (0–6) and two interfaces between the research system and the wider political, professional and economic environment (interface A: project specification and selection; interface B; dissemination) (see figure 2). The model contains numerous feedback loops, corresponding to a non-linear understanding of the research process. *Benefits* are covered multi-dimensionally through indicators like knowledge production, benefits to future research and research use, benefits from informing policy and product development, health and health sector benefits and broader societal benefits.

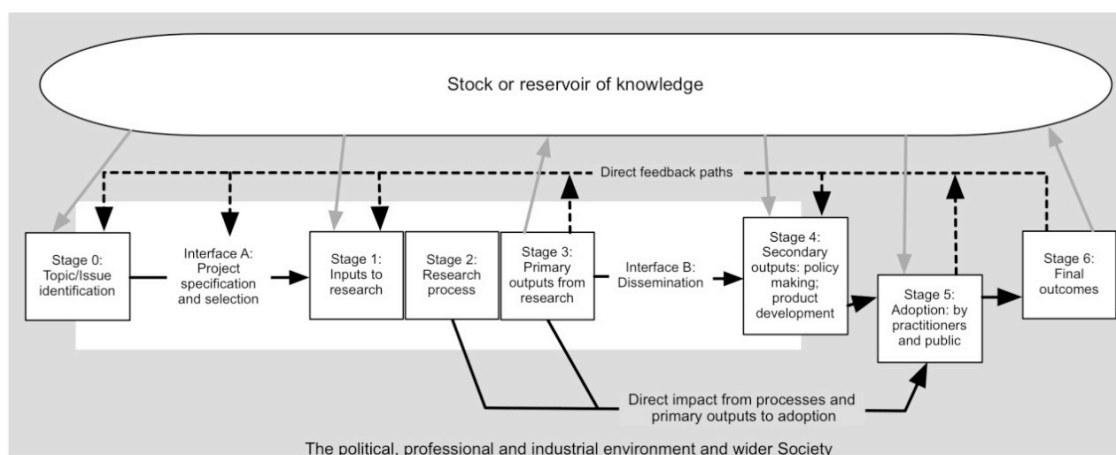


Figure 2. Payback Framework (Donovan and Hanney, 2011)

The payback framework primarily serves as a research tool to facilitate data collection (surveys, interview schedules and document analysis) and cross-case analysis by providing a common structure for each case study. While it was originally developed to examine the ‘impact’ or ‘payback’ of healthcare research, it has subsequently been adapted to assess the impact of research in other areas such as the social sciences (Wooding et al., 2007; Klautzer et al., 2011) and the humanities (Levitt et al., 2010).

In summary, these models help to shift the attention of researchers, to interactions instead of artefacts and to cyclical and complex instead of linear thinking. They thereby may offer ways to get a better grasp of the societal impacts of (real-life laboratory) research. In the following section the research concept “real-world laboratory” is illustrated by a case study in the city of Wuppertal (Germany), before promising avenues to assess its impacts are discussed.

Case study: Real-world Laboratory “Prosperity-Transformation-Wuppertal”

The real-world laboratory “Prosperity-Transformation-Wuppertal” is financed by the Federal Ministry of Education and Research for a period of 36 months (starting on May 1, 2015).

The projects combines the application and development of an alternative assessment of urban wellbeing (prosperity) with a specific support and companionship for identified initiatives that contribute to the production of wellbeing while also following a path to a low carbon society. It basically explores possible ways of not only decoupling economical prosperity from resource consumption, but also decoupling wellbeing from economical and material growth, meaning to reach a high quality of life on a sustainable basis (WBGU 2011; Schneidewind and Singer-Brodowski, 2013).

The virtues to generate and understand research impacts in “urban laboratories” have been described (e.g Karvonen and Van Heur, 2014, Nevens et al., 2013; Wiek et al., 2015),

developed and tested. Assessing societal wellbeing and prosperity by simply measuring national or regional GDP has been criticized since long and the last decade has seen the development of a variety of more complex alternatives (Stiglitz, Sen and Fitoussi, 2009; UNDP, 2011; OECD 2011 and 2013). This project employs the OCED “Better life index” that measures wellbeing through eleven dimensions, including objective figures like household income, health status, education, social networks or environmental quality but also subjective wellbeing (OECD 2013). This approach has only been applied on a national and regional level yet.

An *urban* prosperity definition for Wuppertal, based on the OECD dimensions, shall be further developed in a science-society collaboration with stakeholders, initiatives and political decision makers. Consequently, a transdisciplinary research approach is used (as in „Co-Design“ and „Co-Production“, ICSU, 2013). The development of such a “Better life index urban” is followed by mapping innovative initiatives throughout the city, contributing to local wellbeing. Chosen initiatives will be collaboratively analysed regarding their specific patterns of production of wellbeing. Using the concept of real-world laboratories, those initiatives will be supported and accompanied in experimenting with or new or stronger ideas for building capacity to enhance quality of life.

In short, research questions are:

- How can an extended prosperity conceptualisation, based on the established measurement system from the OECD-Wellbeing-Scheme (OECD, 2011 and 2013), be operationalized at the city level?
- How and in what intensity are single prosperity dimensions influenced by specific projects and initiatives of the city, industry and civil society organisations? How does this relate to the ecologic sustainability effects of the initiatives? Is an absolute decoupling observable?
- How can existing initiatives be expanded and networks supported to produce urban prosperity by simultaneously saving natural resources?
- Applying the concept of real-world experimentation, what patterns can be identified for building (societal) capacity for the production of wellbeing?.

Discussion and Conclusion: How to get a grip on the Societal Impact in the case of the Wuppertal Real-World Laboratory

Contemplating the working definition of real-world laboratories and the sketched case “Prosperity-Transformation-Wuppertal” we pursue with first considerations regarding the societal impact of real-world laboratories. What chances offer these for understanding and creating the conditions under which research has an impact?

As an alternative to a “linear” reconstruction of the societal impact development (“input-output-outcome-impact”-process-chain) or to formative criteria, which focus on the quality of the transdisciplinary research process (e.g. Jahn and Keil, 2015) we propose the use of the SIAMPI-framework (Spaapen and van Drooge, 2011). This framework fits quite well to the characteristics of a science-society-interface like the “real-world laboratory” and helps to get a first glimpse on important *conditions* under which societal impact unfolds and facilitate the learning processes inside real-world laboratories. To focus on productive science-society *interactions* as a prerequisite of future societal impacts of real-world laboratories could also support directing the attention on activities, which scientists can navigate, feel responsible and are affected by.

Interactions in the SIAMPI-Framework are divided in direct, indirect and financial interactions. In the case of “Prosperity-Transformation-Wuppertal” interactions will predominantly take place direct through personal contacts with existing initiatives (for example will each initiative be accompanied by a PhD-student), mutual experimentation, planned workshops, joint lectures and others. Indirect interactions – through information carriers – are planned in terms of a discussion paper sequence, refereed articles, an anthology, the publication of the PhD-thesis and presentations on international conferences. Focussing the creation of societal impact may go along with a shifting focus of scientists from Input-Output thinking to thinking about interactions. Interactions that are of core importance in the emergence of societal impact.

The Payback framework offers a perspective on the complex, cyclical nature of how research unfolds impacts on society. Although it has been applied in numerous fields, it still comes with a strong disciplinary focus. Alternative, and yet very sophisticated frameworks for the assessment of the impact of transdisciplinary research or participatory research (e.g. Walter et al., 2007, Wiek et al., 2014) have been developed, taking up the complex and cyclical perspective. They may form another avenue of inspiration for the assessment of real-world laboratories.

The new research setting “real-world laboratories” finally is packed with expectations such as catalysing sustainability transitions, comes with numerous open questions and, due to both, offers also exciting insides in the functioning of a transformative science.

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