Towards Transdisciplinarity:

Understanding Current Multidisciplinarity in Designing Sustainable Urban Solutions

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The objective of this paper is to explore the current strengths and weaknesses in design practice when experts from different professional areas come together to design urban solutions according to sustainability principles. Through interviews with professors from diverse fields we aim to clarify how various professionals define the concept of sustainability and locate themselves, their specialist knowledge and practices within it, as well as how they perceive the other disciplines' possibilities to provide input. This sheds light on the current gaps and misconceptions in multidisciplinary urban system design, and on how knowledge and competence is currently used, transferred and shared or protected. This in turn informs how to better build a truly transdisciplinary urban design collaboration process.

More than half the world's population now lives in urban areas, and by 2030 it is predicted that five billion people will be living in cities (UNFPA, 2007: 1). Such concentration of services and human resources creates threats to sustainable development, but also carries great potential for more effective use of material resources, land, and promotion of prosperity. However, prosperity is too often tied to the idea of economic growth rather than ideals of "happiness" or "a good life". Economic growth, originally intended to increase production and consumption in order to create more wealth and well-being, simply "isn't working" in delivering poverty reduction or adjusting to the limits of the ecosystem (Marks et al. 2006: 6).

Moreover, the scale of the coming changes in urbanization necessitates proactive planning now, rather than the present-day reactive approach (UNFPA, 2007), and it is thus in the urban context where the future of sustainability is to be made. New kinds of innovations, changes in systems of production and consumption, and even societal transformations are required. Dealing with this kind of system complexity in urban design requires a collaborative approach with many experts and stakeholders participating, and collaboration brings with it its own challenges.

The aim of this study is to examine the mechanics and background of this type of interaction in sustainable design processes, in the context of collaborative urban system planning. The context of the study focuses particularly on the Creative Sustainability (CS) Master's degree programme in Aalto University, Helsinki, Finland. This focus has been selected as the aim of the programme is to foster sustainable innovation through principles of urban and industrial sustainability and corporate responsibility, and especially because the programme and its individual modules serve as a suitable laboratory for both initiating and observing multidisciplinary and interdisciplinary projects. In the next sections we elaborate on the concepts of urban design for sustainability and transdisciplinarity before moving on to describing the empirical study.

Urban sustainability

A city can be defined as the "interface space between humans and nature" and as a "social-ecological system" (Du Plessis, 2008: 1) that is marked by complexity, uncertainty, and diversity, representing a realm where "social, technical and economic developments interact with elements of value and culture" (Klein, 2004: 517). Urban planning – originally a rather positivistic practice related to spatial and quantitative information – is taking on an increasingly normative role, as functionally and technically feasible solutions are no longer sufficient: projects today also need to be socially acceptable and ecologically sustainable (Pinson, 2004: 506).

For planners, urban designers and architects, this changes how projects are regarded and what methods, frameworks and tools are appropriate, especially as many more stakeholders are increasingly participating in the decision-making process (Després et al, 2004: 476-478; UNFPA, 2007). Such a project is thus managed more like a "chain of encounters" (Després et al, 2004: 478). What is at work in transdisciplinary urban context planning and design is "communicative rationality" rather than simply "cognitive rationality" (Després et al. 2004: 476).

Sustainable design and a systems approach

Traditionally sustainability as a concept is perceived to address the three dimensions of ecological, economic and social (or socio-cultural) development (Brundtland, 1987: Ch. 2). Although all dimensions of sustainability are said to be equal, the environmental dimension forms "a precondition" for the other dimensions (Tukker, 2008: 15). Furthermore, other definitions of sustainability emphasize different dimensions and in general have a "clear anthropocentric character" with human development as the key point (ibid.: 15). Discussion around the vast number of attempts to "operationalise the notion of sustainable development" to create holistic or separated frameworks and indicators for sustainability (ibid.: 19) is "far from unambiguous" (ibid.: 24). Specifically, many concepts of sustainable consumption and production (SCP) garner agreement as long as they are expressed as *general notions*, but when the attempt is made to specify these notions, interpretative conflicts arise (ibid.). Sustainable design itself can be implemented only if "an appropriate understanding of unsustainability" and the problem context are defined (Clune 2009: 262). According to Clune "how you define is how you design" (2009).

Brezet proposes that the type of innovation with the most capacity for environmental improvements is "system innovation" (1997: 21). Sustainable system innovation enabled through "system design" (e.g. Vezzoli et al., 2008) not only entails technological innovation, but socio-cultural and organizational innovation as well (ibid.: 3). This requires promotion of a systems approach and understanding in complex networks of collaboration. Understanding the interactions – in the system that is designed as well as in the collaborative network – helps to link to a cumulative knowledge framework.

Understanding transdisciplinary processes

Research on what sustainability means must inevitably have a "trans-scientific character" (Tukker, 2008: 25), because basic disciplines of society "cannot in isolation provide sufficient and necessary solutions for sustainability" (Shin et al. 2008: 1833). An interdisciplinary approach is an "essential requirement" in design for the environment (Lewis and Gertsakis, 2001: 15) and even more in sustainable design. This section will elaborate upon the definitions of and issues entailed in multidisciplinarity, interdisciplinarity and transdisciplinarity.

Multidisciplinary processes involve several disciplinary perspectives juxtaposed side by side, with each perspective having its own autonomy. The intention is not to integrate the knowledge of a complex issue or produce a holistic view of the study area, but to broaden the knowledge base with more information sources, methods and theories (Hukkinen, 2008: 62-63; Bruun et al, 2005: 28), and there is thus little cross-fertilization among the disciplines and no explicit goal to achieve synergy in the outcomes (Pohl et al, 2008: 5). Interdisciplinarity rather aims for a more comprehensive – even unified – understanding of the given issue, which is marked by its complexity. Transdisciplinarity, especially in the realm of sustain-

ability, goes a step further by extending into society itself, involving for example political actors and other societal sectors beyond academia (Hukkinen, 2008: 62-63, 67; Bruun et al, 2005: 31).

Transdisciplinary processes are moreover generally understood as being normative or socially responsible (Hukkinen, 2008; Pohl, 2005: 1159); in short, "transdisciplinarity raises the question of not only problem solution but problem choice" (Klein, 2004: 518). This involves a shift from science *on* or *about* society towards science *for* and *with* society (Scholz and Marks in Bruun et al, 2005: 31).

While the type of knowledge and boundaries between disciplines can change, sound disciplinary contributions are still needed if transdisciplinary research is to be meaningful (Pohl et al, 2008: 7, 8). A "cohesive approach" or "an integrated knowledge approach to sustainability" does not work in conflict with existing core disciplines but rather enables them "to better perform their proper functions" (Shin et al, 2008: 1834). There arises a need to "rearrange" a particular discipline's knowledge in a way that transdisciplinarity can be achieved (Pohl, 2005: 1175).

Transdisciplinary knowledge

Inter- and transdisciplinarity require a new blending or 'hybrid' understanding of knowledge: a cognitive process whereby two partial domains of knowledge, two partial mental models, meet and meld, creating an "input space" (according to Hukkinen, 2008: 71) or a "mediation space" (according to Després et al, 2004: 475). Put more simply, when one expert meets another expert, they begin to explore where they have a common understanding. This is done cognitively through the use of analogies or pattern recognition, adopting selective elements and relationships from the familiar input spaces to construct a new human-scale mental model that is easy to understand. (Hukkinen, 2008: 71) This blend in fact becomes a new, emergent domain of knowledge that is qualitatively different from its partial inputs (von Ghyczy in Hukkinen, 2008: 65).

According to Després, the mediation space in transdisciplinary research thus includes the following: 1) definition of complex research objects and problems; 2) definition of epistemological positions; 3) selection of operational concepts; 4) elaboration of the research strategy; 5) combination of research methods; and 6) construction of interpretative theoretical frameworks. (Després, 2004: 475) This happens iteratively: the heterogeneous sources of knowledge contributed in various components and forms from the various disciplines are iteratively integrated to produce new, emergent forms of systems knowledge (by analyzing complex empirical knowledge), target knowledge (goal setting in order to better deal with problems), and transformation knowledge (by investigating how existing practices can be changed) (Wiesmann et al, 2008: 6). The forms of knowledge other than scientific critical to sustainability-oriented system design and planning also include instrumental and ethical knowledge (of cultures, norms and beliefs, for example) (Klein, 2004: 521).

Systems intelligence moreover introduces the perspective of an "adaptive, acting and feeling" human approach to the systems framework (Saarinen and Hämäläinen, 2010: 19). In design what emerges is an "emancipatory knowledge", which is open and systems oriented (Saarinen and Hämäläinen, 2010; see also Clune, 2009), and sees "the totality of approaches informing each other" as practical knowledge will be informing the technical knowledge (Clune, 2009: 11). In summary, for a transdisciplinary process to truly succeed, the meeting and melding/blending of the various types of knowledge needs to occur at the level of defining goals, "co-constructing" the research object (Després et al, 2004: 475), choosing or creating a common framework, communicating and sharing vocabulary, agreeing on ethical standpoints, and creating a shared vision (e.g. Gloor in Archer et al, 2009).

Barriers to collaboration and transdisciplinarity

Coming to a mutual understanding and reaching a shared mediation or input space is the most obvious challenge in achieving transdisciplinarity. Experts can feel vulnerable when their competence is redefined and new evaluation criteria are needed (Klein, 2004). Disciplinary theories that only apply in more restricted domains are often wrongly scaled up to infer universal laws (Hukkinen, 2008: 54). Moreover, different systems (and subsystems) differ in hierarchies of level (qualitative and functional) and scale (Du Plessis, 2008: 4), and there are likely to be crucial differences in how disciplines frame their space and time boundaries when defining the system or even in how they define the social-ecological system itself (Hukkinen, 2008). These differences and conflicts can lead to an overall lack of commitment, understanding, and action.

Even the most non-hierarchical network suffers from the lack of an effective and committed mediator, gatekeeper (Gloor in Archer et al, 2009: 40), or hybrid expert (Hukkinen, 2008) that can facilitate the process, moderate the participation, and negotiate the power relations. Neglecting the diversity of goals, values and expectations in transdisciplinary processes may result in purely symbolic participation; this in turn carries the danger of solidifying roles and positions with low innovation potential (Wiesmann et al, 2008: 8).

Stereotypes and assumptions about the other disciplines can also lead to underestimation or overestimation of the others' competence and experience (e.g. Wiesmann et al, 2008). Typically, or stereotypically, the "social scientist consults the natural scientist about *what* to implement and the natural scientist consults the social scientist about *how* to implement" (Pohl, 2005: 1171). However, a study found that especially in sustainability-oriented research, researchers tended to be either an "Engaged Problem Solver" engaged in solving environmental problems, or a "Detached Specialist" who provides expertise to those solving the problems. Engaged Problem Solvers tend to avoid discussing (or even refuse to discuss) a topic in an abstract way, while Detached Specialists can discuss things in a more abstract, generalized and context-free manner (ibid.: 1170).

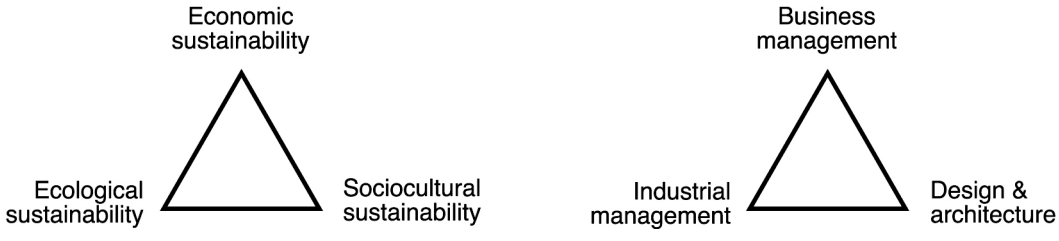
Studying these experts in a transdisciplinary knowledge network (with a framework for actions accordingly) is crucial in gathering research material on transdisciplinary processes. In order to detect and understand these issues in practice, the following two sections present the empirical data gathering in our study and our findings.

Materials and methods

In this study interviews were conducted with a group of professors working in the Creative Sustainability study programme. The data – from both the qualitative interviews and quantitative questionnaires – was then analyzed in order to clarify how various professionals define the principles of sustainability, locate themselves in relation to those principles, how they perceive the other disciplines' possibilities to provide input, and how knowledge and competence is currently used, transferred and shared or protected in what we assume are usually multidisciplinary and not yet truly inter- or transdisciplinary processes.

As our focus, we chose triangular differentiation (see Figure 1) according to the three well-known pillars of sustainability and three professional areas mentioned in the CS web pages. This three-fold differentiation between both the dimensions and the professions is not clear of controversy, and it challenges the interviewees to balance between different professional points of views and reflect on their knowledge.

Figure 1: Differentiations used in the interview.



Working theses

We formed several working hypotheses to consider from the points of view of urban sustainability and the transdisciplinary approach. One clear set of research questions regarding design in urban contexts pertains to how sustainability is defined by various professionals and by emphasizing these various dimensions. We are therefore interested in explicitly drawing out these definitions and how different concepts, their definitions, and approaches are perceived.

Another area of questions is related to the transformation from multi- to interdisciplinary approaches towards transdisciplinarity. The assumption is that in a systems context knowledge transforms according to the number of perspectives brought into the picture and that this requires some sort of theoretical framework relating to intelligence and communication skills, and even an ethical vision.

Lastly, according to the literature, there are hybrid experts (Hukkinen, 2008) or gatekeepers (Gloor, 2006). The assumption here is that the interviewees represent a group that is open to notions promoting transdisciplinary processes and are familiar with transdisciplinary practices. Furthermore, the assumption can be made that these people are either Detached Specialists or Engaged Problem Solvers (Pohl, 2005). These types might handle controversies in defining sustainability differently.

Box 1: Working theses for the interview analysis.

1. Definitions of (dimensions of) sustainability are lacking or vague, but a relation to the problem context helps to understand them. It is also possible to find emphases for sustainable design in the urban context.
2. Disciplines tend to define systems with their space and time boundaries differently; collaborative action thus requires a common framework (knowledge, language, vision).
3. In contrast to traditional disciplinary professionals, people participating in multidisciplinary practices are more open to transdisciplinary processes as well. An individual's approach to problems is related to their professional personality type.

Findings

The questions were worded such that the three sustainability dimensions and three professional areas had to be compared each to each other. The responses are visualized three-dimensionally so that even the conflicting answers can be represented (see Figures 2 and 4). Responses to questions on how different professions in urban design emphasize sustainability dimensions are positioned in a three-dimensional space with axes of increasing importance (see Figure 3).

The four professors interviewed can be seen even as hybrid experts in the field of transdisciplinary sustainability, due to their profession in multidisciplinary education. They represented fields from business (2) and design (2). In this analysis we should therefore bear in mind that the gathered interview material is from pioneering academics from management level (professors in business and design) who strongly promote transdisciplinary principles (Pohl 2005: 1175). Therefore, in the analysis we focus on similarities in thought patterns regarding urban sustainability and transdisciplinarity, to address both our working theses and the findings from literature.

Defining urban sustainability

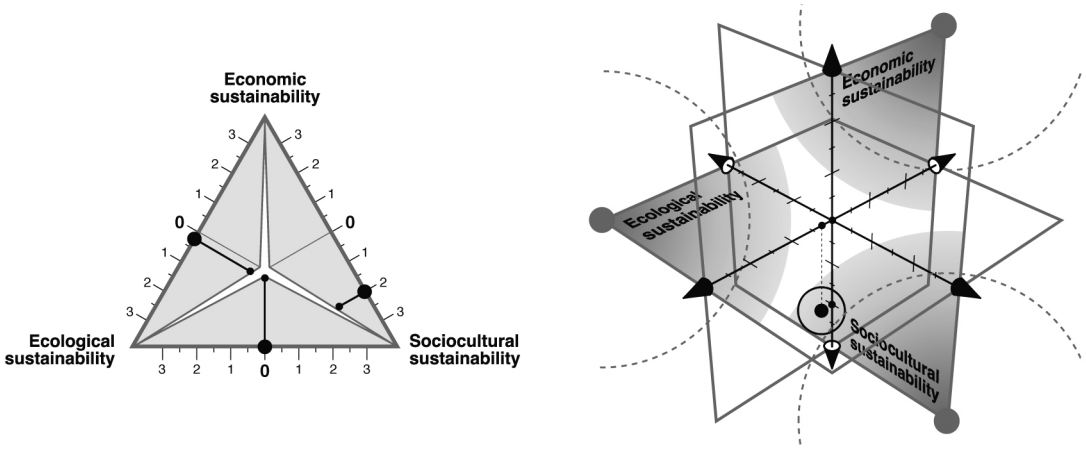
To define sustainability in urban contexts, the respondents were asked to choose how they would emphasize the three dimensions of sustainability: economic compared to environmental, environmental compared to socio-cultural, and socio-cultural to economic.

- *Question: From your professional point of view, which dimensions of sustainability should be emphasized over another, when pursuing more sustainable solutions for products, services and living environments in urban contexts?*

In the responses there was no clear unified mindset, and all three emphases were placed first in some answer. This seemed to be due to a different understanding of the interconnected dimensions themselves, as it was possible to see any of them as a prerequisite for the others. The urban context, however, helped the

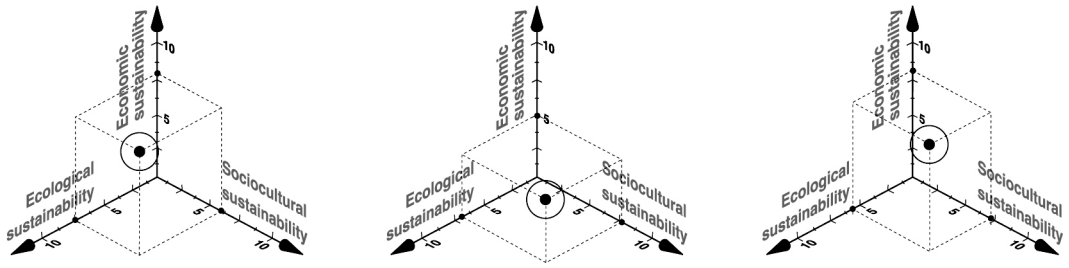
interviewees to create some differentiation (see working thesis 1), and there was some agreement on the importance of socio-cultural aspects over economic (see Figure 2).

Figure 2: Which dimension of sustainability should be emphasized in urban contexts, median results.



Interviewees were asked to compare emphases in dimensions of sustainability in relation to different professional areas. This was to determine how important the dimensions of sustainability were perceived to be to the individual fields in the urban design context. All four interviewees addressed the importance of time scales multiple times, when addressing problems related to different professional areas (see working thesis 2). There were problems in actually defining these professional areas; regardless there was some agreement that can be seen in median results (see Figure 3).

Figure 3. The importance of different dimensions of sustainability in relation to different professional areas in urban design contexts, median results.

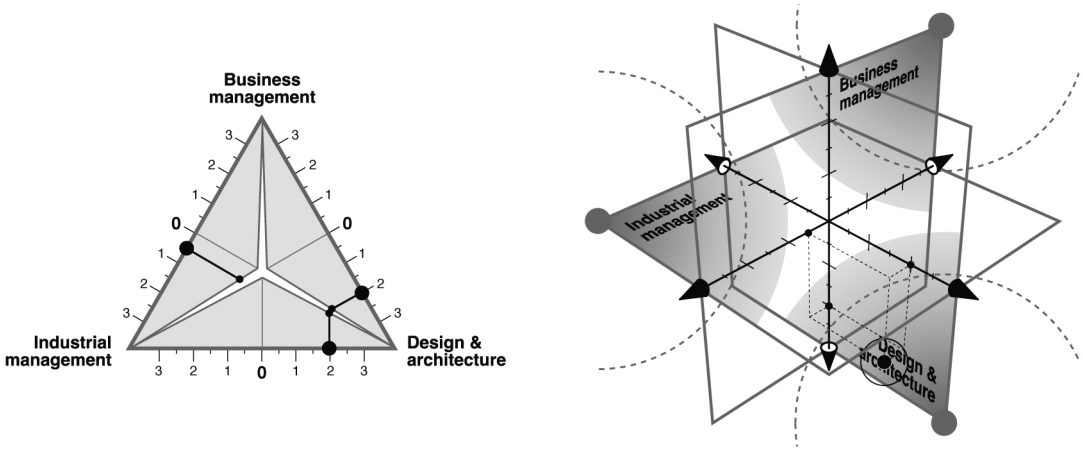


The interviewees were also asked to compare the importance of the different professional areas in an urban design process:

- *Question: How crucial a role do different disciplines play in an urban context sustainable design process, if compared to each other?*

There was no clear agreement in the results, as business and industrial management (and also sometimes design) were seen as somewhat inseparable. However, because of the urban context, design and architecture were perceived to have a somewhat larger role than industrial management and business management (see Figure 4). Interestingly the important role of design and architecture was strongly agreed on by the business side, even more than by design professionals.

Figure 4. The importance of the three professional areas in urban context design processes, median results.



Differences in approaches to transdisciplinarity

All interviewees agreed that problems related to sustainability are complex and require collaborative action (see working thesis 3). They also agreed that disciplines tend to perceive sustainability in several ways (see working thesis 2). The starting point was seen in finding "the right problems" and initiating a dialogue between professions, and for this particular context frameworks and even cases can offer the space where merging of the disciplinary knowledge can happen.

An interdisciplinary approach with holistic views was seen to be beneficial, with some limitations regarding sustaining the "disciplinary core", which relates to the risk of losing "what the different parties actually care about in that system" (Hukkinen, 2008: 45). In other words the disciplinary identities or disciplinary perspectives are regarded as still strongly needed.

It was seen as most problematic to open disciplinary competences to "outsiders", perhaps for the individual vulnerabilities and stereotyping tendencies mentioned in the literature. Both a mutual framework (including language, ethics, and a vision) and independent professional identity are seen as necessary. Perhaps success in transdisciplinary activities means that one is able to balance between the two.

The differentiation between Detached Specialists and Engaged Problem Solvers (Pohl, 2005) was not necessarily clearly seen in the interviews, but some of the interviewees emphasized the context more strongly than others, as others emphasized process. Similarly to Pohl, these types were not clearly relating to professional background, but instead it seems the "two roles are interchangeable and are not mutually exclusive" (Pohl, 2005: 1171).

Box 2: Approaches to multi- or interdisciplinarity.

> *"Intellectual environments that typically conceptualize (…) bring a wide scope of actors into the puzzle solving. And with the kind of time horizon that is much longer than is currently (…), that type of approach could then be triggered from more ecological and more socio-cultural sustainability approaches and then be piloted with a set of actors together"* (interviewee 1).
>
> *"There has to be a kind of disciplinary core (…) and then you should, after, or when you have that it's better also to notice that I'm different than the other one... and then you can start to learn ... how to communicate and so on"* (interviewee 2).
>
> *"It's not enough that you have an ideology for sustainability. That means that you also have to have an understanding of the (…) real processes that are in use currently, and then that are in the opportunity space that can be created through the combination of professions"* (interviewee 1).

Discussion and conclusions

Already now and even more so in the future urban life will be largely accountable for the sustainability of societies. At the same time the urban context includes complex and tight networks creating opportunities for system innovations. Not only cities (Du Plessis, 2008), but also collaborative networks can be seen as social-ecological systems (Hukkinen, 2008). The shared aspect in these types of systems is that "their constituent agents are constantly making predictions based on its various internal models of the world […] and adapting to each other and to the external environment" (Du Plessis, 2008: 4). In this sense the dynamic system of a city is the ideal context in which to study the complex issue of sustainability.

Our group of respondents seemed to agree that there are "sustainability gaps", varying by "time, space and perspective", which exist for a society related to problems in understanding what should be done, can be done and has been done "according to the paradigm of sustainability" (Shin et al, 2008: 1834). The process of creating holistic and innovative ways of thinking for sustainable design is not straightforward, because it is not simply a "conflict between private interests, short-term and public long-term perspectives", but rather "an unceasing debate between different worldviews of humanity and nature" (ibid.: 1823). To proceed towards transdisciplinarity knowledge frameworks and scenarios, indicators, even visions and mental models have to be brought into the discussion and integrated, as was clearly acknowledged by the interviewees. The key element seems to be in balancing the different dimensions, issues and roles that are related to the problem context, and these should be studied further.

Sustainable designers should have an understanding of "how both social and technical innovations are required by design" (Clune 2009: 57) and be able to collaborate with several professionals. This expanding disciplinary approach naturally affects the professional identity of the designer. Collaboration with stakeholder networks creates a new role for design that is also aimed at "promoting, facilitating and setting the conditions" for system innovation (Vezzoli et al, 2008: 2).

While disciplinary identities or disciplinary perspectives seem to remain a prerequisite, in order to be able to properly access transdisciplinary knowledge, subsequently one also has to be ready to expand her disciplinary perspective. According to Pinson, transdisciplinarity is precisely how multidisciplinarity can be interpreted in a way that does not exclude specialization (2004: 507). Perhaps transdisciplinary activities require the ability to balance between specialization and generalization. In a transdisciplinary approach to design and research Clune's proposal "how you define is how you design" (2009: 269) should be developed further to "how you elaborate is how you collaborate".

The importance of an integrated knowledge approach is in its ability to "generate the art of stewardship for building a sustainable society" between ecology and economy (Shin et al. 2008: 1836) and also further. People's happiness can be seen as the greatest good, and this understanding of happiness also embraces "living and doing well" (Marks et al. 2006: 6). This is one of the key questions to address in disciplinary collaboration towards transdisciplinarity, because it is more important to "get the actions within systems right than the theories of those" (Saarinen and Hämäläinen, 2010: 18). This encompasses actions and activities within transdisciplinary networks, collaborative design processes and cities themselves.

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