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Principles for Designing Transdisciplinary Research

Proposed by the Swiss Academies
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3.3 Systems, target and transformation knowledge

TR addresses three kinds of research questions: (a) questions about the genesis and possible development of a problem field, and about interpretations of the problems in the life-world; (b) questions related to determining and explaining practice-oriented goals; and (c) questions that concern the development of pragmatic means (technologies, institutions, laws, norms etc.) as well as the possibility of transforming existing conditions. In their vision of research for sustainability, Swiss researchers defined three different types of knowledge which are also often used to characterise TR: systems, target and transformation knowledge.[28]

Table 1: The three forms of knowledge

Form of knowledge	Research questions
Systems knowledge	Questions about the genesis and possible further development of a problem, and about interpretations of the problem in the life-world
Target knowledge	Questions related to determining and explaining the need for change, desired goals and better practices
Transformation knowledge	Questions about technical, social, legal, cultural and other possible means of acting that aim to transform existing practices and introduce desired ones

The difference between TR on the one hand and basic and applied research on the other is a gradual one: TR does not start with specific disciplinary paradigms and action perspectives. Instead, in order to meet its research objectives in the best possible way, TR takes into consideration a large array of potential disciplinary paradigms and life-world perspectives, and it explicitly narrows down its focus to a few of them in the phase of identifying and structuring problems. TR takes into account that knowledge about problem fields is uncertain and social groups' stakes are high. Moreover, TR takes into account the fact that the definition and analysis of problems constitutes disputed ground. Therefore, the production of the three forms of knowledge faces *particular challenges*:

—Systems knowledge confronts the difficulty of how to deal with *uncertainties*. These uncertainties are the result, on the one hand, of transferring abstract insights from a laboratory, a model or a theory to a concrete case underlying specific conditions. Furthermore, empirical or theoretical knowledge about a problem may be lacking, and depending on the interpretation of a problem, these uncertainties may be assigned different degrees of importance, which leads to diverging assessments of the need for action and of target knowledge and transformation knowledge. We subsume all these aspects under the term "uncertainties". If systems knowledge is uncertain, this can be used as an argument to block attempts to transform a problem situation.[29] Therefore, TR faces the challenge of finding a transparent way of dealing with uncertainties in order to avoid blocking the research process.

—In the case of target knowledge, the question is what *the multiplicity of social goals* means for research, for society's practice-related problems, and for transdisciplinary collaboration between science and actors in the life-world. TR faces the challenge of clarifying a variety of positions and prioritising them in the research process according to their significance for developing knowledge and practices that promote what is perceived to be the common good. This is necessary not only when the need for action has to be identified and objectives have to be determined, but also when describing the systems to which they refer and the possibilities of inducing change (see Tool 2, p. 40).

—In the case of transformation knowledge, *established technologies, regulations, practices and power relation*s must be taken into account.[30] This is the mere consequence of pragmatism, since options for change have to rely on existing infrastructure, on current laws, and to a certain degree on current power relations and cultural preferences, in order to have any chance at all of being effective. When these social, cultural and technological givens are not considered, this leads to the often criticised discrepancy between knowledge and practice.[31] For TR, the challenge here is to learn how to make what is established more "flexible".

Transformation knowledge

Technical, social, legal, cultural and other options for change, depending on views of systems relations and goals

Challenge: *Learning how to make existing technologies, regulations, practices and power relations more flexible*

Target knowledge

Pluralism of norms and values, depending on views of systems relations and options for change

Challenge: *Clarification and priority setting of various values in relation to the common good as a regulatory principle*

Systems knowledge

Uncertain knowledge about the genesis and possible development of a problem and about problem interpretations, depending on perceptions of goals and options for change

Challenge: *Reflecting on and dealing with uncertainties through real-world experiments*
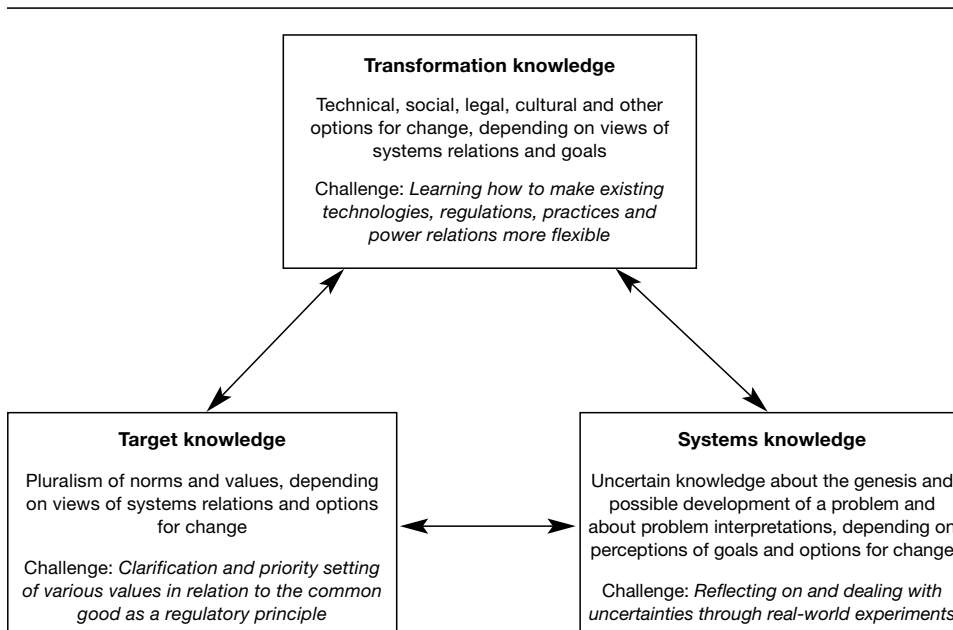
Figure 5: Interdependencies between the three forms of knowledge

TR aims to develop knowledge and practices that promote what is perceived to be the common good. Therefore, TR must consider systems and transformation knowledge. The resulting *interdependencies between the three forms of knowledg*e are the main viewpoint from which the need for knowledge must be identified and structured. Research questions relating to systems, target and transformation knowledge are not isolated in TR; instead, they can only be answered by referring to the other two forms of knowledge (see Figure 5). Thus, an empirical analysis of systems relations will refer to a particular means of transforming a specific social practice and to a specific idea of a better practice. (In the process, a new kind of systems knowledge may be necessary, as illustrated in Example 4, p. 48.) When research questions refer to target knowledge, they are examined based on specific assumptions about systems relations and with a view to particular options for transforming existing practices. For example, when a comparative life-cycle assessment of two products is made, it is based on specific models of natural and economic processes; moreover the assumed transformation is that a positive assessment will allow the product to be distributed more widely. Finally, studies of possible change options are based on specific assumptions about systems relations, goals and better practices, and address the question of what can be done to establish these as standard practices under the given circumstances.[32]

▷ *TR is sometimes referred to by trans-disciplinary researchers in the German-speaking world as an "eierlegende Wollmilchsau", i.e. as beset by the quandary of being "all things to all people".[33] This is an expression of the experience that projects are often confronted with unrealistic requirements and expectations. For researchers, such excessive demands can easily lead to overburdening. Provided one does not believe that TR will become "all things to all people", it can be useful to reduce complexity by positioning research questions with regard to systems, target and transformation knowledge, while taking into account both the interactions between these forms of knowledge and the particular challenges that characterise each of them (see Tool 2, p.40). Research questions may focus on systems, target or transformation knowledge, each with its particular challenges. Positioning the need for knowledge with regard to the three forms of knowledge ensures that their interdependencies are taken into account, even if only one of these forms of knowledge is aimed at.*

Reduction of complexity by specifying the relations between forms of knowledge is an instrument that is often implicitly used, but has until now seldom been explicitly connected with this purpose.

JUST PULLED OUT OF THE HAT:
THE EGG-LAYING, WOOL-BEARING DAIRY PIG

Karl Herweg *

Tool 2: Positioning the need for knowledge with regard to the three forms of knowledge

	Research questions	Particular challenge	Questions to help with positioning
Systems knowledge	Questions about the genesis and possible development of a problem and about life-world interpretations of a problem	Reflecting on and dealing with uncertainties with the help of real-world experiments	② ③
Target knowledge	Questions related to determining and explaining the need for change, desired goals and better practices	Clarifying and prioritising diverse perceptions of targets and values, taking into account the common good as a regulatory principle	① ③
Transformation knowledge	Questions about technical, social, cultural, legal and other possible means of acting to transform existing practices and introduce desired ones	Learning how to make existing technologies, regulations, practices and power relations more flexible	① ②

① *To what understanding of the genesis and possible development of a problem and life-world interpretations of it does the research question refer?*

② *To what kind of need for change, desired goals and better practices does the research question refer?*

③ *To what technical, social, cultural, legal and other possible means of acting does the research question refer?*

Tool 2 helps to position TR vis-à-vis the three forms of knowledge. Using the example of systems knowledge, it can be read as follows: "TR about systems knowledge deals with questions about the genesis and possible development of a problem and about life-world interpretations of the problem. The particular challenge is to reflect on and deal with uncertainties with the help of real-world experiments. TR that produces systems knowledge must answer questions 2 and 3 when tackling problem identification and structuring, because of the interdependencies between the three forms of knowledge relevant to TR."

27 Bruce et al. note: "Disciplines have survived for so long in the academic world because they serve the very useful function of constraining what the researcher has to think about. They set a boundary on the parameters of interest (what to include and what to leave out) and dictate the range of methodological approaches that are relevant. They thus provide a clearly defined starting point for a research project but they also pre-determine to a large extent what the outcomes of the research will be. If this framework is removed (...) in-experienced researchers can be overwhelmed by complexity." (Bruce et al. 2004, p. 467)

28 In the *Visions of Swiss Researchers*, "systems knowledge" is introduced as knowledge of the current status, "target knowledge" is knowledge about a target status, and "transformation knowledge" is knowledge about how to make the transition from the current to the target status (ProClim 1997). As this formulation can be misinterpreted and given a technocratic bias, we describe the contents differently (see Table 1). There are different ways of distinguishing between the three forms of knowledge, especially in relation to TR on sustainable development (Deppert 1998, p. 36, Becker et al. 1999, pp. 1–20, Becker and Jahn 2000, p. 79, Brand 2000, pp. 19–21, Burger and Kamber 2003, p. 52, Nölting et al. 2004, p. 254). Jantsch makes a similar distinction when he describes the "empirical level", the "normative level" and the "pragmatic level". He also mentions the "purposive level", which is at the overall level of the "science/innovation/education" system (Jantsch 1972, see Annex A1). Similar groups of questions can be found in Costanza (1997, p. 79) and Grunwald (2004).

29 See also Sarewitz (2004).

30 See Brand (2000, pp. 20–21), and Brand (2005, in particular pp. 152–158).

31 Routines of practice, regulations, technologies and power relations exist and develop in a very close relationship to one another, rather than independently (see e.g. Hughes 1986, Callon et al. 1992, Callon 1995, Hughes 1998, and Oudshoorn and Pinch 2003).

32 See for example studies on the eco-labelling of hydropower (e.g. Truffer et al. 2003).

33 The term used in the German original of the present publication is "eierlegende Wollmichsau" (literally an "egg-laying, wool-bearing dairy sow") – i.e. an impossible but highly desirable animal in agricultural production. The "eierlegende Wollmichsau" was a central metaphor both at the inaugural conference on socio-ecological research in Berlin, 2002, and at the conference on the future of collaborative research ("Zukunft der Verbundforschung") of the

German Society for Human Ecology in Sommerhausen in 2003. In an analysis of experience garnered by the Swiss Priority Programme Environment, Defila und Di Giulio (1996) describe this multiplicity of requirements and explore its significance in research projects.