Transdisciplinary research: Bridging the great divide between academic knowledge production and societal knowledge requests

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ABSTRACT

This paper is based on a keynote address given at the 2019 IIILs 2018 conference in Orlando, Florida on March 14th. In that address, I spoke about how Design Science Research could help bridge the rigor-relevance gap in management science, and probably in other fields as well. I showed that by weaving design, testing and iterations of the two processes together in a logical and systematic manner, new actionable knowledge can be created along with new scientific knowledge. In this paper I explore the concept of rigor-relevance from a different approach, namely Transdisciplinary Research. Transdisciplinary Research is a process that involves both academic researchers and individuals from professional practice collaborating on finding a possible solution to a complex problem. Knowledge artifacts from the Transdisciplinary Research process contribute to the body of scientific knowledge while at the same time developing solution concepts that can be used by practitioners. In other words bridge the great divide referred to in the title of the paper. Transdisciplinary Research is a complex process involving diverse stakeholders. This requires participants have or acquire new and different competences in order to be effective.

Keywords: Transdisciplinary research, complexity, rigor-relevance gap,

1. INTRODUCTION

Transdisciplinary Research (TR from now on) has its roots in environmental science, specifically the issue of sustainable development, and is considered to have developed due to complex, socially relevant problems that exist in the life-world [1]. Historically, these problems have been strongly related to the idea of sustainable development and consequently a large part of the literature on TR stems from fields working on sustainability[2]. Policies and initiatives for promoting sustainable development target the behavior of individuals, organizations – both profit and not for profit – whole industries, and governments. The social aspect of the research process makes working on issues surrounding sustainability highly complex (Conklin). Proponents of TR argue that this approach is necessary in order to promote sustainable development because it spans different sectors, includes actors from scientific and professional backgrounds and leads to knowledge that is useful for both science and practice.

The goal of this paper is to present the concept of TR as a type of research approach particularly suited for assuring the supply and demand of knowledge between universities and the rest of society is effectively met. By 'effectively' I mean that each stakeholder gets the knowledge they need in a form they can both use: either for solving a complex, real-life problem, which is needed by professionals, or that which makes a contribution to theory, as in the case of the university researchers.

I start the paper by explaining what the actual gap is between the type of knowledge society needs and what it gets from academic research. I then go on to describe the historical and cultural background of the 'great divide' in order to illustrate why it exists. This is followed by a section on the foundations of TR, including its core concerns, its main characteristics and the processes involved in it. I finish the paper with a short discussion on what competences are need in order to work effectively in TR projects, including how we can help our students to gain the needed competences for doing so.

2. THE GREAT DIVIDE

In their book entitled 'The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies' Nowotney, et al [3] discuss two types of knowledge. The first is Mode 1 knowledge, which contributes to scientific theory and scientific practice by developing new theories, research questions, hypotheses and or methodologies in a specific discipline. Mode 2 knowledge is that which can be used for solving complex societal problems such as a practitioner might be dealing with. Following this, I propose that the 'great divide' is inherent in the Mode 1 type of knowledge produced by scientific research. According to van Aken [4] management research turns out knowledge that is "... either scientifically proven, but then too reductionist and hence too broad or too trivial to be of much practical relevance, or relevant to practice, but then lacking sufficient rigorous justification." (p. 221)

Where from, the great divide?
But where does this 'great divide' originate and why? And if bridging it is so important, why does this not occur more often? I propose that the 'great divide' is a result of two factors. The first one is the location where scientific research has traditionally taken place – the university – and secondly how scientific research is performed, typically among researchers from one or maybe two disciplines working together.

Research is done in university departments
In his article that pleas for more interdisciplinary research, Brewer [5] comments that while the world has problems, universities have departments. He is referring to the fact that academic research is typically done within the physical (and cognitive) boundaries of universities in general and in faculties more specifically. The quote illustrates the idea that universities are designed and organized along lines of departments and disciplines, which does not foster collaboration among colleagues from other departments or faculties.

Related to the idea of research taking place in universities is the fear among academics that the quality of science will be eroded as other stakeholders are introduced into the research process. This is especially true in cases where the research has a direct and dependent link to innovation because this could seriously limit researcher autonomy, as they need to satisfy industry goals [6].

Research is done within a discipline

In this section, I try to shed more light on the origin of the 'great divide' by exploring the concept of 'academic discipline' and the consequences associated with staying within the boundaries of one.

First let us look at the etymology of the word discipline. According to Merriam - Webster, the word 'discipline' originates from the Latin words discipulus, which means pupil, and disciplina, which as a noun means teaching. As a verb disciplina means training someone to follow a rigorous set of instructions, but it also means punishing and enforcing obedience. Think about the idea of 'military discipline'. In addition, 'discipline' can mean policing certain behaviors or ways of thinking. Individuals who have deviated from their 'discipline' can be brought back in line or excluded. Disciplinary boundaries exist because they create some coherence in terms of theories, concepts and methods that allow the testing and validation of a hypothesis according to agreed rules. These rules differ according to the specific discipline, making them to some extent incompatible. Therefore it can be argued that epistemology constrains cross- disciplinary synthesis.

One characteristic of an academic discipline is that it has a particular object of research (e.g. law, society, politics), though the object of research may be shared with another discipline. Disciplines also have a body of accumulated specialist knowledge referring to their object of research, which is specific to them, and not generally shared with another discipline. Disciplines also have theories and concepts that function to organize the accumulated specialist knowledge effectively. Furthermore, disciplines use specific terminologies or a specific technical language adjusted to their research object. Another characteristic is that disciplines have a set of research methods developed according to their specific research requirements. Finally, disciplines have some institutional manifestation in the form of subjects taught at universities or colleges, respective academic departments and professional associations connected to it.

There are consequences related to disciplines and maintaining disciplinary boundaries. For example, as a result of increasingly overlapping subject areas, disciplines are now identified more through the methodology they apply to certain topics or research fields, rather than through the topics or research fields themselves: and one should not underestimate the importance of methodology as it determines the quality of the knowledge claims made, based on the research.

Furthermore, and I think most of us who publish in scholarly journals will recognize this, academics are rewarded for disciplinary studies. Other types of studies – multi, inter or trans – are rarely published in scholarly journals. I notice this in my own work, which is often an interdisciplinary case study. While the case study was the most popular qualitative methodology used in Sage journals in 2017, as a percentage of all published research reports it is miniscule[1]. The top 100 most cited journals in the world are in the Bio-medical field and in 2007, qualitative studies made up less than four percent of the papers published in them [2].

Problems in the life-world cross the boundaries between academic disciplines as well as university boundaries. Often these real-world problems are extremely complex, being framed in terms of values and power structures, neither of which are typically considered in mono or multidisciplinary studies.

3. COMPLEXITY, STAKEHOLDER DIVERSITY AND DISCIPLINARITY

In this section I look at complex problems in relation to stakeholder diversity and disciplinarity. I start with a discussion about what I mean by complex problems.

Complex problems
Complex problems, sometimes referred to as 'wicked problems' can be defined as those that are not clearly defined, able to be approached from different perspectives and have no one clear solution. Wicked problems have several defining characteristics [7] that I would like to discuss further. Firstly, there is no agreement by stakeholders on the definition of the problem, owing to diverse and multiple values, varied perception, and different perspectives of those faced with defining it. Secondly, there is no clear solution to the problem due to the multitude of possible solutions and the trade-offs associated with each of the possibilities and finally, complex problems have no clear or easily identified cause. In fact, there may be multiple causes related to the diversity of stakeholders and their perspectives. For example differing jurisdictions or regulatory issues that stakeholders operate within.

The characteristics of complex problems presented above are in stark contrast to what Rittel and Weber [7] refer to as 'tame problems', which are well-defined, able to be solved by one approach and have one solution. Problems in the natural science have these traits, but problems in the social sciences do not. The consequence of this are that no one discipline or methodology can be used to guide actions aimed at reaching a solutions to a complex problem due to the multitude of possible solutions, each having a trade-off.

Stakeholder diversity
Conklin [8] proposes that solving a complex problem is a social process influenced by social complexity, which increases as the diversity of stakeholders involved in the problem-solving process increases. Furthermore, as the complexity of the problem increases, the number and diversity of stakeholders increases as well [7].This is seen in Figure 1 below.

Disciplinarity
Figure 1 illustrates the idea that as the complexity of the research problem increases, the diversity of the stakeholders also increases. I propose that as the complexity of the problem increases, the type of research needed in order to solve the problem changes from a monodisciplinary approach to a transdisciplinary one.

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[1] https://www.methodspace.com/qualitative-research-2017/
[2] http://library.comsats.edu.pk/Files/Impact_Fator-wise_Top100Sciene_Journals.pdf

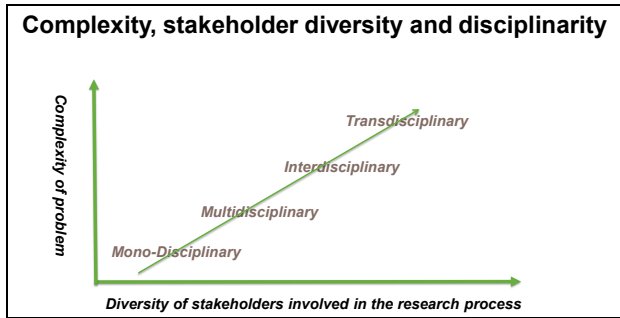**Complexity, stakeholder diversity and disciplinarity**

Figure 1: The relationship between complexity, stakeholder diversity and research approaches

Mono-disciplinary research is a process governed (disciplined!) by a paradigm, which is a specific set of guidelines that include ontologies, epistemologies, objects of studies, frames of reference, theories and technologies[9]. Research questions originate in theory and research artifacts are used to build or further contribute to this theory, through testing hypotheses for example. In monodisciplinary research, problems have a relatively low level of complexity and have a minimal diversity of stakeholders involved in solving them.

Multidisciplinary research is a process that includes a range of different disciplines and is sometimes used for solving 'real-world' problems. Researchers in multidisciplinary projects typically a paradigm from their discipline. The purpose of this approach is to juxtapose rather than combine the different perspectives and thus, in theory, adding a breadth of knowledge, information and methods. Research is carried out independently using a paradigm of a specific discipline. Artifacts are then compared to come to a more complete understanding of and possibly a , and In this case the diversity of stakeholders as well as the complexity of the problems are increasing.

Interdisciplinary research is a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice."[3]

Interdisciplinary research is conceptualized differently in the literature, varying from, wide interdisciplinary research, in which disciplines with little compatibility work together (such as physics and education) to narrow interdisciplinary research, which takes place among disciplines with comparable paradigms [10]. For example in a project involving biology and chemistry. Interdisciplinary research projects typically try to solve problems that occur in the social world, which contributes to the complexity of them.

Transdisciplinary research is a process that integrates different paradigms and results in new types of solution-orientated knowledge as well as new scientific knowledge. TR combines interdisciplinarity with a participatory approach, meaning that it is a collaborative process between academics from different and unrelated disciplines and non-academic stakeholders. TR is aimed at solving fuzzy, real-world problems occurring in social-technical systems and as such are highly complex. In the next

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[3] https://www.nsf.gov/od/oia/additional_resources/interdisciplinary_research/definition.jsp

section I discuss the concept of transdisciplinary research further.

4. TRANSDISCIPLINARY RESEARCH

TR is a process supplementing traditional, disciplinary and problem centered "interdisciplinary" scientific activities. Klein [1] defines TR as 'a process or an activity that produces, integrates and manages knowledge in technological, scientific and social areas.' TR works by organizing processes to incorporate procedures, methodologies, knowledge, and goals from science, industry, and politics. However, as Klein points out, TR does not replace other approaches that are crucial for building theory. Emmelin [11]remarks that TR is a type of knowledge production occurring when a common set of axioms prevails, related to but lying beyond and complementing traditional disciplines. Thus, mono and multidisciplinary research approaches remain crucial for developing new knowledge; TR is not a replacement for these approaches, but rather an addition to them.

Core ideas and concerns of TR
The core idea of TR is that individuals from different disciplines work together with individuals from the professional field to produce new knowledge aimed at solving real-life problems. TR is way to organize processes of mutual learning between science and society o that people from outside academia can participate in the research process [12], and as such has the potential to contribute to the improvement of society , to different bodies of knowledge and to stakeholder learning.

Klein, et al point out four core concerns of TR [1]. The first is that TR is focused on real-life problems, usually where a transition of a system is being promoted. The second core concern is that TR transcends and integrates disciplinary paradigms. Thirdly, TR is a participative approach to research in the sense that academics work with practitioners on solving problems and fourthly, TR strives for a unity of knowledge that goes beyond individual disciplines.

The TR Process
TR has basically three phases [13], namely problem identification, knowledge production and knowledge application. Problem identification is about actually trying to define the problem at hand, knowledge production is the co-creation of new and transferable knowledge and concerns the actual doing of the research. The third phase is called knowledge application, which is the process of bringing the results to fruition and applying them in the life-world of the stakeholders as well as adding to the scientific body of knowledge. The next sections look at more closely at each of the phases of TR.

Defining the problem
"Problems are not given. They are constructed by human beings in their attempts to make sense of troubling and complex situations." This quote by Donald Schön [14, p. 261] gives the essence of problem identification in TR, where problems are defined and framed by different actors. They are in fact social constructs that do not exist until defined by individuals or groups. In monodisciplinary research, problems exist outside of the social world and are discovered by researchers looking from a specific disciplinary paradigm rather than constructed in a social process. In MR, problems may be complicated, but are

not necessarily complex. This is due to the nature of the problem itself and the fact that from an MR perspective, problems exist outside of the social world. In the case of TR, participants acting in a social world define the problems to be researched. These problems are typically ill defined, complex and subject to social forces that may not be known beforehand, or emerge as the research process is underway. Furthermore, problems in TR typically deal with a transition of an existing system to a new state [15].

Developing research questions

Changing systems requires developing knowledge about the initial state of the system. Systems knowledge is needed to understand this initial state of the system – its structure, the dynamics of it and the history of the system, or how and why it developed as it did. Knowledge about what the future system should look like is needed to develop the goal of the research or in other words a desired or target state of the system. Questions relate to what the desired state of the new system is and help explain the importance of the change. A third type of question relates to the elements of the transition process, which considers how to go from the initial state to the desired one. Questions here are concerned with organizing the knowledge production process, including developing the methodologies for coming to a solution. This is sometimes referred to as a reflexive process, as knowledge about the actual learning processes of stakeholders is crucial [16].

Knowledge creation

Knowledge creation in TR is a co-creative learning process that entails participation by each of the stakeholders throughout the process aimed at developing solution-oriented and transferable knowledge [1]. The second phase of the TR process entails executing the research according to an adopted set of integrated methods, which helps to integrate the different bodies of knowledge coming together during the process. The key here is a research design that promotes specific goal-oriented collaboration among the stakeholders, as well as the level of stakeholder participation.

In our experience, the beginning of this stage is closely linked by a feedback loops with the problem definition phase; new knowledge about the current state of the system is explicated and fed into the vision on the target state in an iterative process.

Managing the TR process can be very difficult. Problems include conflicts between stakeholders concerning suitable methodologies, knowledge integration may not occur due to cognitive, organizational, technical or communicative reasons or the research team itself may not function effectively [17].

Knowledge application

Knowledge application, which is bringing the results to fruition and applying them in the life-world of the stakeholders as well as adding to the scientific body of knowledge, is the third phase of the TR process. It is the process where research results are used, applied and implemented. It is a (re-) integration of results into societal practice in the form of strategies, concepts, prototypes, measures, etc. and scientific practice, in the form of new theory, methodologies and research questions. According to Lang, et al [13] the classical transfer of knowledge from science to practice takes on a different form in TR, namely that of (re) integration of the new knowledge into the existing worlds. Furthermore, TR triggers learning among stakeholders, which is another non-tangible outcome. Problems with up

scaling and lack of transferability of results are issues at this stage that need to be managed.

A Conceptual model of the TR process

The model shown in Figure 2 below is a culmination of the discussion about the TR process so far and shows the interconnectedness and iterative aspects of the TR process.
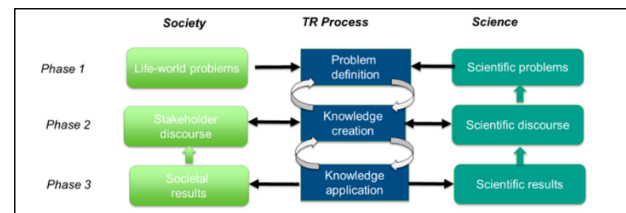

Figure 2: A phase model of TR processes (based on [13]*)*

In Figure 2 we see that both life-world problems and scientific ones give input for the problem definition. In phase two, stakeholder-specific discourses influence the knowledge creation process. These discourses are based on and influenced by the different aspects of society, for example politics, media, governmental and non-governmental institutions, etc. Different institutions and the research done within them, on the other hand, mediate scientific discourse. For example universities, industrial research firms, consultancies. Phase three involves integrating new knowledge into society in the form of reports, new insights or innovative policies and at the same time new research questions, theories or methods for scientific practice. Thus, TR as it has been described in this paper can bridge the great divide between science and practice, while assuring the supply and demand of knowledge between universities and the rest of society is effectively met.

5. COMPETENCES FOR PARTICIPATING IN TR PROJECTS

Working in TR requires two types of competences needed for the special challenges of working in TR projects [18]. The first type is needed for a fruitful exchange and interaction between worldviews in transdisciplinary processes. This concerns collaborating in the TR environment. Examples of these types of competences are to the ability to reflect on one's own discipline and relate one's own way of thinking and acting to that of other experts from in and outside academia. Another example of this type of competence concerns accepting scholars from other disciplines and experience-based experts as equal. And finally adapting to collaborating with individuals from different fields of expertise is crucial to effective behavior in TR projects.

A second type of competence relates to the ability for designing and managing the social and technical aspects of TR projects. For example knowing what types of special challenges and problems can arise in TR projects, designing consensus-building and integration processes and effectively supporting efficient and effective communication and collaboration. In essence this is an ability to understand and guide interdisciplinary communication, with the addition of experience-based experts, which makes it even more complex. Participants in TR projects can learn by doing if the project environment has elements of reflection built into the processes, which in effective projects is usually the case [19].

Towards a transdisciplinary higher education curriculum

Any curriculum aiming to prepare students for working in TR projects will need to consider the two types of competences just discussed. Additionally, courses should cultivate curiosity about other disciplines and an acceptance of how others think and act [18]. One could say the 'ability to leave one's comfort zone' and feel competent in doing that.

A curricula aimed at developing TR competencies should be made up of both practical and theoretical elements. The latter are important for gaining knowledge about different fields and the concept of working in a TR project. The former is to experience TR first-hand. However, DiGiulio and Defila [18] warn that a practical element should not be a dry run; it needs to be directly linked to what students are currently engaged with. For example our students were writing their theses on supply-chain management or information systems.

In a curricula guided by the concept of TR, disciplines should not disappear and are in fact essential building blocks needed for sustainability learning. Only once the building blocks are in place, can students begin on learning the key skills of transdisciplinary education, namely the ability to locate and work with pertinent information, to compare and contrast different methods and approaches, to clarify how differences and similarities relate to a designated task, and to generate a synthesis, integrative framework or more holistic understanding of a particular theme, question or problem. Hyun [20, p. 9] comments that:

"In terms of higher education curriculum, developing and offering transdisciplinary degree programs that encompass relevant scientific épistémè with the human knowledge of the real-life world (i.e., praxis, poïesis, and phronēsis) would be a critically and socially responsive practice. In this regard, academic departmentalization, its fragmentary structures, and curricula are mostly based on the traditional mono-épistémè, which should be challenged."

6. CONCLUDING REMARKS

In this paper I conceptualized TR it as a way of organizing learning and knowledge production processes among stakeholders from the triple helix – industry, government and academia and aimed at solving complex societal problems. In my university we have the mandate to improve society and are starting to integrate TR more thoroughly into the curricula. However, it is not an easy road because it demands new competences from the faculty and the staff. However, it is important to do so if we as educators and scholars, want to have real impact on our life-world.

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