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Alliances for Interdisciplinarity and Transdisciplinarity: A Call for Response

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Abstract: Prompted by William Newell's 2013 call for the Association of Interdisciplinary Studies (AIS) to consider whether to rethink its mission in light of other organizations' interests, this article begins by reflecting on similarities and differences among five of the founding organizations of a recently formed Global Alliance for Inter- and Transdisciplinarity. In chronological order of their own founding dates they are AIS, the Network of Transdisciplinary Research, the Integration and Implementation Sciences network, the International Network for the Science of Team Science, and the Center for Interdisciplinarity at Michigan State University. Descriptions of the five in Part I account for their emergence, communication venues, keywords of representation, website features, and prominent outputs. Given the centrality of integration in both inter- and trans-disciplinarity, it also describes their stances on this prominent topic. Part II reflects on implications of the current heterogeneity of the core concepts, focusing initially on generalizations including distinctions between Zurich and Nicolescuian approaches to transdisciplinarity followed by the premise of distinct Franco and U.S. traditions of the field of nanomedicine. It then draws further insights from case studies of institutionalizing interdisciplinarity across Europe, Russia and the South Caucuses, Africa, Latin and North America, Australia, and Asia. After commenting on signs of change in AIS, discussion turns to historical precedents for prioritizing problem solving, followed by future horizons for both inter- and trans-disciplinarity with emphasis on implications of their heterogeneity and overlaps with other prominent concepts such as Convergence and Mode 2 Knowledge Production. The closing section presents final reflections for answering Newell's challenge for AIS members to consider expanding its definition of interdisciplinary studies and conception of integrative process in light of other organizations' interests.

Keywords: interdisciplinarity, transdisciplinarity, team science, integration, alliance

Recent formation of a Global Alliance for Inter- and Transdisciplinarity (ITD Alliance) is an occasion for reflecting on how organizations differ while also having common values and goals. An alliance forms for the mutual benefit of

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individuals or groups on a temporary, an unspecified, or a long-term basis. By joining forces they are able to advance overlapping interests, in the process expanding their knowledge base while strengthening separate efforts through a unified voice. The structure of an alliance may be a loose network or a formal partnership such as a union of workers, a consortium of businesses, a confederation of political allies, or in the academic world a professional society. Following suit, interactions of their members may take the form of informal exchanges, cooperation and coordination on designated tasks, or full-scale collaborations that could even lead to legal mergers. Each organization typically retains its individual mission but subordinates differences when joining others for a shared purpose. A prior attempt to coordinate efforts, the International Network for Interdisciplinarity and Transdisciplinarity (INIT), faltered due to lack of long-term financial backing and a governance structure. Launched in 2019, the new ITD Alliance is endorsed by the Swiss Academies of Arts and Sciences and has a formal Board as well as by-laws, but it is still dependent in its early days on members' dues and donations. Initial founding members included the US-based AIS, Swiss-based Network of Transdisciplinary Research (td-net), Australia-based Integration and Implementation Sciences (i2S), US-based International Network for the Science of Team Science (INSciTS), and US-based Center for Interdisciplinarity at Michigan State University (C4I). They were also joined by the German-based Methodology Center at Leuphana University in Lüneburg and the Swiss-based Transdisciplinarity Lab at the Department of Environmental Systems Science in ETH Zurich's federal institute for science and technology.

AIS included three of these organizations on its website page "Interdisciplinary Connections"—td-net, i2S, and INSciTS. In 2013, though, AIS co-founder William Newell challenged the Association to consider whether its mission needs rethinking in light of others' conceptions of inter- and transdisciplinarity, including the dominant AIS definition of interdisciplinary studies and conception of integrative process. When the Association was founded in 1979, Newell recalled, the locus of interdisciplinary activity in the United States was mostly education and especially undergraduate liberal arts courses, though other scholars have highlighted interdisciplinary fields as a prominent category as well. Since 1979, Newell argued, the primary locus of activity and funding at large had shifted from AIS interests in teaching to research, from undergraduate to graduate levels, from humanities and "soft" social sciences to natural sciences and medicine (and to a lesser extent "hard" social sciences), from an individual to a team activity, and from the ivory tower to the real world including participation of non[*sic*]-academics in research and problem solving. These trends, he exhorted, raise questions about the identity of AIS. Newell highlighted two developments in particular: the science of team science and "transdisciplinary studies," though the latter term is not widely used (p. 35). The first development, he suggested, raises the question of whether

interdisciplinary process should be recast as a team activity. The second pushes the Association to rethink its long-standing premise that interdisciplinarity is reliant on disciplines. He also suggested both developments raise questions about whether interdisciplinarity is focused on application and implementation instead of academic knowledge, whether it is located in the "real world" instead of the university, and whether it is nested in political or social activity rather than intellectual inquiry.

This article answers Newell's challenge for AIS members to consider implications of other organizations' interests by comparing in chronological order of their own founding five of the initial members of the ITD Alliance: AIS, td-net, i2S, INSciTS, and C41. Table 1 is a composite of data for comparison: accounting for their emergence, affiliation, communication venues, keywords of representation, website features, and prominent outputs. Given its centrality in both inter- and trans-disciplinarity, it also describes their stances on the cross-cutting topic of integration. Klein and Newell (1997) deemed integration the "acid test" of interdisciplinarity (p. 404), while Pohl, van Kerkhoff, Hadorn, and Bammer (2008) called it "the core methodology underpinning the transdisciplinary research process" (p. 42). The article then weighs validity of generalizations about both inter- and trans-disciplinarity, including "Nicolescuian" versus "Zurich" conceptions of transdisciplinarity and Franco versus U.S. conceptions of the interdisciplinary field of nanomedicine. It next draws insights from a new international collection of case studies of institutionalizing interdisciplinarity across Europe, Russia and the South Caucuses, Africa, Latin and North America, Australia, and Asia. After commenting on signs of change in AIS, discussion turns to historical precedents for prioritizing problem solving, followed by future horizons for both inter- and trans-disciplinarity with emphasis on their current heterogeneity and overlaps with prominent concepts such as convergence and Mode 2 knowledge production. The closing section presents final reflections for answering Newell's call for AIS members to consider expanding its definition of interdisciplinary studies and conception of integrative process in light of other organizations' interests.

Part I: Comparing Members of the ITD Alliance

Comparison of the five selected founding members of the new ITD Alliance reveals both similarities and differences.

Association for Interdisciplinary Studies

Founded in 1979 in the United States, AIS was launched at a final session of a national conference in the state of Ohio on Teaching of Interdisciplinary Social

Table 1: Composite data for the five organizations in this article: the Association for Interdisciplinary Studies (AIS), the Network for Transdisciplinary Research (td-net), the International Network for the Science of Team Science (INSciTS), Integration and Implementation Sciences (I2S), and the Center for Interdisciplinarity (C4I).

Science. Its founding members emphasized integration is the distinguishing feature and indicator of quality in interdisciplinary education. The most prominent model endorsed by the Association has been Allen Repko's (2008, 2012) textbook for students engaged primarily in individual research projects. Per O'Rourke's (2017) and O'Rourke, Crowley, and Gonnerman's (2016) classification of approaches to integration, it is a top-down blueprint in which Repko assigned it to stage 9 in a linear 10-step model, based on my initial attempt to understand what is required for integrating insights from different disciplines (Klein, 1990). Repko's version reinforced two widely shared beliefs in AIS: that integration is a cognitive process and that establishing common ground is fundamental to achieving comprehensive understanding of a complex question, problem, or theme. His version enjoyed the imprimatur of the Association by virtue of being featured in its publications and conference presentations, to the degree it was promoted as *the* model for interdisciplinary research.

Newell (2013) asserted it became "the de facto 'lead model' largely by default" (p. 33). However, as a result of further study and involvement in td-net, i2S, and INSciTS, my thinking expanded to recognize the elevated role of iteration and recursivity in new models of inter- and trans-disciplinary collaboration. When Rick Szostak joined Repko in third and fourth editions of the handbook, they acknowledged iteration might result in rethinking original assumptions though still assigned integration to a later stage. At the same time, the growing body of literature on transdisciplinarity was highlighting communicative and organizational dynamics as well as interaction of cognitive and social dimensions of integration.

Repko and Szostak (2017) were also mindful of the developments Newell signaled, deeming transdisciplinarity (TD) and team science "complementary scholarly enterprises" for AIS (p. xvii). They called TD, in particular, a form of "interdisciplinarity plus" that integrates insights from both academic disciplines and perspectives outside the academy. Yet, even while contending it is not contradictory to the practice of interdisciplinarity, they declared emphatically transdisciplinarity is *not* interdisciplinary studies (p. 25). Repko and Szostak further suggested their model might apply to teams. However, they referred readers to [IN]SciTS and td-net for fuller explanation of dynamics of collaboration and engaging stakeholders while retaining an academic and cognitive orientation. Awareness of competing approaches grew, though, as several AIS members became involved with other organizations. The same year the third edition of the textbook appeared, for instance, three of us co-hosted a session on AIS at the 2017 td-net conference at Leuphana University in Lüneburg, Germany (Klein, Keestra, & Szostak, 2018). We introduced the Association's mission, constituency, activities, and resources then opened discussion to exploring ways of serving common interests with the audience, which included members of i2S, td-net, INSciTS, and C4I. Ensuing dialogue on reasons individuals attended the session revealed differing motivations, ranging from simple curiosity to a desire among those having prior interactions with AIS to pursue future connections. Participants' sense of whether joining the Association would advance their interests also varied, ranging from doubt to eagerness. These differences illustrate an important benefit to alliance. Interaction is a reciprocal process, presenting opportunities for all sides to learn about each other and, echoing Newell's call to AIS members, to consider whether their missions might be expanded, modified, or remain unchanged. In a significant step toward dialogue, at the same 2017 conference representatives of a number of founding organizations for the ITD Alliance met informally to begin exploring prospects for a new coalition under td-net's oversight. Initial "founding members," including ones in this article, pledged verbal support for the initiative, though subsequently the Alliance developed a formal payment structure distinguishing "institutional" and "individual" members.

Network for Transdisciplinary Research (td-net)

Td-net was launched in 2000 by the Swiss Academic Society for Environmental Research and Ecology. In 2003 the Swiss Academy of Sciences took it over and since 2008, td-net has been an initiative of the Swiss Academies of Arts and Sciences. The Network was created for the explicit purpose of promoting transdisciplinarity and its starting point according to the website is environmental and sustainability research, while also advancing a problem-oriented, stakeholder-inclusive connotation of TD documented on the multi-lingual Publications and Tour d'Horizon pages (https://transdisciplinarity.ch/en). The movement that gave rise to the Network emerged in environmental research during the late 1980s and early 1990s in German-speaking countries and to a lesser extent related activities in Sweden and in the Netherlands. Since then this discourse has spread to Africa, Latin America, and Australia. Jürgen Mittelstrauss (1992) is often credited with introducing the concept of the *Lebenswelt* (lifeworld) into definition of transdisciplinarity, positioning real-world problems as the starting point for research rather than disciplines and, subsequently, aligning it with a higher degree of integration than interdisciplinarity. The website acknowledges a plurality of definitions: for example, conducting research on problems such as cancer, bridging Western and other forms of knowledge, and bringing together scientific and spiritual thinking in a holistic manner. Nonetheless, td-net is strongly focused on societal problems and mutual learning in collaborations involving academic researchers and stakeholders from other sectors, including professionals in government and industry as well as members of local and regional communities. The seven defining principles of td-net include orientation to societal challenges, comprehension of the complexity of problems, development of knowledge and practices that promote the common good, integration of different perspectives, production of systems-target-and-transformation knowledge, conception of science as part of a social learning process, and bridging of abstract and case-specific knowledge.

Although integration is regarded as a core methodology for transdisciplinary research, authors in td-net literature have identified differing forms. Zierhofer and Burger (2007) distinguished thematic, product- or problem-oriented, and social types of integration while Jahn, Bergmann, and Keil (2012) identified different epistemic, cognitive, social-organizational, and communicative levels. Two chapters in the *Handbook of Transdisciplinary Research* (Hirsch Hadorn, et al., 2008) present a closer view of integrative process. Bergmann and Jahn (2008) generated a model based on the CITY:*mobil* project, which grappled with the challenge of mobility in two German cities. The project involved 20 participants from multiple disciplines and stakeholders in departments of city and transportation planning. The four-phase model that emerged placed integration at a third and a final stage, but the authors

emphasized it is an ongoing process. In a subsequent chapter, Pohl, van Kerkhoff, Hirsch, Hadorn, and Bammer (2008) presented a more general model of integration in a matrix combining three types of collaboration—common group learning, deliberation among experts, and work of a subgroup or an individual—with four methods—mutual understanding, theoretical concepts, models, and products. Like Bergmann and Jahn, they also stressed the importance of ongoing attention to process while affirming integration is not solely cognitive. Institutional factors are enabling conditions as well. Mindful of the need for tested methods and tools, td-net has also produced a Toolbox calling attention to synthesis and integration as well as participatory research, team-based collaboration, design thinking, and impact-oriented research. In addition, other well-known techniques include Delphi, design thinking, scenario integration, Venn diagramming, actor constellation, emancipatory boundary critique, multi-stakeholder discussion groups, storywall, and a give-and-take matrix. The next organization has also advanced an expanded connotation of transdisciplinarity, but in a different arena.

Integration and Implementation Sciences

The Integration and Implementation Sciences website was established in 2002, and the first published mention of "i2S" appeared the following year (Bammer, 2003). The i2S network evolved from Gabriele Bammer's (2013) effort to create a new discipline of integration and implementation sciences with the aim of providing concepts and methods for "integrative applied research" on complex real-world problems, synthesizing disciplinary and stakeholder knowledge, understanding while managing unknowns, and coordinating support for policy and practice. Bammer likened this effort to create a new discipline to the model of statistics. The website keeps users informed about relevant publications, journals, conferences, organizations, tools, and approaches (https://i2s.anu.edu.au/what-i2s). The Integration and Implementation Insights blog, established in 2015 on a separate but linked site, is also a forum for sharing methods and practices while fostering a community of expertise (http://i2Insights.org). And, links in the Resources section lead to other organizations: including AIS, td-net, INSciTS, and the ITD Alliance. Bammer et al. acknowledged core elements of integrative applied research already exist, but cautioned progress is limited by fragmentation resulting from dispersal and marginalization. In an effort to achieve a more coordinated effort, she and 26 other authors came together under the mantle of the i2S mission to propose a knowledge bank for integration and implementation (Bammer, et al., 2020). It would guide users to related approaches: including action research, interdisciplinarity, transdisciplinarity, systems thinking, complexity science, sustainability science, integrative assessment, systemic intervention, and participatory methods.

To elaborate, the knowledge bank would render related forms of expertise more visible and accessible while presenting an authoritative voice to policy makers and funders. Its scope would be greater than a toolkit, though many such resources would be included along with integrative databases, atlases, and compendia the authors reported have not been able to gain traction on their own. The task of building a knowledge bank, however, is formidable, and the authorship group admitted they illustrate in microcosm challenges that coalitions face. Building a repository requires compiling pertinent expertise, indexing and organizing it, as well as understanding reasons for continuing fragmentation in order to mitigate them. It also entails assembling a coalition of communities and teams, and making their expertise easy to find by a wide range of individuals, teams, and communities of practice. In addition, a host of other practical matters loom, including long-term funding, intellectual integrity, technological interoperability, and meta-data standards. In order to strengthen individual efforts regional coalitions have formed. For instance heads of organizations in the Oceana region, where the i2S home is located, created the Network of Interdisciplinary and Transdisciplinary Research Organization to ensure funders and research policy makers understand, value, and support research integration and implementation (https://nitro-oceania.net/about/). In Africa, the International Research Council's initiative on Leading Integrated Research for Agenda 2030 also aims to increase integrated research on sustainability challenges in the region (https://council.science/what-we-do/funding-programmes/lira2030/). Although the next organization differs, it too is fostering allied efforts.

The International Network for the Science of Team Science

Coining of the acronym "SciTS" for science of team science dates to a 2006 conference sponsored by the US-based National Cancer Institute (NCI), though a designated community was launched in 2010 at the first SciTS conference then subsequently renamed "INSciTS" in 2018 when securing tax status as a nonprofit organization. The NCI is part of National Institutes of Health, the largest medical research agency in the country. This point of origin established a close and continuing relationship with clinical and translational sciences, which aims to bridge scientific research and protocols of practice in health and wellness. Hall, Stipelman, Vogel, and Stokols (2017) attributed this movement to increases in teamwork and real-world problem solving aimed at accelerating discovery and innovation. Some individuals became involved with td-net in subsequent years, but the dominant definition of TD in INSciTS highlights new methodological and conceptual frameworks, not co-production of knowledge with stakeholders in society. The most explicit alignment with integration appears in a state-of-the-art report on *Enhancing the Effectiveness of Team Science* (NASEM,

2015), linking "deep integration" with organizational factors, communication, and interplay of social, psychological, and cognitive dimensions of teamwork. The current president of INSciTS, Stephen Fiore (2008), has proposed remaking interdisciplinarity as teamwork, arguing it is not feasible to conduct interdisciplinary research independently. He cited the Renaissance-man model of Leonardo da Vinci. However, that connotation is a pre-disciplinary construct and borrowing concepts and methods as well as hybrid specialization are more common than the notion of a Renaissance-style "generalist."

INSciTS has relied primarily on annual conferences to reach and to build its audience, though members have produced a substantial record of publications in a remarkably short time. NCI also sponsored a bottom-up, user-generated Team Science Toolkit, though it is currently dormant. The growing literature on team science includes not only the 2015 NASEM report but a recent volume of *Strategies for Team Science Success,* described as a *Handbook of Evidence-Based Principles for Cross-Disciplinary Science and Practical Lessons from Health Researchers.* This subtitle, though, is deceptive, since authors came from a wide range of backgrounds, thereby broadening insights and recommendations for both theory and practice (Hall, et al., 2019). Like O'Rourke et al. (2019), the editors and some authors also called attention to technological capabilities that are enhancing dataset integration and collaborative data analysis. Furthermore, they advocated engaging stakeholders including practitioners, policymakers, members of industry, community organizations, and citizens. The latter two groups, however, are not typically involved deeply in the actual process of research and decision-making. INSciTS-affiliated authors Hall, et al. (2012) have also promoted a top-down, linear blueprint model of transdisciplinary team-based research: moving from development and conceptualization to implementation and translation. They acknowledged movement across stages may be recursive, but in the final phase specify findings are applied along a pathway from discovery to implementation. As a result, influence is typically a one-way flow *from* science *to* protocols and procedures in professional practice. Comparably, the 2015 NASEM report aligned translation with application and transfer of scientific knowledge, in contradiction to scholarship in humanities and the field of translation studies that recognizes historical and cultural influences problematize direct transfer from an original meaning to a new context. Like INSciTS, the next example also endorses collaboration but on a more global scale.

The Center for Interdisciplinarity

Founded in 2017, the Center bears the name "interdisciplinarity" in its title but is also committed to a connotation of transdisciplinarity consistent with problem-oriented research involving stakeholders beyond the academy. This definition is in keeping, as well, with the land-grant mission of the Center's

host institution, Michigan State University (MSU). The Morrill Act of 1862 established support for U.S. colleges specializing in agriculture and mechanical arts of applied sciences and engineering. C4I combines the Morrill Act's commitment to service with activities that advance interdisciplinary research and education across the local campus while also contributing to scholarship on both crossdisciplinary and cross-sector approaches. Two activities illustrate this combination. The first, the Transdisciplinary Graduate Fellowship Program, supports student partnerships with community members in order to work on a significant problem, while also providing training in teamwork transferable to future endeavors. The second and signature project, the Toolbox Dialogue Initiative (TDI), conducts capacity-building workshops beyond MSU using philosophy-based, survey-style instruments for identifying underlying beliefs and values that influence the ability of individuals with different forms of expertise and worldviews to work together. Thus, the Initiative aims to improve collaboration, whether for strategic planning in a particular organization or enhancing communication in projects (Hubbs et al., 2020). Individuals associated with the Center also interact with other groups, including involvement in conferences and publications of AIS, i2S, td-net, and INSciTS. In the latter case C4I was host to the 2019 team-science conference. Featured plenaries included not only long-standing INSciTS interests in clinical and translation sciences but also insights from agricultural research, the land-grant focus of MSU, and a rare demonstration of Indigenous modes of collaborative dialogue in a roundhouse seating rather than traditional academic hierarchy of an elevated speaker platform.

Furthermore, scholars affiliated with C4I have made significant contributions to understanding the nature of integration. They have identified multiple means: including unification by reduction, a global theory or an overarching abstract model, interconnections between fields, local theories, and micro-level integrations. In addition, they distinguished four faultlines of definition: linear algorithmic step models vs. heuristic and constructivist frameworks that pay greater heed to iteration and reflexivity, cognitive vs. social and communicative aspects of teamwork, interdisciplinarity as an individual vs. a collaborative phenomenon, and emphasis on disciplines vs. inclusion of societal perspectives outside academic walls. They also identified differing levels of abstraction and concreteness as well as multiple epistemologies and methodologies (O'Rourke et al., 2016; O'Rourke, 2017). More recently, O'Rourke reported the TDI team is now conducting research on the relationship of integration and convergence (personal communication, February 26, 2021). The second concept has become a term *du jour* in the US, bolstered by the National Science Foundation's (NSF) alignment of convergence with solving complex problems by "deep integration" of knowledge, methods, and expertise from different disciplines and new frameworks for discovery and innovation. NSF's website further links the concept with transdisciplinarity (https://www.nsf.gov/od/oia/convergence/index.jsp). Supported by a NSF Convergence grant,

C41 is currently building on the Toolbox Initiative to explore disciplinary identity and its relationship to epistemic cognition, drawing insights from a survey and interviews with scientists. Individuals associated with the Center, O'Rourke also reported, have been expanding understanding of integration as both a conceptual approach in academic settings and a socio-behavioral approach in collaborations with community stakeholders. Comparable to AIS, C41 has treated integration as a foundational concept for interdisciplinarity, but extends the focus to transdisciplinary and collaborative research (https://tdi.msu.edu/research-overview/tdi-integration-research). Hence, O'Rourke et al. (2019) linked integrative process with iteration, negotiation, trade-offs, and contextual parameters, not a universal model.

As the forgoing examples illustrated, historical perspective is illuminating. When AIS was founded in 1979, its leaders felt the term *interdisciplinary* lacked sufficient stature to include in the Association's title. By 2013, though, the governing board formally adopted *interdisciplinary* instead of *integrative* to be more consistent with contemporary usage, adding "especially outside of North America" (https://interdisciplinarystudies.org). Comparably, Bergmann and Jahn observed a parallel with *transdisciplinarity*. When they conceptualized the CITY:*mobil* project in 1993, the term was not widely recognized in Germany. So, they called it "interdisciplinary, problem and actor oriented" (2008, p. 90). By the late 20th century, however, TD had become a more common and sanctioned signifier. To recall, td-net enjoys sponsorship of the Swiss Academy of Arts and Sciences and INSciTS was endorsed initially by the (U.S.) National Cancer Institute. AIS does not have a formal institutional sponsor, but i2S and C4I have university affiliations. Their separate missions also vary. Interdisciplinarity and integration remain central to AIS, with the aim of promoting best practices. In contrast, td-net has been a leading advocate of engaging stakeholders in transdisciplinary research with a frequent focus on sustainability, while INSciTS continues to advance collaborative problem solving in health and wellness even while now expanding contexts. The core connotation of TD in INSciTS also continues to emphasize conceptual and methodological frameworks, rather than fuller involvement of stakeholders. In turn, i2S is advancing integrative applied research by synthesizing disciplinary and stakeholder knowledge with unique concern for unknowns and uncertainties. And, given that C4I is the most recently founded organization, its scholars are drawing on the full body of literature on inter- and transdisciplinarity even with a strong orientation to philosophy.

Part II: Deepening Answers to Newell's Challenge

Part II moves beyond the five selected organizations to provide historical perspective on the current heterogeneity of both inter- and trans-disciplinarity.

The central question of Barry and Born's 2013 book sets a framework for answering Newell's challenge. They asked "How might one understand interdisciplinarity less as a unity and more as a field of differences, a multiplicity" (p. 5). Multiplicity requires scrutinizing generalizations about definition.

Generalizations

Generalizations about inter- and trans-disciplinarity typically accentuate difference. Sue McGregor (2020), for example, distinguished Zurich (Swiss) and Nicolescuian approaches to transdisciplinarity. The first is based on a 2000 international conference on TD in Zurich that reflected growing momentum for real-world problem solving in general and sustainability in particular. The second approach is associated with the Centre International de Recherches et Études Transdisciplinaire (CIRET), founded in 1987 in Paris. The axiomatic methodology of the second approach is based on three pillars: multiple levels of reality, the logic of the included middle, and complexity. CIRET is fostering an open form of rationality, subjectivity, and ethics that is both transnational and trans-epistemic (https://ciret-transdisciplinarity.org/index_en.php). Yet, founder and president of CIRET Basarab Nicolescu (2010), stressed it is not a new discipline or a superdiscipline. In comparing the two models, McGregor purported the Zurich approach synthesizes knowledge of disciplines and social actors in order to foster socially robust, reflexive, and accountable research without concern for reality, axioms, or logics. She added Nicolescu deemed his approach theoretical and the Zurich approach phenomenological and not vested in formulating a methodology. However, "Zurich Approach" is a narrow classification, ignoring scholarship on methodology as well as epistemic and ontological dimensions including Ludwik Fleck's (1979) conceptual framework of thought styles and Funtowicz and Ravetz's (1990) post-normal science as well as systems thinking, complexity theory, and ecological principles. Furthermore, the Zurich conference, which was attended by nearly 800 people from roughly 50 countries, included presentations on both methods and philosophical implications of prioritizing problem solving and stakeholder inclusion. Another debatable form of generalization posits a distinct style pegged to geographical location.

In a book comparing nanomedicine in France and the United States, Séverine Louvel (2021) acknowledged national contexts shape institutional policies. She cautioned, though, against a sharp distinction between an American and a Franco form of this field, noting variations in their research organizations and universities. International scientific communities, she added, also influence goal setting and practices. At the same time, however, a new book of case studies on institutionalizing inter- and trans-disciplinarity revealed patterns across particular countries. It emanated from panels at two td-net

conferences, at Leuphana University (Germany) in 2017 and at the University of Gothenburg (Sweden) in 2019. When co-editors Vienni Baptista and Klein (forthcoming), invited others to join presenters, chapters on Africa and Latin America highlighted the need for universities to address socio-economic development and sustainability. Some chapters also recognized the legacy of political regimes, including colonialism in post-independence Ghana, centralized control of education in Brazil after 21 years of military dictatorship, and the Soviet era in Russia. In addition, authors documented the power of national policies. In the United Kingdom a standardized framework for research excellence invokes "impact" and "research users." However, it prioritizes economic rationale over socially useful knowledge and co-production with stakeholders. Comparably, despite the Dutch National Science Agenda to bring together partners from science and society to work on urgent questions, collaboration remains problematic in education and training as well as stakeholder involvement. And, in Mexico, despite the National Council of Science and Technology's alignment of interdisciplinarity with co-producing solutions to problems, all fields are evaluated by the same criteria. Traditions differ as well. In Armenia and Georgia few documented attempts at integrating cross-disciplinary approaches into academic practice exist, in contrast to extensive experience in Western countries co-creating knowledge with societal actors. And, in China, transdisciplinary research is not grounded in Western assumptions about collective action, governance structures, and individual agency.

Comparative analysis of both similarities and differences across geographical contexts further calls to mind Newell's 2013 concern that expanding conception of theory and practice might erode some of AIS' past focus on "interdisciplinarity itself," prompting the question of whether there is a universal "itself." He was especially concerned about whether expansion of meaning would make it impossible "to disentangle problems of teamwork from problems of interdisciplinarity" and thus "be drawn into the messy world of interpersonal dynamics, motives other than discovering truth, and problems of communication and technology" (p. 37). Newell further charged team science scholars with being "largely unaware of interdisciplinary process, let alone theory" (p. 36), and scholars of transdisciplinary studies for operating "without benefit of knowledge of interdisciplinary process or theory" (p. 35). Yet, developments traced in Part I have been rendering dynamics of collaboration intrinsic to theory and process, not apart from them. A lot of initial work in other organizations, he rightly noted, was done without awareness of AIS. However, the reverse is also true, reinforcing the need for dialogue between organizations. The current roster of "Core Values" on the Association's website indicates its priorities remain integration and best practices in curriculum development, program administration, pedagogy, learning assessment, and accreditation. Yet, new members of the Board have been promoting values of diversity, equity, and inclusion as well. "[D]evelopment of real-world

applications" has also become a declared interest along with strengthening the role of interdisciplinarity and integration "beyond" the academy. This composite was not part of early representation of AIS. Even when approaching its 25th anniversary in 2003, a Self-Study and Strategic Planning Report did not include them. Moreover, the only listed connections to other organizations were U.S.-based organizations, many focused on undergraduate education. Even prior to Newell's 2013 call, though, recommendations for conferences included a session on transdisciplinarity and for the journal expanding authorship beyond an "'in' crowd" while covering graduate education and fields such as women's studies and American studies.

Historical Warrants for Prioritizing Problem Solving and Critique of Disciplinarity

Mindful of the foregoing recognition in AIS of real-world applications and work beyond the academy, it is important to realize their priority has been asserted since the early 20th century. Roberta Frank (1988) claimed the term *interdisciplinary* likely emerged at the Social Science Research Council (SSRC) in the mid-1920s. She called it "a kind of bureaucratic shorthand" for problem-oriented research that crossed two or more of the seven discipline-based societies of the Council (p. 73). The roster of real-world problems at the time included crime, social welfare, migration, and interracial relations, and by the 2020s the SSRC website was listing new challenges such as climate change and COVID. In recalling the organization's history, Kenton Worcester (2001) deemed founding the SSRC "an intrinsically interdisciplinary operation" capable of counteracting overspecialization, departmentalization, and isolation. Furthermore, Frank added, the Council was not alone, revealing both widening support for alternatives to the discipline-dominated system of higher education and multiplicity of motivations. During the 1920s and 1930s, the most popular terms at the U.S.-based National Research Council were "new fields," "overlapping projects," "interrelated research," and "borderlands" and "borderline research" (1988, pp. 73–74). Stephen Turner (2017) also recalled Rockefeller Foundation philanthropy in the 1920s and 1930s supported shifting social sciences toward a more "realistic" direction in order to produce "useful knowledge" directed at not only social problems but also the phage group's collaboration to integrate physics and biology, a key event in the history of molecular biology. Hence, both societal and scientific problems were the focus of early conceptions of the purpose of interdisciplinarity.

Even with etymological documentation of the term *interdisciplinary* in the 1920s, the claim of SSRC as a point of origin, though, is challenged by many scientists who credit the Manhattan Project in the 1940s. This war-time initiative not only crossed sectors of the academy, government, and industry.

It also combined intellectual and instrumental goals of generating scientific knowledge for building nuclear weapons. The military-industrial route to interdisciplinarity, Steve Fuller (2017) emphasized, pitted "normal science" against use-inspired basic research that reflected two conceptions of success: victory in war, responding to the urgency of combating a common foe, and monopoly in commerce, scaling up knowledge production outside of university laboratories and for economic gain. Fuller (2010) further deemed the military-industrial route "antidisciplinary," because it denied the premise that disciplinary knowledge production is natural. He likened it to "deviant interdisciplinarity" because it did not aim to integrate existing disciplinary approaches. Instead it redirected attention toward interrogating "normal understanding" of disciplinarity, advancing an epistemic goal of ameliorating the human condition, as well as interpenetrating disciplines to the degree their boundaries are porous and malleable. Most theoretical discussions, Fuller added, treat interdisciplinarity as an endeavor within the academy. Yet, the military-industrial route denies academic sovereignty over knowledge production, while prioritizing instrumental needs of defense. The commercial side of the equation would loom even larger during and after the late 1970s in science-based fields of intense international economic competition that continue to be high priorities today, including engineering, manufacturing, computers, and biomedicine (Klein, 1996).

Yet, another cluster of problems has prompted a sense of urgency today for solving problems prominent in missions of td-net, i2S, INSciTS, and outreach activities of C4I. This sense of urgency is prominent in state-of-the-art reports from science-policy bodies. In an overview by the U.S.-based National Academies of Science, Engineering, and Medicine, authors of *Facilitating Interdisciplinary Research* acknowledged historical precedents. However, they accentuated "new knowledge" and "hot topics" such as nanotechnology, genomics and proteomics, bioinformatics, neuroscience, conflict, and terrorism (NASEM, 2005). Eleven years later a survey report on interdisciplinarity for the Global Research Council's annual meeting highlighted today's "grand challenges." Descriptions of case studies in this report documented the global reach of concerns: spanning Africa, the Americas, the Asia-Pacific region, and the Middle East and North Africa. The concerns spanned problems of climate change, drought, hunger, and disease, as well as initiatives in energy, water, and technologies of information and communication (Gleed & Marchant, 2016). Four years later a policy paper in the OECD's (2020) science, technology, and industry series situated the concept of transdisciplinarity in "solution-oriented" research aimed at complex societal challenges, including the COVID-19 pandemic . Authors of the paper further contended complex problems require integrating knowledge from academic disciplines with knowledge of public and private sector stakeholders. Here too case studies spanned familiar examples of climate change, natural disasters, sustainability of natural resources, and

public health but also added mobility technology for aging citizens, governance of rights in land use, and preservation of traditional music culture. Given aforementioned calls in AIS to include greater focus on interdisciplinary fields such as women's studies and American studies, it is also important to note the role they have played in prioritizing which problems require inter- and trans-disciplinary approaches.

During the 1960s and 1970s, new fields arose from socio-political movements outside the academy with the aim of addressing questions of social justice. Major examples included Black/ethnic/and women's studies. Poststructuralism and critical race theory further problematized traditional forms of enquiry, amplified in closing decades of the 20th century by gender and sexuality studies as well as postcolonial and transnational interrogations of Western paradigms of knowledge and culture. In addition, new fields of environmental and urban studies critiqued siloed disciplinary approaches while prioritizing "real world" problems. Hence, in contrast to the premise of a complementary relationship with disciplines in AIS, these movements amplified critique of disciplinarity. In accounting for the role of stakeholders in transdisciplinary research, Aant Elzinga (2008) further observed members of the public and other end-users might be invited to participate in research projects, but their roles are typically limited to supplying information or providing feedback on solutions academics propose. Elzinga himself treated interdisciplinarity as a prelude to making participation of stakeholders a core element of transdisciplinarity. This driver is evident in peace and conflict research, systems and human ecology, work-life studies, women's studies, social work and nursing as well as policing and research on higher education. However, Elzinga (2008) reiterated, academics are still cast as rational actors in a hierarchy of power that renders "public," "society," "practitioner," and "user" problematic while taking science at face value (p. 356). More broadly, advocates of greater recognition for lay, traditional, and Indigenous knowledge also challenge pejorative characterizations of stakeholders as "*non*-scientific" "*non*-academic," and "*non*-expert" (emphasis added).

In the aggregate, developments over time have pluralized the meaning of interdisciplinarity (based on Klein, 2021). They emerge and take root in a complex ecology of spatializing practices and transaction spaces. Rhetorics of holism and synthesis also compete with instrumentalities of problem solving and innovation as well as transgressive critique. Even with differences, though, typical warrants today include complexity, contextualization, collaboration, and socially robust knowledge. Yet, when reflecting on the state of the university in the 21st century, Crow and Debars (2017) concluded many institutions continue to lag behind in accommodating new interdisciplinary forms of knowledge production, limiting their ability to address scientific and societal problems. They also continue to prioritize academic knowledge. Daniel Stokols' (2006) conceptual framework for a science of transdisciplinary

action research also recognized it unfolds in three ways: among scholars of disciplines; among researchers from multiple fields and community practitioners who represent different professional and lay perspectives; and among community organizations across local, state, national, and international levels. These assessments require deeper understanding of implications of the ascendancy of transdisciplinarity for defining interdisciplinarity

Transdisciplinary Horizons

The concept of transdisciplinarity is linked historically with the quest for unity of knowledge, dating in the West to the idea of synoptic knowledge in Ancient Greece. This intellectual aim persisted over ensuing centuries. Initial use of the term, though, is dated conventionally to the first international seminar on problems of interdisciplinary teaching and research in universities in 1970, co-sponsored in France by the Organization for Economic Cooperation and Development. The generic definition was "a common system of axioms for a set of disciplines," exemplified by anthropology as a broad science of humans. Individual connotations differed, however, and subsequent definitions based on them. Nicolescu credited Jean Piaget with coining the term, though Peter Weingart (2000) attributed it to Erich Jantsch. Hirsch Hadorn, Pohl, and Bammer (2008) also credited Jantsch, while Palmer, Riedy, Fam, and Mitchell (2017) traced origin to both Piaget and Jantsch. Piaget (1972) regarded transdisciplinarity as a higher stage in epistemology of interdisciplinary relations, informed by a general theory of systems or structures. Jantsch (1972) proposed, instead, a teleological and normative model of the university based on purpose-oriented knowledge triangulating systems design laboratories, function-oriented departments, and discipline-oriented departments. In the latter half of the 20th century, though, TD became associated with new synthetic paradigms as well: notable among them general systems theory, feminist theory, post/structuralism, cultural critique, and sustainability. They shared a common goal of advancing overarching models but differed in outlooks that Raymond Miller (1982) compared in his typology of interdisciplinary approaches in social sciences published in the inaugural volume of this journal.

Even early on, then, TD was a multiplicity. In contemplating future prospects Russell, Wickson, and Carew (2008) admonished, "Transdisciplinarity is a practice, not an institution, and the more flexible, adaptable and open it remains, the greater will be its contribution" (p. 470). Two recent books document current multiplicity of developments associated with TD including not only overarching theory but also problem orientation and stakeholder engagement. When Barry and Born (2013) asked whether interdisciplinarity is a multiplicity, they identified three logics of interdisciplinarity today. The first—accountability—is often associated with the economy but also has a

democratic imperative that asserts political priorities and the common good. Hence, they cautioned against reading interdisciplinarity exclusively as emanating entirely from governmental preoccupation with accountability, innovation, and commercialism. It is neither solely instrumental nor promulgates only social and economic transformations. The second—innovation—is a spectrum of arguments about how research should contribute to economic growth. This purpose has a history dating to the mid-19th century but has intensified in recent years. In contrast the third—ontology—is a philosophical discourse that interrogates rationales of both accountability and innovation. They cite ethnography in the Information Technology industry. It appears initially aligned with the logic of innovation when, for example, ethnographers identify customers' desires to leverage product design and marketing. Yet, ontological rationales also appear, including theoretical and methodological preferences as well as the nature of technology. In recounting emergence of the Art-Science movement in the United Kingdom during the 1990s, Barry and Born also identified multiple rationales. Instruments of legitimation that popularize or communicate science to consumers differ from engaging the public in scientific debate. In the latter case, ontological questions critique, challenge, and transform existing ways of thinking about art and science.

In the second recent book, introduced earlier, Louvel (2021) acknowledged interdisciplinarity depends on societal concerns and advancing knowledge through political support and stakeholder cooperation. Yet, she argued, it is also a scientific agenda. Louvel concluded prioritizing definitions is part of the boundary work individuals and groups perform when selecting relevant approaches and constructions of a field. In the case of nanoscience they include definitions as an area in biomedical engineering, as an archipelago of objects and approaches in existing interdisciplinary communities, and as an extension of disciplinary territories. Louvel added researchers are conducting two types of interdisciplinary collaboration. In the first, projects bring together academic researchers from natural and biomedical sciences with chemical, material, and physical sciences within the university. In the second, they treat interdisciplinarity as a dialogue between academics and stakeholders within the medical profession. At the same time, nanomedicine exhibits the logic of ontology: by generating new ways of conducting, organizing, and evaluating science. Not everyone would agree with Louvel, though, that interdisciplinarity should stop short of a full sociopolitical order anchored by explicit organization, hierarchies, rules, rewards, and sanctions. She argued instead for greater organization to benefit both science and society, with central oversight in a portfolio of strategies rendering disciplinary and interdisciplinary research co-existing sociopolitical orders. Like other fields, nanomedicine also exhibits internal divisions and oppositions that belie a unified vision. Consequently, the social space of this and other fields is multi-layered, rendering interdisciplinarity a generic or an umbrella term for differing practices. Multiplicity

also raises a question about relationships of inter- and trans-disciplinarity with other prominent concepts. Two stand out in literatures cited by founding members of the ITD Alliance.

Overlap with convergence is evident in C4I's current alignment of convergence with interdisciplinarity and integration in a project supported by the U.S.-based National Science Foundation, as well as growing interest among members of INSciTS. Convergence has become a term *du jour* in the country. Some universities promote it as a means of fostering coherence across campus around themes, often linked to grand challenges while aimed at reducing fragmentation due to dispersed specialties and fulfilling the university's social mission. In addition, the concept is associated with an intellectual and creative process of convergence-divergence. Authors of a U.S.-based National Academies of Science task-force report on *Convergence* explained this process brings together different forms of expertise in a new system that continues to spin off applications and components, which may be further recombined and integrated in innovative ways. Moreover, in aligning convergence with transdisciplinarity, the report called TD an "expanded form of interdisciplinarity" serving both epistemological and instrumental goals: including understanding complex biological systems, improving patient outcomes, revolutionizing manufacturing, enhancing energy storage, and providing secure food supplies (NASEM, 2014). NSF has had the concept in its portfolio since 1954 but is aligning it today with problem-driven research emanating from either scientific questions or societal needs. Its Big Ideas initiative targets not only convergence but also data, infrastructure, astrophysics, Arctic change, a quantum revolution, and the future of work at the human-technology frontier. Even while endorsing values of inclusion and diversity, however, this effort prioritizes positioning the United States on the cutting edge of science and engineering, in a competitive international marketplace of ideas and applications (https://www.nsf.gov/news/special_reports/big_ideas/NSF).

Overlap with Mode 2 Knowledge Production has also reinforced the prominence of transdisciplinarity, including connotations of both problem-oriented and stakeholder-inclusive research. In a widely read treatise, Gibbons et al. (1994) proposed a new mode of knowledge production is fostering synthetic reconfiguration and recontextualization of research beyond academic settings. In contrast to the traditional discipline-based form of Mode 1, defining characteristics of Mode 2 include complexity, non-linearity, heterogeneity, and transdisciplinarity. New configurations of research work are being generated continuously, and a new social distribution of knowledge is occurring as a wider range of organizations and stakeholders are contributing their skills and expertise. As traditional academic and disciplinary boundaries of control blur, notions of competence are also being redefined and new criteria are needed for appropriate evaluation. Gibbons et al. initially highlighted instrumental contexts of application, such as aircraft design, pharmaceutics,

electronics, and product development. Subsequently, however, Nowotny, Gibbons, and Scott (2001) extended the theory to include participation in the *agora* of public debate. When lay perspective and alternative knowledges are recognized, a shift occurs from solely reliable scientific knowledge to inclusion of socially robust knowledge as well. Some have disputed how new Mode 2 actually is, while others have questioned claims of epistemic transformation and prioritizing Mode 2. Overlaps might also suggest relationships may be portrayed as a Venn diagram. However, Daniel Stokols cast doubt on such depictions. Early notions of convergence, for example, were narrower than current conceptions of transdisciplinary and collaborative research in STEM fields of science, technology, engineering, and mathematics. Related concepts also appeared earlier in community-engaged action research and the field of social ecology (personal communication, July 6, 2019).

Conclusions for Answering Newell's Challenge

Mindful of organizational and historical perspectives traced above, a number of shifts must be considered in contemplating the future of any one organization and its alliance with others. Empirically grounded accounts and case studies abound, expanding awareness of contextual parameters of both theory and practice while elevating transdisciplinarity. Organizing languages and their conceptual frameworks have changed as well. At the first international conference on interdisciplinarity in 1970, they were logic, cybernetics, structuralism, general systems, and organizational and information theories. Today the typical warrants are complexity, contextualization, and collaboration (Klein, 2021). Weingart (2010) further cited a shift in science policy over the second half of the 20th century, signaled by increased industrial expenditures for research and development to support fundamental research. As a result, he contended, knowledge production is no longer solely a search for basic laws and, despite their intellectual autonomy, disciplines are affected by external resources and influences. Transitory networks and contexts have also formed, replacing traditional disciplines as sites of research. Nonetheless, Weingart cautioned against overstating external drivers. Claims that discipline-based knowledge production has been replaced by a new mode of research are not corroborated by empirical evidence. He projected traditional disciplines and crossdisciplinary fields will continue to exist side by side, paralleling Louvel's belief a disciplinary and an interdisciplinary sociopolitical order will continue alongside each other.

Further echoing the current multiplicity of both inter- and transdisciplinarity, Robert Frodeman (2017) suggested definitions of the concepts have functioned as boundary objects with different meanings at different times for different groups, though interdisciplinarity is most often a

portmanteau word for more-than-disciplinary approaches. He added, though, the concept of innovation stood out across the 46 chapters of the 2017 *Oxford Handbook of Interdisciplinarity*, leading him to question whether the usefulness of interdisciplinarity may be ending. Politicians and citizens speak instead of "impact," "accountability," or "relevance." Frodeman (2013) himself has advocated prioritizing problem-focused research now. And, reflecting on the future of interdisciplinarity Machiel Keestra (2019) called in a recent volume of *Issues in Interdisciplinary Studies* for placing greater weight today on actionability, grounded in the realization knowledge is valid from both different perspectives (as in interdisciplinarity) and a social context (as in transdisciplinarity). Keestra further contended actionability constitutes a fundamental challenge to the traditional form of integrative interdisciplinarity that prioritized academic, epistemological, and cognitive dimensions. The value of experiential knowledge, interests, and norms is recognized along with stakeholder expectations. When Russell, Wickson, and Carew (2008), in turn, contemplated the future of transdisciplinarity, they identified three drivers today. The first—the knowledge economy—prioritizes problem-oriented or applied research. The second—an environmental imperative—incorporates contextualization of problems and a systems approach. The third—an engaged populace—calls for an inclusive approach. Contradictions among the three drivers, they suggested, are faultlines in conceptualizing transdisciplinarity, comparable to Barry and Born's depiction of the three logics of interdisciplinarity as competing rationales.

Russell, Wickson, and Carew (2008) further noted transdisciplinary activities are contributing to development of a methodology inclusive of iterative reflection and collaboration of both internal academic and external social actors with philosophical implications. Yet, the first driver reinforces priorities of economic growth and international competitiveness at a time, they added, when public funding for higher education has declined. As a result, many research universities have consolidated around particular strengths and external priorities that will generate revenue, stirring critique of which kind of research is devalued because it is not competitive in the high-stakes academic political economy of grants and contracts. Governmental and administrative intervention in setting priorities is also being interrogated. Critics charge, for example, the Triple Helix partnership of universities, industry, and government comes at the expense of bottom-up initiatives emanating from a wider range of intellectual interests. Russell, Wickson, and Carew themselves cautioned consolidation around selected strengths runs the risk of creating "mega-silos" that construct new priorities at the expense of other areas. As a result, attempts to institutionalize transdisciplinarity may actually inhibit flexibility and openness while diminishing prospects for creativity, interconnection, complexity, and systems thinking. In the process, ownership of research is channeled in some directions rather than others, perpetuating

imbalances of power that determine which form of knowledge counts and whose voice is heard, including not only particular academic experts but also professional practitioners and residents of communities. Given multiple claims and practices, though, Russell, Wickson, and Carew proclaimed transdisciplinarity cannot boost the economy, save the environment, and empower the community at the same time.

In closing, deeper understanding of conflicting priorities and heterogeneity of practices returns discussion to Newell's challenge to consider how interdisciplinarity is defined. This article has called attention to not only multiplicity but also the prominence of transdisciplinarity today. The distinction, though, is questioned. Harvey Graff (2015) charged the "name game" is littered with typologies and terminology that have generated more confusion than clarity (p. 215), while Jerry Jacobs (2013) dubbed the "jungle of terminology" a "cacophony" (pp. 3, 124). Graff further contended a monolithic "standard version" prevails, singling out the U.S.-based National Institutes of Health (NIH) as an exemplar of a normative Big Science model that hegemonizes large-scale team-driven research. He further contended transdisciplinarity pales in comparison to the primacy of interdisciplinarity (pp. 3-4). Graff is correct to criticize marginalization of other areas of interdisciplinary work: including general education, arts, and digital humanities. He is also right to declare applied research is often less prestigious, and the increased number and size of teams raises concern about minimizing individual achievements. However, his minimizing of transdisciplinarity ignores its heightened visibility and status today. Moreover, NIH is a large federation that does not follow a single definition or project a "succinct, conflict-free, and romanticized account of a 'great transformation' neatly unconstrained by time, place, and historical context" (p. 215). And, branding "multidisciplinary 'wars' on poverty, cancer, drugs, history, communication, the human genome, and on and on" as "fallacies" is a glib dismissal (pp. 155-156). They have entailed significant fundamental research and pragmatic solutions to societal problems (Klein, 2021). Graff is not alone in his critique, though. Callard and Fitzgerald (2015) contended "Interdisciplinarity is a term that everyone invokes and none understands." And, in her genealogy of the word claiming origin at the SSRC, Roberta Frank (1988) suggested its ubiquity means "no one can pin down what people have in mind when they utter it." To the contrary, patterns of consensus refute assertions that "none understands" and "no one can pin down" the meaning of the term.

Proliferation and dispersal across an increasing number of contexts complicate understanding of both inter- and trans-disciplinarity. However, they do not render it impossible or terminology a Tower of Babel. When heterogeneity, not universality, becomes the groundwork of theory and practice similarities and differences must be compared. The global scale of the ITD Alliance, in particular, accentuates the need for mutual learning across intellectual traditions, socio-political forces, cultural perspectives, and institutional structures and

missions. Each organization in an alliance, however, must ensure its website is regularly updated. Hosts of the td-net site are doing so now as they migrate to a new digital format, and its bibliography has long been updated regularly. The i2S website is also being updated to include new developments as they arise, and the Insights blog continues to add new posts while archiving earlier ones for access. For their part, AIS, INSciTS, and C4I are in need of updating, though AIS is starting to do so with Publications. For its part INSciTS needs to archive more materials from past conferences and C4I to capture outcomes of both education and research activities. In addition, all five organizations need to conduct the kind of introspection that Newell called for in 2013, both internal to their membership and in dialogue with other organizations. The state of interdisciplinary theory Newell represented in 2013 was AIS-centric, but this tendency appears in other organizations as well, driven by the need to advance their individual missions. Each of them, though, needs to weigh implications for their agendas and claims to authority. An alliance is an ideal forum for doing so. For AIS members in particular, this journal is an ideal site for respond to Newell's challenge.

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