Transdisciplinarity in Information Systems: Extended Reflections

Completed Research Paper

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Abstract

In this paper, we review the concept of transdisciplinarity with emphasis on its value for Information Systems (IS) theory and practice. In keeping with prevailing research on this topic, we study the relation between IS research and concepts originating from theoretical debates around disciplinarity. In particular, we attempt to deepen the understanding of transdisciplinarity as a means of overcoming (or extending) prevailing disciplinary undertakings. We attempt to locate the concept, thus, within the theoretical ambit of IS, especially concerning issues of relevance and impact – two fundamental properties of transdisciplinarity. We build towards new or extended applications of transdisciplinary in the Information Systems with reference to Information and Communication Technology for Development (ICT4D). In conclusion, we note the disciplinary competencies that underpin transdisciplinary approaches.

Keywords

Transdisciplinarity, Information Systems, disciplinarity, pluralism.

Introduction, aim and significance

Thomas Friedman uses the metaphor of the "flat world" (2005) to describe the dynamics of a globalised information economy. Whilst this world indicates the flattening of formerly divisive boundaries (especially in economic terms), it also refers to the emergence of a single, hyperconnected landscape. In this is contained a process of perpetual digitisation – also termed hyperconnectivity – which itself creates new opportunities for social, cultural and economic engagement. In the sciences of Information Systems (IS), this flattening of the world through digitisation also prompts the reshaping of disciplinary boundaries. Information Systems should ideally respond to the multitudinous dynamics of a flat and hyperconnected world, some of which go beyond its historical disciplinary scope. The flat earth premise is therefore also useful in exploring the 'next frontiers' of the computing disciplines.

Information Systems has arrived, in some respects, at its Rubicon. As it grapples with a legacy of positivist orthodoxy, espoused largely by its functionalist thinkers (see Hirschheim & Klein 2012), Information Systems is challenged to deepen and broaden its philosophical underpinnings. In this context of disciplinary uncertainty, there is scope for flat-worlded and hyperconnected thinking: "[t]he time has come for us to begin exploiting the 'flatness' of this world with open minds and a commitment to transdisciplinary research and education, the next frontier in the intellectual and societal growth of human kind" (Madni 2007:10). And although research in IS has indeed been characterised by the use of a variety of methods and theoretical underpinnings, this raises concerns about the "rigour of scientific results of IS research and about the legitimacy of the IS academic field" (Porto de Albuquerque et al. 2009:88). Conversely, a number of researchers have supported the view that diversity is a strength of the IS field, and that pluralism is necessary in coping with the complex and multidimensional issues studied (ibid.).

In this paper, we further explore these concepts of diversity, pluralism and multidimensionality with emphasis on their value for Information Systems theory and practice. In keeping with prevailing research on this topic (Porto de Albuquerque et al. 2009; Hassan 2011; Wahoff et al. 2012), we study the relation between IS research and concepts originating from theoretical debates around disciplinarity. We attempt to locate the concept, thus, within the theoretical and educative ambit of IS, especially concerning issues of relevance and impact – two fundamental properties of transdisciplinarity.

In the following sections, we briefly describe our methodological approach as a qualitative review of IS literature. This is followed by an exploration of the lead concepts of 'disciplinarity' as employed and advanced in the Information Systems literature. We proceed to discuss examples and new applications of transdisciplinary IS, as evidenced in the body of literature that was surveyed. Finally, these sections – reviewing the theoretical and practical instances of transdisciplinarity – are summarised by highlighting key outcomes and implications. We conclude the paper and discuss the competencies that personify 'transdisciplinarians'.

Methodology

This paper explores transdisciplinarity in IS by means of a qualitative, meta-analytical review. This method is similar to former approaches in this field (see Eybers et al. 2013; Boell et al. 2013). A literature search was performed on peer-reviewed academic resources, notably in the AIS Senior Scholars' Basket of Journals, the ACM Digital Library, and the IEEE Xplore Digital Library. In addition, Google Scholar was employed as a site aggregator, to also include resources not found in the latter: books, working papers and proceedings. Search terms (across the title, abstract, keywords, and body) constituted the key words that inform this review: "information systems", "-disciplinary/ity", and "intra-, multi-, pluri-, cross-, inter-, trans- disciplinary/ity". This was crosschecked against the period 2000-2014, although older material is included for historical context. The literature search yielded thousands of (potentially relevant) resources, and was further distilled by eliminating unwanted/non-relevant keywords (e.g. "wearable health systems"; "landscape ecology"; "information retrieval") that did not immediately pertain to the concept or nature of (trans)disciplinarity. Resulting resources – particularly titles, abstracts and keywords – were assessed for relevance and a literature pool was thus compiled.

Similar to the method of Eybers et al. (2013:3), a meta-synthesis approach was used to "integrate, evaluate and interpret the content of the final literature pool". This is presented in a narrative form, so to arrange a logical and seamless flow of ideas. This structure helps position the common properties and discussion points that are central to the analysis. It must be noted that this review is by no means exhaustive, and that potentially relevant material may yet be included in future analyses. We did attempt, however, to canvass the most applicable and significant academic resources.

Disciplinarity in the Information Systems

The characteristics, rules and goals of Information Systems indicate four 'doxas' that have shaped its development as academic field (Hassan 2011:456): (1) the IS research community sees no difference between fields, disciplines or sciences; (2) IT changes so rapidly, and thus the IS field needs to change to remain relevant; (3) disciplines are by definition rigid, inflexible and uni-theoretical; and (4) because IS is pluralistic, IS should not become a discipline. And although IS is generally regarded as an interdisciplinary field (Porto de Albuquerque & Simon 2007), there have been ongoing calls for its embrace of pluralism and transdisciplinarity to widen its scope (Galliers 2003). There is, Galliers argues, "strength in diversity and pluralism", with a reductionist agenda for IS being dangerous and self-defeating because "[c]losed systems exhibit entropy; open systems do not" (2003:346-347). This notion of diversity as a disciplinary property is therefore seen as capable of ordering the uncertainty of single or bounded disciplines.

To fully grasp such concepts of disciplinarity, one may look to another, that of multidisciplinarity. This denotes the collaboration of scholars from various disciplines to investigate a specific problem from multiple perspectives. The problem with multidisciplinary projects, however, is that they often "mechanistically pool the expertise of participant disciplines" (Kyriakidou & Ventners 2007:840). Resultantly, there is little understanding amongst collaborators of the goals and preconceptions of other team members, which may eventually lead to a breakdown in communication (ibid.). The participant

disciplines may naturally differ in ontological, epistemological and methodological perspectives. Although inherent to most applications of disciplinarity, if not resolved, these may contradict the very principle of diversity that multidisciplinary projects embrace. However, the degree of integration between disciplines is restricted to the linking of research results; disciplinary perspectives are not changed, only contrasted (Choi & Pak 2006:355).

Interdisciplinarity, conversely, tries to integrate multiple perspectives into a coherent whole. Transdisciplinarity goes even further by applying new insights and knowledge to the benefit of organisations and society. The goal of an interdisciplinary science, like IS, is to integrate and synthesise borrowed ideas into its core, maintaining a coherent and stable theory (Hassan & Will 2006:174). This implies that the focus is primarily on rigour, while a transdisciplinary field aims in the first place for relevance. This does not mean, however, that relevance is unimportant for interdisciplinarity or that transdisciplinary science should not be rigorous. Since the core of IS has always been inclusive, the discipline should be able to easily transform itself into a transdisciplinary field using a never-ending cycle of borrowing and consolidation to ensure both relevance and rigour (Teo & Srivastava 2007:518, 528).

The differentiation between inter- and transdisciplinarity is, however, not that clear in literature. Vashist et al. (2011) hold that the creation of a new discipline is typical of transdisciplinarity, while Porto de Albuquerque and Simon (2007:1460) believe it is typical of interdisciplinarity. Most authors seem to agree that boundary spanning is typical of transdisciplinarity. Therefore, it makes more sense to regard the creation of new disciplines as interdisciplinarity. This keeps the transdiscipline category open for research activities that transcend disciplinary borders. Both notions share the idea of an integration of concepts and approaches from several disciplines in order to explore and solve problems that cannot be dealt with in a singular discipline. When interdisciplinary work leads to a new discipline (such as IS) the methods and theories may become standardised, but this new discipline may again be combined with other subjects in a cyclical way to create new interdisciplinary or transdisciplinary research (e.g. e-commerce).

Furthermore, the criteria of novelty and importance seem to differentiate transdisciplinarity from interdisciplinarity (Weber 2012). This is where research in IS can make a significant contribution since a strong focus on problem solving is typical of both IS and transdisciplinary research (Porto de Albuquerque & Simon 2007:1460). Critical theory and action research are examples here of IS paradigms and research methodologies that focus on improving organisations and society.

The concept of novelty is also significant in transdisciplinarity with regard to its theoretical contributions. Weber's (2012) suggested framework and criteria – including novelty and importance – can be used to evaluate and develop new and innovative theories in the IS discipline. The static borders of a settled discipline often need to be deconstructed in order to see and solve new problems. Deconstruction is the idea that all phenomena are deeply embedded in cultural environments and that these layers must be uncovered to deepen our understanding of a discipline (Porto de Albuquerque & Simon 2007:1460). When a discipline becomes established it becomes a "self-bounded entity", and its scope is determined by the specialities of its researchers, journal editors' and reviewers' agendas, and the needs of universities and colleges offering the subject (Hovorka 2010:6). Deconstruction is typical of postmodernity, while the related call for a pluralistic approach to solve complex problems is typical of the related concept of postpositivism. Hirschheim (1985) already argued for methodological pluralism in IS theory that transcends the limitations of the scientific method (positivism). A transdisciplinary approach is one way to improvise and to prevent the fixation on method that may hamper and restrict creativity in IS research (cf. Carte et al. 2012:5,6).

The main attributes of multi-, inter- and transdisciplinarity are summarised, and compared to intradisciplinarity, in Table 1.

Attribute	**Intra-disciplinarity**	**Multi-/Pluri-/Cross-disciplinarity**	**Inter-disciplinarity**	**Trans-disciplinarity**
Collaborative nature	Collaboration of researchers within one discipline	Collaboration of researchers from various disciplines	Collaboration of researchers from various disciplines, integrating various insights; synthesis	Collaboration of researchers from various disciplines, integrating various insights
Goal	To optimise quality of research output	To show different perspectives on a phenomenon	To understand a complex phenomenon which cannot be solved within a single discipline	To solve problems; to change behaviour significantly
Disciplinary nature	Discipline static and looking inwardly	Discipline unchanged but interacting with other disciplines	Discipline enriched New discipline	Across disciplines, beyond academic disciplines, looking outwardly
Theoretical nature	Theoretical exercise	Theoretical exercise	Theoretical exercise	Theoretical exercise leading to practical solutions
Source/cause	Stimulated by complex theoretical challenges	Stimulated by complex theoretical challenges	Stimulated by complex theoretical challenges	Stimulated by complex practical problems
Methods	Using methods from one discipline	Using methods from different disciplines	Connecting approaches in order to find successful methods	Holistic approach to unify knowledge inputs
Result	Better solutions for disciplinary challenges	Better understanding of contributing perspectives regarding complex problems	Improved understanding and sensitivity for complex problems	Better solutions for complex problems
Scope	Organisation (narrow)	Organisation/ Society	Organisation/ Society	Society (broad)
Properties	Definite	Definite	Evolving to definite	Evolving

Table 1. The attributes of intra-, multi-, inter- and transdisciplinarity (cf. Vashist et al. 2011; Elliot 2011; Madni 2007:2; Galliers 2003:347; Porto de Albuquerque & Simon 2007:1460; Hassan & Will, 2006:172).

Transdisciplinarity in practice

The impact-orientation of transdisciplinary work may be a particular contribution from the IS field – information systems are today pervasive across societal domains, and are used to change processes and behaviour to complement insights from other disciplines and to enhance efficiency (Fredette et al. 2012). This is coupled with the mutually transforming application of disciplinary approaches to solving complex societal problems. Examples of such (potential) transdisciplinary applications are briefly described below, although these are generally for demonstrative purposes, and are by no means exhaustive.

Urban and landscape development. Urban development faces a diversity of issues at global, regional and micro levels – these are interdependent and interwoven in complex relationships and systems. There is the need for meta-theoretical and integrated perspectives that enable the application of transdisciplinary approaches to urban development planning (Woiwode 2013:400). Transdisciplinary research agendas here include urban governance and communication; poverty, exclusion and social justice; climate change resilience; and the role of planning professionals and local politicians in urban management (ibid.). These areas pose cross-cutting research questions for Information Systems. This may necessitate that principles of software and systems design, information technology, and design science co-evolve with principles of planning in instituting effective urban development.

Health and wellbeing. Global health priorities are similarly complex and multidimensional. This opens up the possibility for transdisciplinary theory and practice, integrating methods and approaches from various disciplines to solve immediate health problems. This does not merely imply the combination of expertise, but the holistic unification of methods and disciplines, e.g. from medical informatics, computer science, biostatics, psychology, social sciences and health economics (Ammenwerth et al. 2004). In this case, transdisciplinarity leads researchers and practitioners to re-evaluate the multiple pathways to illness and wellbeing – informational, technical, socio-cultural, and environmental, among others (Pescosolido et al. 2008).

IS Development and business modelling. There is a recognised need in information systems development (ISD) to do modelling on a business level before more detailed and robust modelling is done on a technical system level (Joubert et al. 2013:241). Most business level modelling employs some form of natural language constructs that are easy to use by untrained users. Conversely, these are generally too ambiguous to be used in subsequent systems level modelling by systems analysts (ibid.). An example of transdisciplinary research here is to develop subsets of morphology, syntax and semantics concepts that may be used to analyse texts containing business rules during IS analysis and design. This may deepen the understanding of the fundamental entities in business and ISD modelling and their relationships in order to improve informal, mostly textual, business modelling (ibid.).

Sustainability. The practical, environmental application of digital technologies is a potential opportunity for transdisciplinary Information Systems (Elliot 2011:200): not only should technology try to minimise its own impact but it should also be used to address the carbon footprint of other industries. This necessitates the collaboration of different disciplines to approach a common problem and to find solutions that may change business practices in the process (ibid.). In a similar vein, Hovorka and Corbett (2012) developed a trans-disciplinary framework for IS Sustainability Research. The authors highlight innovation in terms of research approaches, the transdisciplinary conception of new knowledge and the integration of theory and practice, facilitated by Information Systems, as essential foundations of maintaining a sustainable biosphere.

Transdisciplinary research. Similar to the use of IS to facilitate green IT in other industries, is the use of IS to facilitate transdisciplinary research in other disciplines. Larsen et al. (2010) developed software that links related literature using divergent and inconsistent terminology, which makes it difficult for individuals to sense the connectedness with their own work. The researchers claim that the use of this technology will enable behavioural scientists to build upon another's work. Since the purpose of this software is to enable an integrative, holistic approach, it may be regarded as transdisciplinary in its own right. A shared ontology that overcomes mismatches in terms and concepts is another example of "transdisciplinary intervention" (Madni 2007:7).

IS theory and philosophy. A more theoretical example of transdisciplinary work in IS is the creation and use of frameworks. The development of frameworks is one way of integrating perspectives from different disciplines centred around one complex problem (cf. Elliot 2011:220). Frameworks are useful to mould divergent facets into a new, coherent and holistic paradigm/construct. This may explain the popularity of frameworks in IS theory.

The special interest group for philosophy of the AIS (SIGPhil) focuses on IS theory and philosophy. This group of researchers is exploring ways to enrich the IS discipline using philosophy, which is a humanities field, to reflect on the state of the art in IS. Humanities-enriched IS is one attempt to transcend the traditional boundaries of the IS discipline, e.g. the exploration of the application of IS/IT in business and organisations. In addition to being a central part of the business sciences, IS may also become part of this network of disciplines in order to contribute to them and to borrow from them (cf. Hovorka 2010:11-13). The linking of scientific disciplines with the humanities is necessary to address social issues in these disciplines (Madni 2007:9). Porto de Albuquerque and Simon (2007:1459) see the relationship between IS and the human sciences as a multidimensional field, the study of which needs the articulation of a plurality of research approaches and theories. Philosophical rigour (creative and differentiating thinking) is as important as methodological rigour (replicability) since it is necessary to reflect in depth about new complex phenomena in order to understand them properly (Teo & Srivastava 2007:528). The integration of ideas from the humanities as reference disciplines may stimulate the innovative thoughts needed.

Computing and education. The integrative and holistic characteristics of transdisciplinarity in IS are important to ensure the attainment of the ideal graduate attributes (or 'graduateness') of computing students. Due to the wide and divergent scope of the IS subject there is a real danger that computing departments will deliver "multidisciplinary illiterates" or generalists rather than specialists (Hassan 2008:1). A transdisciplinary education agenda should identify complex problems and include these in curricula. It should furthermore research solutions to bridge respective knowledge gaps (Madni 2007:8). In this regard, the internet becomes useful in facilitating transdisciplinary research and distance learning. This will help infuse the transdisciplinary thinking skills that are needed to develop computing students in the flat world era (Madni 2007:10).

University-community engagement. University-community engagement is another transdisciplinary means of employing specialised knowledge and skills on a practical and grassroots level. This is because universities, and specifically university networks, are ideally placed to help address immediate societal concerns. One of the foremost objectives in universities' transdisciplinary roles in the knowledge economy can be to establish empowering and agentic linkages in terms of neighbouring and constituent communities. Scholarship on this type of engagement is growing, especially among proponents of the capability approach (Sen 1999), and later scholars who study collective and relational dimensions of agency, self-efficacy, human development, and empowerment (see Tiwari & Ibrahim 2012). University-community engagement in this sense, especially in terms of a socially responsive policy, can be regarded as a method, process, programme and practice of transdisciplinarity.

Towards new and other applications of transdisciplinarity: ICT4D

Information and communication technology for development (ICT4D) is a recent movement of IS engagement that incorporate elements of transdisciplinary practice and scholarship. ICT4D has an important role in supporting the future of social and economic development with the integration of available technologies and the existing knowledge landscape (Nor & Muhlberger 2011:137). This relatively new field can be regarded as both an academic discipline and a pragmatic effort in applying new technologies and systems for societal gain. One may therefore regard it as a 'pracademic' endeavour: pracademics span both the somewhat ethereal world of academia as scholars and the pragmatic world of practice (Walker 2010:1).

Essentially, ICT4D is concerned with facilitating an inclusive modern society, where information and communication technologies are catalysts for social and economic "empowerment" and/or "freedom" (cf. Heeks 2008). Communication is central to this process, enabling the access, production, and transfer of information – as such, strengthening the processes of sustainable development and socio-economic progress (UNDP 2010). The multi-levelled relationships between information and communication are facilitated in a hyperconnected landscape. Ultimately, the proliferation of the internet and associated digital technologies enables certain transformative capacities, put in force by ICT4D pracademics.

The hyperconnected landscape is not limited to the mere deployment of physical artefacts (mobile devices, personal computers, digital media), or virtual operations (software, databases, social networks). Rather, it concerns the myriad culminations and usages of these in our human societies. In ICT4D, hyperconnectivity is leveraged in environments that are – perhaps critically? – starved of its presence. For Heeks (2008), ICT4D can address the problem of digital exclusion, working to integrate communities into the digital era. For Unwin (2009), it can support the future of rural development. And for many others yet, ICT for development can bring about positive social, cultural, and economic change (cf. Harris & Harris 2011; Sahay 2013).

At closer inspection, these views are provocative, and very often the subject of long-standing academic disputes (cf. Kleine & Unwin 2009). In this vein, any account of ICT4D must explore understandings and interpretations of each of the term's root components – "ICT" and "4D": which types of technologies are to be employed for development, who are (technologies) being developed for, what kind of expertise is needed, what type of development is envisaged, and whose notion of "development" is being advanced? In light of these critical inquiries, the discipline of ICT4D itself has undergone a steady evolution. This is with respect to both its development agenda and its disciplinary applications.

In a study uncovering important trends in ICTD/ICT4D, Gomez (2013) found unprecedented growth in the quantity and diversity of research publications and contributions to knowledge in the field. According to the authors, the published ICT4D literature exhibits a dynamic tension between a focus on business and economic development, and a focus on empowerment and community development. These remain the two most salient domains of work in the field (ibid.). Moreover, surveyed ICT4D literature indicates a decreasing interest in pure information systems, a sustained interest in telecentres and public access venues, and a growing interest in the use of mobile phones for development (which has since spawned the sub-discipline known as M4D).

Gomez (2012) concludes by indicating what he regards as a changing, maturing and increasingly transdisciplinary field. This dynamic is twofold: firstly, most of the recent surveyed literature is focused on particular countries or organisations. This represents a gradual departure from field-based descriptions, as more research emphasises scalability, best practices, and national policymaking across multiple areas of inquiry (e.g. economic prosperity, human development, organisational policy, social capital, or cultural engagement). This departure is regarded by Heeks (2008) as an important signifier in the transition from ICT4D 1.0 to 2.0. Secondly, recent trends suggest that ICT4D is shedding its a-theoretical past by exploring more conceptually nuanced and multidimensional foundations for its work (Gomez 2013). This may again be a reflection of a transdisciplinary field, which recognises an extended and transformative domain of inquiry.

Summative reflections

Our review of the literature extends the notion of transdisciplinarity to Information Systems as an academically diverse field. This warrants new research agendas that address the flattening of the world from digitisation and its implications for IS; the increase in complexity in different facets of social life (urbanisation, health and wellbeing, education, business and community engagement); the disciplinary bridging of theory with practice; and the need to broaden the philosophical underpinnings of IS to require a more diverse approach to research. These issues are both relevant and impactful and contribute to disciplinary pluralism.

Following Hassan (2011:456), to transform Information Systems from its multimodal existence into a "vibrant, diverse, academically and socially relevant and influential discipline", we foresee a series of actionable strategies. These both cement and enrich the field and offer a structure for engaging with complex and evolving disciplinary properties. Actionable strategies include (adapted from Hassan, 2011:471-2):

(1) Agreeing on the intellectual ideals for IS: this requires that academics and practitioners reach consensus on the nature of the field and its diverse subject matters. This not only relates to its *core concerns* but also to the *rules surrounding the relationships between* these concerns.
(2) Focusing on conceptual formation: what needs to take place in the IS field is the construction and development of "endogenous concepts and theories from these borrowed concepts", not more borrowing and testing of other disciplines' concepts and theories.

(3) Focusing on theory construction: IS can construct theory by developing strategies to reconstruct and simplify the complex realities of its subject matters. By doing so, the field can "understand, explain, and predict phenomena and events involving the object of study".
(4) Erecting genealogical boundaries: these circumscribe the kind of areas that discourses within a discipline belong to, areas within which the discourse performs its fundamental activity and produces a distinct identity.
(5) Fostering the development of professional bodies: the professional body distils what is most useful and most fruitful for practical ends. Although these may act autonomously from the academic discipline, they are intimately interdependent.

With the embrace of these strategies, we may build towards an Information Systems domain that provides for a 'unique disciplinary subject matter', or at least contributes to a discourse for doing so. Further work may explore the particular actions and elements of each strategy, so to ground their practical relevance for the field.

Concluding thoughts

In this paper, we reviewed the concept of transdisciplinarity and its relevance for Information Systems theory and practice. We have uncovered some of the essential properties of transdisciplinarity, namely its broad, evolutionary scope, its focus on societal complexity, its holism, its practical relevance and its tangible impacts. The evolving scope and practical orientation of IS allows for a fruitful integration along transdisciplinary lines. This is possible by appropriating a number of actionable strategies that cement the relevance of the discipline. What remains to be examined are the many preconditions that allow academics and practitioners to act in a transdisciplinary way, or to embrace the concept more effectively. We may deem these as 'disciplinary competencies', as described by Mittelstrass (2011:337): (1) the unconditional will to learn and the readiness to do without one's own disciplinary ideas; (2) the development of interdisciplinary proficiency, consisting of a productive immersion into the approaches of other disciplines; (3) the capacity to reformulate one's own approaches in light of the inter- or multi-disciplinary competence thus gained; and (4) the production of a common text (or agenda) in which the unity of the argumentation ('transdisciplinary unity') takes the place of a simple combination of disciplinary components. We would naturally deem these as the qualities necessary to be 'transdisciplinarian' – pracademics who collaborate across and beyond disciplines; who solve problems and change behaviour significantly; who help develop practical solutions stimulated by complex problems; who are capable of disciplinary immersion; and who take a holistic approach to unifying knowledge.

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