TRANSDISCIPLINARY INTELLIGENCE: LINKING FACTORS OF KNOWLEDGE PRODUCTION AND THE CULTURAL DIMENSIONS OF INDUSTRIES

by

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To my beloved Grace, for the journey together,

to my Mother, for raising me to think and to toil,

&

to my Abuela Tina, for teaching me about life & the world

with her example, her spirit, and her words.

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by

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DISSERTATION

Presented to the Faculty of

The University of Texas at Dallas

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY IN

ARTS, TECHNOLOGY, AND EMERGING COMMUNICATION

THE UNIVERSITY OF TEXAS AT DALLAS

August 2021

ACKNOWLEDGMENTS

Like in the movies, the credits for this work go well beyond the byline in the cover. First, I would like to thank all my participants and co-investigators (you know who you are) without whom this research would not have happened. I would like to thank all my colleagues at the ArtSciLab, especially Paulina Antoinette White for her immense help in the execution of Project HERMES, and Dr. Kathryn Evans, Dr. Yvan Tina, Dr. João Silveira, former co-director Cassini Nazir, and A.B.D. Chaz Lilly for laying the groundwork with their own research adventures. I would like to thank the staff of the Eugene McDermott Graduate Fellows Program for all their support throughout the years, particularly Reena Schellenberg and Sherry Marek. I would like to thank the Family that is the Eugene McDermott Scholars Program Alumni Association (AKA the McDermott family) for their cheering, interest, and help in completing this research. I would like to thank my committee for their unwavering support and guidance in this journey: to Dr. Frank Dufour for first suggesting this doctoral path to me; to Dr. Heidi Rae Cooley for facilitating collegiality in spite of departmental mores; to Dr. Roger F. Malina for his mentorship & friendship; to Dr. Haemin Dennis Park for keeping me vigilant about scope ambitions; and to Dr. Mark Cooper for his valuable feedback and advice even before he formally joined the committee. Finally, I would like to thank my family and my friends (who also are family) for pushing me towards the finish line, now and always…

July 2021

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This research project developed metrics, tools, and a training program that help experts from different fields and diverse publics to collaborate on finding hidden insights for future-making and on solving the wicked problems of the world. Current transdisciplinary practices and tools in this area have a limited scope, mostly concentrated in the fields of translational medicine and environmental sciences. This project blends together research trends and theoretical discourses from a wide array of academic fields to build the Transdisciplinary Intelligence (TDIQ) framework, a cohesive and complementary theory of transdisciplinary knowledge production and the societal impact of industry. The framework includes a double-helix training program consisting of an apprenticeship and a simulation meant to prepare individuals for transdisciplinary work. The framework also offers a portfolio of quantitative and qualitative instruments to measure the Transdisciplinary Intelligence of individuals, collectives, organizations, and other networks, as well as a Transdisciplinary Intelligence Inventory that assesses the context/environment in which these actors operate. This Transdisciplinary Intelligence approach to knowledge production, innovation, and problem-solving stands to

benefit a variety of stakeholders, such as research institutions, innovation-focused organizations, policy-makers, and governmental agencies. The results from the research herein have implications for higher education, research practices, training for the jobs of tomorrow, and the co-production and co-design of desirable futures.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PROLOGUE

This dissertation stands at a singularity of historical forces, intellectual trends, moral imperatives, and impending futures; all which have influenced its form, its purpose, and me, its author (or perhaps its perpetrator), during the four-year period of its so-called *making*. As a result, and also as a reflection of the transdisciplinary phenomena it studies and represents, this doctoral work diverges from the ordinary expectations of a dissertation in a multitude of ways that require from readers not only a kind of *suspension of disbelief* in terms of academic assumptions, but a reading that verges on the counterintuitive and paradoxical. Appreciating this work involves a reading that calls for expertise as much as it demands a curious and open mind. A reading that unfolds narratively while the work itself exists essentially as a hyper-linked text without a dictated/doctrinal beginning, middle, and end, except for the limitations of the written page and the bounded codex. A reading that understands claims of masterly specialization inherent of a doctoral pursuit, but a specialization that manifests as a wide and complexifying scope of inquiry. A reading that grapples with simplification and metaphors in the text in order to be faithful to the complicated truths of reality. A reading that relies on skepticism of how things are, as much as it thrives upon faith of how things could be—all which seem to match the challenges of reading and overcoming the signs of our times.

Yet, like many a hero from mythology and history, the reader may more easily navigate outside an ordinary reading when considering this prologue not as a presage to heed but as an allegorical map of the beyond that has been charted for them prior to their journey.

The first chapter traces the origins and essences of knowledge, labor, and expertise, elucidating the precipitation of their intertwined complexity manifest in the contemporary world.

The second chapter surveys and distills the theories and constructs pertaining to transdisciplinarity. It frames transdisciplinarity as a phenomenon of cultural emergence within and among different disciplines, while proposing the notion of Transdisciplinary Intelligence as a comprehensive framework through which to measure the fundamentally human endeavor of knowledge production.

The third chapter looks into the past through a transdisciplinary lens. It assesses historical exemplars in three presumptively different (yet remarkably similar) industries to validate the relevance and usefulness of the Transdisciplinary Intelligence Inventory (a cornerstone of the framework) to both explain and anticipate successes, failures, and challenges to come when producing and circulating new knowledge.

The fourth chapter recounts my own experience and efforts in studying contemporary transdisciplinarity. It details the research phases, instruments, and activities that led to this dissertation, all of which respectively combined approaches from quantitative and phenomenological methods to unscramble and grasp the complexities and complications of transdisciplinary phenomena. The findings confirm some well-established beliefs about certain disciplines, while suggesting some surprising interrelationships in the context of transdisciplinary knowledge production.

The fifth chapter outlines and proposes a learning program for Transdisciplinary Intelligence meant to build upon battle-tested educational theories and practices, framed within 21st century affordances and Anthropocene-conscious future-making.

The sixth chapter debates and rebuts anticipated criticisms to this work. It contrasts such potential critiques to the particular purposes and products of this doctoral work, as if finding a fit between the former and the latter worthy of Procrustes's bed.

The seventh and final chapter envisions and speculates promising futures involving Transdisciplinary Intelligence. It centers industries (including educational institutions) as the vital organisms in need of reconsideration, redesign, and harmonization among themselves and with their ecosystems (and their societies) in order to accomplish desirable futures and reach a better tomorrow.

Once equipped with this map of what lies ahead in these pages, and if you have made it this far dear reader, I hope that you find something of value in your reading journey—perhaps some imperfect answers, or more importantly, perhaps some pressing questions that echo those of T. S Eliot's[1] poetic prophecy:

Where is the Life we have lost in living?

Where is the wisdom we have lost in knowledge?

Where is the knowledge we have lost in information?

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[1] Thomas Stearns Eliot and Professor T. S. Eliot, *Complete Poems and Plays* (Houghton Mifflin Harcourt, 1971)., p. 96.

CHAPTER 1

IN THE BEGINNING, KNOWLEDGE

1.1 Interrelating Knowledge & Labor to Expertise & Industry

From the dawn of civilization, when humans "built a space of their own amidst the wilderness of Nature,"[2] knowledge and work have had a symbiotic relationship in which one enables and builds upon the other in a constant cycle—what a person knows allows them to perform work, and at the same time, the work that a person performs allows them to learn or generate new knowledge that they previously did not have. This feedback-loop of a relationship has informed the emergence of societies across time periods and cultures. Hunter-gatherers interacted through their work with their preys and the environment around them, acquiring knowledge not only of food, but also of weather, the stars, and the different forces and systems influencing nature, knowledge which eventually led to religion, priests and priestesses, and a growing society. The growth, in turn, entailed new knowledge about organization and quantities, so elders, math, and rules emerged as proto-governments, setting the course for a division of knowledge and labor (both deeply connected to the binomial of wealth and power) that continues today, but that took different directions in different regions and peoples of the world. While the Western, Indo-European world developed divisions of knowledge and labor along the lines of gender and lineage (which favored the men), the rest of the world developed alternative versions: many African tribes honored motherhood instead of manhood, for the labor it entails would teach

[2] José Ortega y Gasset, *Meditación de la técnica y otros ensayos sobre ciencia y filosofía* (Alianza, 1982).

mothers important knowledge for the entire community;[3] Native Americans established societies based upon certain harmonies and appreciation of all labor roles and the knowledge inherited from their ancestors;[4] and the great civilizations of Asia built societal structures based upon the acquisition and application of knowledge for the sake of community and authority.[5]

Regardless of the historical or geographic background, knowledge generally holds the status of an abstract resource or good (whether personally attained or collectively capitalized[6]), for it can be extracted, accumulated, transmitted, reproduced, managed, and applied in multiple ways, including as the basis "accepted by one or another social group or society of people pertaining to what they accept as real."[7] As an abstract good, knowledge then can be classified not according to its content value (as may be the human instinct) but according to its quantity and quality (such as the widely accepted hierarchy of the data-information-knowledge-wisdom pyramid[8]), all while being represented in exact mathematical calculations[9] as much as in centuries-old philosophical terms. Together with labor, knowledge has been the asset (rather than the virtue) with which civilizations have been built.

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[3] Teresa N. Washington, *Our Mothers, Our Powers, Our Texts: Manifestations of Aje in Africana Literature* (Oya's Tornado, 2015).

[4] Julian Granberry, *The Americas That Might Have Been: Native American Social Systems Through Time* (University of Alabama Press, 2005).

[5] Don Ihde, *Postphenomenology and Technoscience: The Peking University Lectures* (SUNY Press, 2009).

[6] Jay H. Bernstein, "Disciplinarity and Trandisciplinarity in the Study of Knowledge," 2014.

[7] E Doyle McCarthy, *Knowledge as Culture: The New Sociology of Knowledge* (Psychology Press, 1996).

[8] Jay H. Bernstein, "The Data-Information-Knowledge-Wisdom Hierarchy and Its Antithesis," *NASKO* 2, no. 1 (November 4, 2011): 68–75, https://doi.org/10.7152/nasko.v2i1.12806.

[9] Claude E Shannon, "A Mathematical Theory of Communication," *The Bell System Technical Journal* 27, no. 3 (1948): 379–423.

In such resource-based context, accumulated knowledge refined through dedicated labor becomes what's commonly regarded as *expertise*[10]—at once a status, a property, and a performance with social dimensions.[11] In other words, an individual or group can be an expert only when recognized by others, can attain expertise only from and in relation to the knowledge of others (experts and non-experts), and can labor as an expert only when surrounded and experienced by others. For instance, ancient high priests could be experts of worship only among other priests and believers, just as a contemporary physician can be a medical expert only within a healthcare system. Expertise, therefore, epitomizes the symbiosis and the intersection of knowledge and labor in a broader scope and perspective.

When expertise manifests beyond an individual or single group, it gives rise to *industries,* which arguably have impacts of econo-political and socio-cultural proportions, The term *industry,* in this sense, can be appreciated in its etymological essence: *a building with/in* (from Latin *indu*: in/within; and *struere*: to build) of expert knowledge and expert labor belonging to a collective that encompasses organizations, technologies, people of diverse identities, and different sectors and institutions of society.

This understanding of industries as multi-actor systems that claim and perform expertise over an entire domain of the totality of human endeavors, can be better envisioned as a mosaic or a mesh with interlocking notions that can defy linear chronology and intellectual boundaries. For instance, the notion of industries as expert systems echoes Jose Ortega y Gasset's proposition

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[10] Not to be equated or confused with *specialization;* more on the latter in Sections 1.3, 1.6, and 1.7.

[11] Harry Collins and Robert Evans, "A Sociological/Philosophical Perspective on Expertise: The Acquisition of Expertise through Socialization," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 21–32, https://doi.org/10.1017/9781316480748.002.

that ‘elites’ are responsible for propelling civilization forward, while the masses simply keep the gears of society turning normally[12]. To paraphrase one of his key examples, the automobile stands out as an innovation enjoyed by the masses, but that not only do very few people understand intimately how it works, it also was developed solely by a discrete group of inventors (an elite of the auto industry) who took it upon themselves to create it and make it popular—it wasn’t a crowdsourced accomplishment, and industries routinely take on that role of ‘elite responsibility’ for ‘civilization’ in a particular domain. Similarly, considering knowledge a critical part of any and all economic activity can be traced to Fritz Machlup’s work, who in addition to explicitly calling “knowledge production” an “industry” also set the critical and philosophical foundations of studying knowledge from various industry and economic perspectives.[13] As Machlup argued in his magnum opus, concerns regarding (or the centrality of) previously ‘protagonist’ factors, such as material resources, capital, socio-economic/socio-political systems, networks, and even labor itself, are all rendered inconsequential without the knowledge to activate and/or embody those factors. Having all the oil in the world makes no industrial difference without the knowledge embodied in a labor force that can create and use the technology needed to extract and use the oil, to take advantage of the resource, just as a scientific theory is moot without knowledge to connect it in meaningful ways with the ‘real world.’

Nonetheless, this interrelationship of knowledge, labor, expertise, and industry must not be misconstrued as an interpretation in the vein Marxist ‘capitalo-centrism.’ Rather, it recognizes

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[12] José Ortega y Gasset, *The Revolt of the Masses* (W.W. Norton, 1993). Ortega y Gasset.

[13] Fritz Machlup, *Knowledge: Its Creation, Distribution and Economic Significance, Volume I: Knowledge and Knowledge Production* (Princeton: Princeton University Press, 1981), https://doi.org/10.1515/9781400856008.

the "communal production, appropriation and distribution of surplus labor…at home, at work, at large"[14]—a consideration of the role of industry in performing expert knowledge that derives from J.K. Gibson-Graham's feminist critique, and from Donna Haraway's feminist questioning (and refutation) of Western-dominated, male-centric perspectives of knowledge and knowledge producers' "objectivism" which have historically disempowered and marginalized those without access to them.[15] After all, industries are not exempt from the truth contained in the timeless, misattributed aphorism "knowledge is power"[16]—and while expert knowledge and industries can produce world wonders and modern marvels, if left unchecked and unexamined they can also corrupt, corrode, and oppress the societies who fostered them.

1.2 Connecting Expert Knowledge and Power: The Disciplines

Across time and cultures, what the interrelationship of knowledge and labor have shared with the development of industries has been the human motivation behind them: the need to categorize[17] and control people, resources, knowledge, and their power shape reality. Questioning "the manner in which knowledge is employed in a society, the way in which it is exploited, divided and, in some ways, attributed," reveals how knowledge "tends to exercise a

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[14] J. K. Gibson-Graham, *The End of Capitalism (as We Knew It): A Feminist Critique of Political Economy*, 1st University of Minnesota Press ed., 2006 (Minneapolis: University of Minnesota Press, 2006).

[15] Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, no. 3 (1988): 575, https://doi.org/10.2307/3178066; Donna Haraway, *Simians, Cyborgs, and Women: The Reinvention of Nature* (Routledge, 2013).

[16] Usually attributed to Sir Francis Bacon in its Latin form "scientia potentia est," but without archival evidence.

[17] Geoffrey C Bowker and Susan Leigh Star, *Sorting Things out: Classification and Its Consequences* (MIT press, 2000).

sort of pressure, a power of constraint"[18] for those who don't wield it. In such a dynamic, the interrelation of knowledge and labor is a way of control itself by determining not only the sources and applications of knowledge but also the distribution of knowledge and its transformation into different kinds of structured labor. '*Scientia potential est'*, unsurprisingly then, can be found in the writings of a natural philosopher-turned-statesman as well as in the texts of one of the founders of modern political philosophy. Leonardo DaVinci manufacturing novel weaponry for the Borgias, Chinese crafters creating gunpowder and rocketry for military might, Muslim scholars developing algebra by commission of the Sultan in order to gain God's favor, and the Manhattan Project, all exemplified, even if somewhat crudely, the inherent implications of knowledge and labor in political economy terms. In other words, the production and accumulation of knowledge and labor have always been a matter of geopolitical urgency and ethno-economic competition—a Darwinian race among civilizations to always be more knowledgeable, more efficient, more productive, and more brutishly powerful, or perish against the might of those who are. Over millennia, the race has led to the creation of institutions exclusively devoted to the production of new knowledge (universities) and its dissemination (schools of all types) in order to accomplish certain levels of labor among the people and develop specific industries according to the expectations of those in positions of authority. At the same time, however, the Fordian influences and the events of the Industrial Revolution (and the subsequent Taylorism) perverted the relationship of knowledge and work through specialization: while knowledge became more specialized to accomplish greater depth and a better grasp of the

[18] Michel Foucault, "The Discourse on Language," in *Truth*, ed. Jos Medina and David Wood (Ames, Iowa, USA: Blackwell Publishing, 2005), 315–35, https://doi.org/10.1002/9780470776407.ch20.

world,[19] work became specialized in order to strip it from as much knowledge as possible, making labor shallower and thus a commodity to be extracted from alienated people rather than cultivated from a knowledgeable citizenry.

As the aforementioned race amongst societies led to an increase of specialism in the Western world, the need for control emerged in parallel among industries and knowledge-producing entities, manifesting for the former as *professionalization*[20] and as "*disciplines*" and departments for the latter. What expertise thrived upon (socialization, learning, co-labor), this professionalization and disciplinary specialism wielded as sources and claims to power comparable to those of the great institutions of times immemorial: the clergy, the military, the ruling class—and then the professionals and disciplinary experts rising up by leveraging the power of knowledge. This phenomenon mirrored the professionalization of civil service in Ancient China, which favored the division of (bureaucratic) labor based on merit and knowledge rather than lineage or station[21] like it was in Western counterparts.

Through this professionalization, industries such as law, healthcare, and technology, (industries built upon expert knowledge) started to have restrictions and requirements imposed by their own actors in order to control their membership and assert legitimacy in the public sphere and the marketplace alike. This was particularly evident in the 19th century effort to keep

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[19] For instance, medicine eventually splitting into specializations according to organs and types of diseases, which led to vaccines, organ transplants, and antibiotics, but also led to modern doctors who struggle to make any diagnosis without million-dollar equipment.

[20] Harald A. Mieg and Julia Evetts, "Professionalism, Science, and Expert Roles: A Social Perspective," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 127–48, https://doi.org/10.1017/9781316480748.009.

[21] At least for the positions that merited such an approach, and from which the Emperor's seat was exempted.

fake physicians and ill-trained engineers away from the marketable workforce through certifications and formally-sanctioned professional societies and academies, ostensibly due noble concerns for public safety if unauthorized actors were allowed to practice; but the effort also allowed for market manipulation of prices and of supply of services. That reasoning in favor of professionalization in industry made its way to universities and colleges, where expertise readily became another metric by which to institutionalize and assert power between 'masters and apprentices,'[22] to divide and differentiate experts and non-experts, and to reward experts who 'honor' the establishment and punish those who deviate or challenge it —the central premise of knowledge *disciplines*.

The transformation and impact can be summarized like this: whereas the Lyceum and the Academy of Ancient Greece would cover only natural philosophy and the liberal arts, the modern U.S. higher education system comprises hundreds of programs with highly specific domains of knowledge,[23] and the subdivisions and gaps between them continue to multiply year by year, overspecializing experts and alienating them further from one another and anyone outside their field of expertise. In a way, the political economy motivations of knowledge production and the race of specialization that accompany it have manifested in what could be identified as a 'creative destruction' of knowledge production in which 'the new' is constantly

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[22] K. Anders Ericsson, "An Introduction to the Second Edition of *The Cambridge Handbook of Expertise and Expert Performance* : Its Development, Organization, and Content," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 3–20, https://doi.org/10.1017/9781316480748.001.

[23] Mark Garrett Cooper and John Marx, *Media U: How the Need to Win Audiences Has Shaped Higher Education* (Columbia University Press, 2018).

and repeatedly in competition with past and future knowledge[24]—a cyclical palimpsest of values, knowledge, tools, and technology that multiplies exponentially the complications and interconnections of a networked, global world.

1.3 Understandings(s) of the Disciplines

Since before, and particularly after the institutionalization of the disciplines, they have become the baseline by which to describe and measure progress and eras, both inside and beyond the academic circles that begat them. Quantum physics gave name to the Atomic Age, and computer science defined the Digital Revolution. More significantly, the disciplines become mirrors and bellwethers of their times; for instance, the rise and fall of certain disciplines have reflected (and continue to exemplify) the clashes between conservative societies and liberal movements:[25] law and medicine against theology, engineering against crafts and vocational occupations. Ultimately, the disciplines have accrued manifold meanings since the nineteenth century:

- as essential or artificial divisions of the realm of knowledge, metaphorically referred as "branches from a tree;"[26]

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[24] Alan Liu, *The Laws of Cool: Knowledge Work and the Culture of Information* (University of Chicago Press, 2004).

[25] A more specific exemplar can be found in Section 3.3.

[26] Ben Shneiderman, "Creativity and Collaboration: Revisiting Cybernetic Serendipity," *Proceedings of the National Academy of Sciences* 116, no. 6 (2019): 1837–43; RF Malina, C Strohecker, and C LaFayette, *Steps to an Ecology of Networked Knowledge and Innovation* (Cambridge, MU: The MIT Press, 2015).

- as departments within institutions, especially those related to academia,[27] or as institutions in themselves, seeking to establish the foundation of truth[28] through 'a system of control in the production of discourse'[29] (meaning knowledge); and
- as cultures with their own foundational texts, languages, symbols, values, and ecosystems, and to which individuals claim membership and identity,[30] or that can serve as "ideologies that mask or mystify social systems, organizations, and classes."[31]

However, while all of these understandings influence how knowledge is conceived and produced, they obscure the profound interrelationship of knowledge, labor, expertise, and industry already argued herein and that can be summarized in two concepts: *knowledge production* and collaboration.

1.4 From Disciplinary Research to Collaborative Knowledge Production

In the context of expert knowledge manifested as disciplines and as industries alike, the concept of *research* from its "scientific inquiry" sense and approximates more its etymological meanings of "to wander; to traverse again" (Latin *re-circare*) or "to seek out; to search closely" (Old French *recercher*),[32] which then reads like an ontological mandate intended for laboratories, museums, theaters, universities, workshops, and studios alike. From the Louvre in Paris to the

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[27] Immanuel Maurice Wallerstein, *The Uncertainties of Knowledge* (Temple University Press, 2004).

[28] Michel Foucault, "History of Systems of Thought," *Language, Counter-Memory, Practice*, 1980, 199–205; Michel Foucault, *The Order of Things* (Routledge, 2005).

[29] Foucault, "The Discourse on Language."

[30] McCarthy, *Knowledge as Culture: The New Sociology of Knowledge*.

[31] McCarthy.

[32] Douglas Harper, "Research | Origin and Meaning," Dictionary, Etymonline, accessed September 19, 2019, https://www.etymonline.com/search?q=research.

Los Alamos National Lab to the Hong Kong Opera to the Tata Institute of Fundamental Research in Mumbai, those places and institutions are meant for minds to wander and wonder, and in doing so, observing and encountering truths and meaning, whether scientific or existential. Research, therefore, ought to be understood as a habit and purpose of most human activities, well beyond the professional work of scientists and scholars. In such a universal sense, research may also be recognized by its *nom de plume*, its scholarly stage name: *knowledge production*, in which *production* means at once "to bring forth; to exhibit" (Latin *producere*)[33]—precisely the joint function of art, science, and a plethora of transdisciplinary practices related to *knowledge,* the act and substance of *knowing*, a verb and concept so complex that in English it draws upon meanings usually invoked in other languages by duets and quartets of words: "to perceive; to recognize; to understand as fact or truth; to have the knowledge to do."[34]

Focusing on knowledge brings to the forefront an intimately co-related phenomenon that usually gets downplayed or overlooked in other fields: collaboration and its endemic nature in human endeavors.

First off, the experience of knowledge itself, in its manifold variations, entails and constitutes an *intersubjective* collaboration[35], whether between individuals crafting meaning, between an individual and a larger collective assigning concepts, between organizations ascribing significance, or between any of the former categories and the world at large in order to

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[33] Douglas Harper, "Production | Origin and Meaning," Dictionary, Etymonline, accessed September 19, 2019, https://www.etymonline.com/word/production. Harper.

[34] Douglas Harper, "Know | Origin and Meaning," Dictionary, Etymonline, accessed September 19, 2019, https://www.etymonline.com/word/know.

[35] Edmund Husserl, *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy* (Northwestern University Press, 1970).

attain understanding—for knowledge cannot exist in a vacuum. Rather, knowledge has a *connective*[36]nature that makes it at once the origin and the end of a continuous and iterative collaboration among a variety of actors in a complex network as modeled by actor-network theory (ANT).[37] To illustrate this point: *2+2=4* is just scribbles rather than a universal mathematical truth unless those scribbles are knowingly connected both to their symbolic meaning in arithmetic and to the embodied knowledge of mathematicians; *2+2=4* thus has significance and value according to the knowledge connecting it, relating it, to that collaborative experience between sign-symbol, actors, and the world.[38]

Metaphorically (and borrowing from Barad's quantum physics understanding of meaning[39]), knowledge manifests both as discrete particles that can distribute chaotically, and as waves that disperse harmoniously, depending on the way knowledge is measured and on its context. At the individual level, the accumulation of knowledge particles leads not only to attaining expertise, but also to building an identity about it, which then attunes to a wave of knowledge pertinent to a particular community of practice and a particular industry. For instance, Hollywood auteurs like Hitchcock become experts by accumulating knowledge about filmmaking, film genres, audiences, and celebrity, which in turn attunes auteurs with waves in audience tastes, awards trends, and emerging filmmaking techniques of their time. Similarly,

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[36] Nicky Priaulx and Martin Weinel, "Connective Knowledge: What We Need to Know about Other Fields to 'Envision' Cross-Disciplinary Collaboration," *European Journal of Futures Research* 6, no. 1 (December 2018)

[37] Bruno Latour and Centre de Sociologie de L'Innovation Bruno Latour, *Reassembling the Social: An Introduction to Actor-Network-Theory* (OUP Oxford, 2005).

[38] A grossly oversimplified picture of semiotics based upon the work of Umberto Eco, *A Theory of Semiotics* (Indiana University Press, 1976); Umberto Eco, *Opera Aperta* (Harvard University Press, 1989).

[39] Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Duke University Press, 2007).

university faculty members gain tenure by virtue of their research and lectures (knowledge accumulation), which occurs in a web of scholarly collaboration and interactions (e.g., citations, conferences) that harmonizes their knowledge within waves of their field of study.

At the organizational level, accumulating enough knowledge particles embodied in its members may lead to a sizable intellectual capital, but not necessarily lead to robustness and efficiency. Those knowledge particles require appropriate flow and distribution both within and beyond the organization in order to be effective. The power of an organization stems not from its accumulation of intellectual capital (that is, overall knowledge), but from harnessing and attuning particles to the knowledge waves inside and outside its boundaries, such as innovations, disruptions, policies, and social movements. In other words, it's not about content and structures, but about content and structures in connection to the networks of the industry ecosystem and the world at large. That's why Hollywood did not continue with Code-era censorship—that knowledge was out of tune with the waves in society and the periphery of the industry. That's also why most American universities have had to adopt online courses despite dislikes and reservations—because doing otherwise would go against the wave of knowledge known as the 'information revolution.'

At the industry ecosystem level, specific knowledge particles matter less than the wave of knowledge to which they may belong or which they may represent, for such a wave may very well become a 'paradigm shift' for the entire industry ecosystem instead of a ripple if enough critical mass is reached by it. Here, the concept of 'boundary object'[40] (artifacts or ideas at the

[40] Bowker, Geoffrey C, and Susan Leigh Star. *Sorting Things Out: Classification and Its Consequences*, n.d.

intersection of networks, which means they're shared by disparate sets of agents; in the case of persons, they're called "knowledge brokers"[41]) allows for a better understanding of this wave behavior of knowledge within industries. Simply put, without boundary objects creating linkages and overlaps among networks, knowledge could not flow like a wave through those networks. Without ubiquitous high-speed internet as boundary object, the knowledge particle of video-streaming could not have spread to become the dominant paradigm now pioneered by Netflix and coopted by Google, Disney, Amazon, Apple, and others.[42] Without the boundary object of sports, 'elite' American universities could not have maximized their public reputation and fundraising to the levels they've reached under the auspice of 'school spirit' and 'alumni loyalty.'[43]

Ultimately, this metaphorical hermeneutic of quantum proportions affords yet another revelation concerning knowledge: that much like energy, knowledge can be neither created nor destroyed, only transformed—and such a transformation happens through a variety of collaborative realities, be that discovery, synthesis, 'givenness,' transmission, or meaning making. Newton's assertion, then, about "standing on the shoulders of giants"[44] was true and insightful albeit sorely incomplete; knowledge involves not only standing on the shoulders of giants, but doing so while locking arms and dancing the can-can with a thousand peers also standing on giants amidst a world full of awe and wonder.

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[41] Ibid. footnote 8 above.

[42] Robert Kyncl and Maany Peyvan, *Streampunks: YouTube and the Rebels Remaking Media* (HarperCollins, 2017).

[43] Ibid. footnote 5 above; paraphrasing Cooper's and Marx's assertions on the issues of university athletics.

[44] Newton, Isaac. "Letter from Sir Isaac Newton to Robert Hooke". Historical Society of Pennsylvania. Retrieved 14 September 2019.

1.5 Knowledge: Public & Not-So-Private

As mentioned in all of the examples thus far, the final-yet-iterative phase of collaborative knowledge production entails the distribution of the knowledge—both as particles and as waves (to recall the quantum metaphor). Said distribution does not constitute a mere transfer but a multilevel *publication* (Latin *publicare*: to make public; from *publicus:* of the people/state/community[45]): at once the generalization of a certain knowledge (particle or wave) among a public (in industry, a sector of society, or beyond), and the constitution of a public by virtue of experiencing or embodying that knowledge. The distribution/publication of knowledge, hence, ought to be understood again in terms of particles and waves, as well as in terms of viruses and epidemics,[46] which then leads to a triumvirate of distribution modes that sometimes overlap depending on the context.

First there's contagion and replication, which means almost the exact same as with a virus: knowledge particles transmit one-to-one, a host-sender passes on the particle to an equal receiver (e.g., person to person, organization to organization, industry to industry). Contagion and replication happen when a university professor trains and mentors a PhD student, for instance, passing along the knowledge of the field and the professional community;[47] or it can

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[45] Douglas Harper, "Publication | Origin and Meaning," Online Etymology Dictionary, Etymonline, accessed June 19, 2021, https://www.etymonline.com/search?q=publication.

[46] Tony D. Sampson, *Virality: Contagion Theory in the Age of Networks* (U of Minnesota Press, 2012).

[47] Heather Thiry and Sandra L. Laursen, "The Role of Student-Advisor Interactions in Apprenticing Undergraduate Researchers into a Scientific Community of Practice," *Journal of Science Education and Technology* 20, no. 6 (December 2011): 771–84, https://doi.org/10.1007/s10956-010-9271-2.

also happen when a film studio decides to make an adaptation of a fairy tale because another film studio is also working on a similar project.

Second, there's absorption: when a knowledge wave reverberates through an entire organization or industry at such pace and collective sway that no clear one-to-one origin can be traced. This is the mode by which tectonic paradigm shifts occur. For instance, the current incursion of most Hollywood media conglomerates into virtual reality production has unfolded this way, without a single point of origin for the change or source for the knowledge of VR technologies.[48] Similarly, the adoption of Massive Open Online Courses (MOOCs) by universities may involve pioneers, but it has happened without a single leader or 'patient zero' to justify its spread.[49]

Third, there's broadcast: from a single source to many receivers, spreading a knowledge particle in such a way that it turns into a wave due to its reach and magnitude. The basic or traditional models for both movies and universities follow this pattern: one studio delivers a movie to the masses of society via movie theaters, cable, and mass-produced physical copies; a single college professor lectures hundreds of students at a time, thus imparting their knowledge to the student crowd. However, this pattern can also happen at the industry-wide level, like when the Carnegie Foundation singlehandedly prompted the use of credit hours by all universities.[50]

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[48] R. Aylett and S. Louchart, "Towards a Narrative Theory of Virtual Reality," *Virtual Reality* 7, no. 1 (December 1, 2003): 2–9, https://doi.org/10.1007/s10055-003-0114-9; Grigore C. Burdea and Philippe Coiffet, *Virtual Reality Technology* (John Wiley & Sons, 2003); Nonny de la Peña et al., "Immersive Journalism: Immersive Virtual Reality for the First-Person Experience of News," *Presence: Teleoperators and Virtual Environments* 19, no. 4 (August 2010): 291–301, https://doi.org/10.1162/PRES_a_00005; L. J. Heeremans, "In Your Face. An Inquiry into Historical and Contemporary Conditions of Virtual Reality" (Master's Thesis, 2017).

[49] The COVID19 pandemic obviously accelerated and forced this widespread adoption, but that just reinforces the point.

[50] Ibid. footnote 5 above.

The publication of knowledge, in this sense, has the biggest implications for its interrelationship with labor, expertise, and industry. To recall and rephrase Machlup's work once more, the significance of knowledge derives from its enabling and constituting all human activities and experiences, especially those in industries with economic relevance. And the more an industry's knowledge is distributed, the bigger its embodied public and sphere of influence, then the more significance that knowledge has for its industry and the world at large. Significance, in the case of knowledge, translates as impact—one to be categorized, measured, and interpreted as a taxonomy with non-exclusive categories: material, industry-grade, socio-political, and socio-cultural impacts.

Material impacts of industry knowledge are perhaps the easiest one to pinpoint since they involve tangible things. Material impacts manifest when industry knowledge allows for the building of devices, artifacts, and technologies (in the broadest sense) that were not previously feasible. A Hollywood example of a material impact would be simply the production of videotapes and DVDs (and their recording and playing devices) that allow for the experience of films beyond the movie theater. The Internet, as a tangible concept embodied by computing devices, has probably been the most prominent material impact to come out of American universities, since its prototype was developed as an engineering research project by a network of these institutions.[51]

Industry-grade impacts can be more varied, ranging from tangible to abstract to complex depending on the source knowledge. This type of impact is also characterized by its scope: it can

[51] Fred Turner, *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism* (University of Chicago Press, 2010).

affect the inner workings of an industry (intra-industry) or the interconnections among different sectors (inter-industry). Due to the scope, industry-grade impacts can lead to improvements and reinforced interdependencies among actors and particular industries, or to disruptions, fragmentations, and the emergence of entirely new industries (quite in accordance with Schumpeter's idea of *creative destruction*[52]) thanks to the originating industry knowledge. The introduction of television technology stands out as an example for both cases of improvements and disruption, for it meant at the outset the creation of a new industry with its hybrid elements from radio and film (and which succeeded to the astonishment of the most accomplished veterans[53]), only to become integrated with the existing film studios and radio networks under the umbrella term of *media conglomerates.* In the case of American universities, and related to Hollywood, the growing impact of film as a mass medium led to the establishment of film studies degree programs (and a few departments) across many higher education institutions, since the knowledge about and from films had become too influential for society to remain ignored or sidelined in academic circles.[54]

Beyond the boundaries of industries, socio-political impacts manifest by affecting established institutions and power dynamics within a society. For example, the establishment of a solely Hispanic/Latino television network in the United States in the 1980s (present-day Univision) was both a reaction to the political turmoil experienced by that population at the time,

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[52] Joseph Alois Schumpeter, *Capitalism, Socialism and Democracy* (Routledge, 1976).

[53] Hollywood titan Darryl Zanuck of 20th Century Fox infamously predicted that television wouldn't last more than six months. ["Worst Tech Predictions of All Time," *The Telegraph*, June 29, 2016, https://www.telegraph.co.uk/technology/0/worst-tech-predictions-of-all-time/darryl-zanuck-in-1964/.]

[54] Lee Grieveson and Haidee Wasson, eds., *Inventing Film Studies* (Duke University Press, 2008).

and a source of knowledge/point of reference that leveraged and gave voice to a fragmented and often overlooked demographic.[55] And in the case of American universities, socio-political impacts have been more commonplace, for college campuses have notoriously been incubators of political movements since the 1950s, from civil rights activism to the current push for intersectionality and increased environmentalism.[56]

Finally, socio-cultural impacts involve knowledge that thrives despite the test of time and that takes root deep in the persons, ecosystem, and society among which the industry of origin exists. In a way, socio-cultural impacts have a similar magnitude and reach to socio-political ones, but they tend to last longer, be more pervasive, and have a level of concealment that sometimes makes them appear 'natural' or perennial. For instance, a socio-cultural impact induced by Hollywood media conglomerates has been the high expectations regarding solutions to world problems that society has for science and technology[57]—which could be traced to science fiction, one of the most successful genres across media. In another instance, the discipline-based segregation of academic departments at universities, which was a decision based on organizational management rather than pedagogy, has become the standard for educational

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[55] Charles Ramírez Berg, *Latino Images in Film: Stereotypes, Subversion, and Resistance* (Austin, UNITED STATES: University of Texas Press, 2002), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=3442970; Dolores Delgado Bernal, "Critical Race Theory, Latino Critical Theory, and Critical Raced-Gendered Epistemologies: Recognizing Students of Color as Holders and Creators of Knowledge," *Qualitative Inquiry* 8, no. 1 (2002): 105–26; Dana E. Mastro and Elizabeth Behm-Morawitz, "Latino Representation on Primetime Television," *Journalism & Mass Communication Quarterly* 82, no. 1 (March 2005): 110–30, https://doi.org/10.1177/107769900508200108; Frances Negrón-Muntaner, "The Latino Media Gap," *The Center for the Study of Ethnicity and Race Columbia University. Retrieved from: Http://Www. Columbia. Edu/Cu/Cser/Downloads/AdvancedExectutiveSummary. Pdf*, 2014.

[56] Michael Omi and Howard Winant, *Racial Formation in the United States* (Routledge, 2014). Omi and Winant.

[57] David A. Kirby, "Hollywood Knowledge: Communication Between Scientific and Entertainment Cultures," in *Communicating Science in Social Contexts*, ed. Donghong Cheng et al. (Dordrecht: Springer Netherlands, 2008), 165–80, https://doi.org/10.1007/978-1-4020-8598-7_10.

institutions at all levels, including kindergartens, even though the division has been proven repeatedly to erode people's capacity to learn and to relate knowledge to the real world.[58]

What this taxonomy and these examples prove is that expert knowledge or industry knowledge is meant to eventually surpass the limits of its industry and epoch of origin, overflowing towards the future and the world. Knowledge, in the end, is meant to flow and multiply within and without industries in order to capitalize on its power to affect the experience and understanding of the world, no matter how radical, novel, or inconspicuous it may be.

1.6 Knowledge and Institutions: The Mission of the (Research) University

Specialization and overspecialization, as previously established, has resulted in diminishing returns on knowledge and an increasing loss of understanding—understanding of our world and reality, understanding between knowledgeable experts and among people, and understanding of the multifaceted value of knowledge itself.[59] With overspecialization, we end up not only with a society that has general use of the car and the microwave without any idea of or respect for how they are engineered, but also with experts who can't communicate or collaborate with each other because that's outside of their immediate and specific specialties, or whose claims to neutral objectivity are suspect and biased[60] and their knowledge and scholarly

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[58] Julie Thompson Klein, *Interdisciplinarity: History, Theory, and Practice* (Wayne State University Press, 1990); Julie Thompson Klein and Carol Geary Schneider, *Creating Interdisciplinary Campus Cultures: A Model for Strength and Sustainability* (Hoboken, UNITED STATES: John Wiley & Sons, Incorporated, 2009), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=477754; Bernstein, "Disciplinarity and Trandisciplinarity in the Study of Knowledge."

[59] José Ortega y Gasset, *Misión de la universidad y otros ensayos sobre educación y pedagogía* (Revista de Occidente en Alianza Editorial, 1982).

[60] Haraway, "Situated Knowledges."

mechanisms are so byzantine to the point of absurdity, societal irrelevance, and ridicule.[61] At the center of this issue stands 'the modern University,' with its "discipline making…a simultaneously audience-stabilizing and labor-subdividing activity"[62] and its multifold mission to serve common people, the elites, culture, and the economy. Said mission, however, comes with conflicts and paradoxes stemmed from larger sociocultural issues, which affect universities, the industries they help model, and the citizenry they mean to serve and educate.[63] Internally, there are conflicts between departments for resources and the attention of donors, celebrity faculty, funding agencies, and students;[64] competition among knowledge workers for stability (for instance, tenure of professors); and a bourgeois tendency of faculty, administrators, and supporters to not only treat those outside of their areas of expertise as subjects (whether of study, judgment, servitude, or repression) rather than peers or colleagues, but also to prioritize (over real-world applications and improvements that could come from collaboration and intellectual cross-pollination[65]) a sort of ideological purity within their specialty trenches under the guise of 'intellectual rigor & standards' and with peer review as a functional politburo enforcing their respective disciplinary boundaries, be that in medicine,[66] business management, astrophysics,

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[61] As epitomized by the Sokal affair (Sokal 2000) and the more recent Sokal Squared incident (Mounk 2018).

[62] Cooper and Marx, *Media U*. Loc. 302.

[63] Edward Crawley et al., *Universities as Engines of Economic Development: Making Knowledge Exchange Work* (Cham: Springer International Publishing, 2020), https://doi.org/10.1007/978-3-030-47549-9.

[64] Cooper and Marx, *Media U*.

[65] Lee Fleming, "Perfecting Cross-Pollination," *Harvard Business Review*, 2004, 4.

[66] The most atrocious example of this being retrovirology: a type of knowledge that was actively opposed and de-legitimized by the medical and biological communities for decades because it disproved the "Central Dogma" of molecular biology regarding the relationship of DNA and RNA (Coffin, Hughes, and Varmus 1997), a stance which compounded with the advent of HIV and other socio-political stigmas to generate the worst epidemic in human history: AIDS (Grmek 1993).

performing arts, criminal justice, mechanical engineering, or philosophy. Externally, there are disparities in the funding mechanisms for different types of knowledge and for different types of research methods and institutions; there are governmental favoritism for some disciplines (mainly STEM) while others lack regular support (at best) or have barriers imposed upon them (at worst, such as the active defunding of federal arts and humanities programs); there are knowledge abuses and misuses of Orwellian proportions by industry and society (e.g. social media misinformation) that originate from good-intentioned university efforts; there are waves of anti-intellectualism around the world, which only get fueled by the poor communication and public relations skills of most of the intellectual/knowledge-producing class; there are deeply rooted prejudices against certain types of knowledge, such as the colonialist bias of scholarly circles to disregard indigenous knowledge as romantic, mystical, pedestrian/rustic, or deluded[67] because of its holistic/integrative and sustainable considerations of nature and its non-Western origins and practices;[68] and there are insurmountable rivalries between institutions and nations that turn any knowledge production into a veritable arms race that echoes the Cold War. Overall, the hyper-specialized, discipline-siloed 'modern University' is both a victim and a culprit of the complex ills of contemporary research—ills from which knowledge production suffers, but emergent approaches have aimed to overcome this for the past fifty years in the shape of *transdisciplinary knowledge production*, redesigning practices and renewing its values (as

[67] Catherine Alum Odora Hoppers, *Indigenous Knowledge and the Integration of Knowledge Systems: Towards a Philosophy of Articulation* (New Africa Books, 2002). Hoppers.

[68] Perhaps this colonialist bias against the holistic views of indigenous knowledge is part of the implicit reasoning behind the discounting, struggles for legitimization, and other barriers that integrative transdisciplinary practices have faced in the Western world.

Chapter 2 surveys). Simply put, the way forward and toward desirable futures of knowledge production must include restructuring institutions or stymying the rate of specialization.[69]

1.7 Knowledge Boundaries

In terms of boundaries and barriers of knowledge production, the major issues can be summarized as specialization, institutional parochialism, and public blindness—and each of them has a counter-measure or solution already proven to work in some contexts.

The first issue, specialization,[70] is easily explained but so endemic that it may go unnoticed. Put succinctly, it means that the experts engaged in knowledge production have developed a tendency to specialize at such high degree that well-established and agreed upon communities and partnerships fracture implicitly upon the pressure of specialist tribes. As a hypothetical example, it's not just enough to be a physicist, but rather about being a physicist specialized in the quantum mechanics of fluids—which would be different and exclusive of a physicist specialized in the quantum mechanics of neutrinos. Such fracturing both affects the cohesion and functioning of the broader community of physics, and it raises the barrier of entry for hybrids who might be fully versed in the culture of the broader community but not enough in the intricacies of any specialization to fully belong to the core.

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[69] Leigh Carroll et al., "Envisioning a Transdisciplinary University," *The Journal of Law, Medicine & Ethics* 42, no. 2_suppl (December 2014): 17–25, https://doi.org/10.1111/jlme.12183; Evelyn Brister, "Disciplinary Capture and Epistemological Obstacles to Interdisciplinary Research: Lessons from Central African Conservation Disputes," *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 56 (April 2016): 82–91, https://doi.org/10.1016/j.shpsc.2015.11.001; Helen Bridle et al., "Preparing for an Interdisciplinary Future: A Perspective from Early-Career Researchers," *Futures* 53 (September 2013): 22–32, https://doi.org/10.1016/j.futures.2013.09.003.

[70] Tony Becher, "The Counter-Culture of Specialisation," *European Journal of Education* 25, no. 3 (1990): 333, https://doi.org/10.2307/1503322.

Institutional parochialism refers to the tendency of organizations to resist change and enforce 'how things have always been done;' which in terms of knowledge production translates to the aforementioned disciplinary segregation into departments, divisions, and other structural/metaphorical turfs to deter crossing of boundaries under the auspice of 'efficiency' and 'resource management.' This issue has stifled knowledge production particularly in the university setting,[71] representing such a hurdle that researchers across different departments or schools may either be unable to collaborate due to funding intricacies, bureaucratic restrictions, or office politics; or they choose not to bother trying because of the time and efforts required.

The issue of public blindness may seem less harmful but it's just as endemic in society in general. In a way, its core represents a certain pervasive ignorance about the possibility of collaborative knowledge production. This reality comes to forefront in the funding frontline, with most grants designed exclusively for disciplinary purposes, and with most foundations and funders neglecting to even consider project proposals that attempt to integrate academic research areas among themselves or with any other industry in a research-meaningful way—funding has to be clearly for either for one science or another.[72] The only feasible solution to this issue, though, is a general cultural shift prompted by the success in undoing the barriers of institutional parochialism and specialization that 'justify' and inform poor public perception.

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[71] Erin Leahey, Sondra N. Barringer, and Misty Ring-Ramirez, "Universities' Structural Commitment to Interdisciplinary Research," *Scientometrics*, January 25, 2019, https://doi.org/10.1007/s11192-018-2992-3.

[72] Even though this has improved over the last five years, particularly in the European Union and among private foundations. The current COVI19 pandemic also precipitated this shift, at least in terms of public-private science partnerships and funding.

1.8 Knowledge Crossings

Over the last few decades, a handful of academic discourses and intellectual trends have taken interest in the basis and outcomes of knowledge production, particularly as it influences industry and the knowledge producers themselves. The sample herein of conceptual intersections that study knowledge, its production, and its impact may not be exhaustive of all the existing scholarship on the topic, but they represent a significant variety of thought currents and have been influential in crafting and contextualizing the framework and propositions in Chapter 2.

1.8.1 Communities of Practice

Communities of practice (CoPs) refers to quasi-formal organizations or networks of people with shared values, norms, practices, and language (that is, a culture), whose members learn through the group and from each other as they go from peripheral participants to core members of the CoP.[73] Professional associations fall within this category, even though they may be at the limit of formality for CoPs. In other words, an artist becomes an artist by interacting with other artists at festivals and soirees and by partaking in their activities and culture, just as scientists get apprenticed into the CoP through graduate school mentoring, research fellowships, conference participation, and journal publication.

CoPs also entail that knowledge production within and by those groups unfolds through a process of social construction. With scientists, a new theory or discovery does not gain legitimacy until enough members of the core agree on said legitimacy or relevance of the theory,

[73] Etienne Wenger, *Communities of Practice: Learning, Meaning, and Identity* (Cambridge University Press, 1999).

which is why and how retrovirus research remained unrecognized for decades in the medical community until the AIDS epidemic forced the scientific community to pay attention.[74] Similarly, the work of a genius artist may remain in obscurity despite their apostolic adherence to the culture of artists until a critical mass of critics, art historians, and fellow artists agree to celebrate and favor the genius of said artists—usually done well after the death of the genius in the case of this particular CoP.

In a way, this inherent social construction dimension of CoPs means that the impact of their knowledge production also has to be socially constructed, but in an 'outward' fashion beyond the boundaries of the CoP. Their knowledge production efforts, for better and for worse, are meant ultimately for the world at large. While the motivation for an astronomer's discovery or the oeuvre of a visual artist may be to woo and wow their peers, the goals of the discovery and the artwork is to change the world, either by advancing humankind's understanding of the universe or by providing a lasting aesthetic experience to an appreciative public. The impact of knowledge production always aims for the public sphere of the world.

1.8.2 Boundary Objects & Knowledge Brokers

The concept of *boundary objects*[75] in general refers to *anything* at the frontier or intersection of two communities of practice, and which both communities use, share, and know well. In an institutional context to promote collaborative knowledge production, successful

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[74] Mirko D. Grmek, *History of AIDS: Emergence and Origin of a Modern Pandemic* (Princeton University Press, 1993).

[75] GeoffreyC Bowker and Susan Leigh Star, *Sorting Things Out Classificatioannd Its Consequences*, n.d.; Julie Thompson Klein, *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities* (University Press of Virginia, 1996); Klein and Schneider, *Creating Interdisciplinary Campus Cultures*.

boundary objects include opening transdisciplinary research centers, grants exclusively meant for inter- and transdisciplinary research, and even establishing entire schools and degree programs integrating faculty and knowledge from disparate departments.[76] *Knowledge brokers*[77] are a subtype of *boundary object*—the personalized, embodied type which requires actors/nodes who belong to different networks to serve as links or bridges across or among those networks so that knowledge can be shared and activity can be coordinated through them.[78] Faculty members with double appointments, such as in the business school and the psychology department, count as explicit cases of institutionally-sanctioned knowledge brokering. In fact, CoPs with an existing knowledge broker tend to facilitate/generate more knowledge brokers over time, for it becomes a strengthening feature of their network.

1.8.3 Learning Economy & Knowledge-Creating Organizations

During the 1980s and 1990s, derived from Machlup's aforementioned work, knowledge was centered as the concern of economics and business for the upcoming new century.

At the macroeconomic scale, the notion of *learning economy* (a refinement of the 'knowledge economy' concept) proposed a new global model in which economic success is based upon "the dynamic capacity of agents to learn new competencies and skills and to abandon old ones.," and in which the goal is to "to create new kinds of resources through a range of

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[76] Cathy N. Davidson, *The New Education: How to Revolutionize the University to Prepare Students for a World In Flux* (Basic Books, 2017).

[77] Frank J. Van Rijnsoever, Marijn A. Van Weele, and Chris P. Eveleens, "Network Brokers or Hit Makers? Analyzing the Influence of Incubation on Start-up Investments," *International Entrepreneurship and Management Journal* 13, no. 2 (June 2017): 605–29, https://doi.org/10.1007/s11365-016-0416-5.

[78] Van Rijnsoever, Van Weele, and Eveleens.

interactive learning processes."[79] In other words, economic power derives from producing knowledge and learning how to wield it.

At the microeconomic and organizational level, the seminal work of Ikujiro Nonaka reframed business companies and organizations from the machine-like 'efficient problem solvers' of Taylorism (which usually focused on the technical) to *knowledge-creating organizations*[80] that focus on the human elements and behave like living organisms.[81] Nonaka stressed the importance of recognizing and managing both explicit knowledge and implicit knowledge in a spiral cycle of socialization, externalization, internalization, and combination; the structure and function of the organization in this framework also affects how this process and the flow of knowledge happens. Remarkably, *metaphor* and *chaos*[82] stand out in Nonaka's work as fundamental elements and conditions for the production of knowledge.

1.8.4 T-Shaped Expertise

The concept of *T-shaped* individuals emerged from the field of management, in which concerns regarding competent leadership of engineering teams in industry inspired this type of approach;[83] however, it has spread to other industry sectors, such as design, digital technology,

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[79] John A. Cotsomitis, "Is the Learning Economy a Viable Concept for Understanding the Modern Economy?," *International Journal of Social Economics* 45, no. 3 (January 1, 2018): 492–507, https://doi.org/10.1108/IJSE-01-2017-0025.

[80] Ikujiro Nonaka, "A Dynamic Theory of Organizational Knowledge Creation," *Organization Science* 5, no. 1 (1994): 25.

[81] Ikujirō Nonaka and Hirotaka Takeuchi, "The Knowledge-Creating Company," *Harvard Business Review* 85, no. 7/8 (2007): 162.

[82] Nonaka and Takeuchi.

[83] Morten T Hansen, "Introducing T-Shaped Managers," *Harvard Business Review*, 2001, 13.

and business.[84] *T-shaped knowledge*[85] gets that label from a visual metaphor of what their ideal knowledge would be: the stem of the T represents deep knowledge of one area, and the crossbar represents shallow, connective knowledge of many other areas. When applied to managers, it meant that the most effective managers tended to be T-shaped in either of two ways: true experts among the team they manage with shallow but competent knowledge of managerial skills, or expert managers with enough field knowledge to understand and communicate with their reports. The same applies to knowledge production, in which the individual (or collective) may be an expert in one area and competent in others (including collaborative skills), or they can be true experts in collaboration with competent knowledge of many fields. Whichever the case, T-shaped individuals and teams tend to enhance knowledge production because they're positioned to become knowledge brokers and/or boundary objects.

1.8.5 (The Road to) Mode-2 Knowledge Production

While the modern research university may remain steeped in overspecialization, there has been more than a hundred years of scholarly discourse and dialogue already challenging the notions of how 'scientific research' and knowledge production actually occur in the world. All of the shifts and shaking of the *tree of knowledge* prompted a deep and concerted reconceptualization of knowledge production in the 1990s, one differentiating between the old

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[84] I F Oskam, "T-Shaped Engineers for Interdisciplinary Innovation: An Attractive Perspective for Young People as Well as a Must for Innovative Organisations," 2009, 11; T-M Karjalainen, M Koria, and M Salimäki, "Educating T-Shaped Design, Business and Engineering Professionals," 2009, 5; Kathryn A Neeley and Bernd Steffensen, "The T-Shaped Engineer as an Ideal in Technology Entrepreneurship: Its Origins, History, and Significance for Engineering Education," 2018, 32.

[85] Sergio Barile et al., "Structure and Dynamics of a 'T-Shaped' Knowledge: From Individuals to Cooperating Communities of Practice," *Service Science* 4, no. 2 (June 2012): 161–80, https://doi.org/10.1287/serv.1120.0014.

principle of research executed by isolated disciplinary experts, and the new emergent paradigms that contested that old model. In this regard, the seminal work *The New Production of Knowledge* edited by Michael Gibbons[86] established the taxonomy and vocabulary that would influence and somewhat unite all the subsequent advocates of knowledge production since then. The book defines and categorizes knowledge production in almost monochromatic terms: *Mode 1*, corresponding to the old view of science and pure/basic research; and *Mode 2*, the emergent paradigm. This *Mode 2* supersedes the old model of knowledge production because of its features: it's focused on solving problems; there's development of particular frameworks and dynamic attitudes and practices to fit the context of the problem; knowledge and its production are shared with/distribute among stakeholders aside from the research experts; and there's critical implementation of heterogeneity/diversity, social accountability, and reflexivity into its practices.[87] *Mode 2* thus defined and crystalized what the book explicitly calls *transdisciplinarity,* and which Chapter 2 herein (as well as the rest of this doctoral dissertation) examines in detail as the more denotative *transdisciplinary knowledge production* (TDKP).

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[86] Michael Gibbons, ed., *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies* (London ; Thousand Oaks, Calif: SAGE Publications, 1994).

[87] Ibid. 23 above, pages 14-35.

CHAPTER 2

CULTURE, INTELLIGENCE & TRANSDISCIPLINARITY

2.1 Discourses Across and Beyond the Disciplines

As specialization reached the limits of its promise to solve the "wicked problems"[88] of the world (complex, intractable, and multidimensional), and as technological progress grown in the forms of sustainability, biomedical sciences, cybernetics, renewable energy and others, the need for collaborative, heterogeneous knowledge production and problem-solving has expanded well beyond the purview of single disciplines of knowledge. Over the past fifty to sixty years, there have been concerted approaches to revising the notions and methodologies of disciplinarity as a response to wicked problems, resulting in a discreet variety of categories for these novel approaches that have been studied and well documented in their characteristics, affordances, and pitfalls.[89] The following subsections provide very brief and abridged definitions of the emergent modes of knowledge production beyond disciplinarity collectively called "interdisciplinarities."[90]

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[88] Horst WJ Rittel and Melvin M Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4, no. 2 (1973): 155–69.

[89] Klein, *Interdisciplinarity*; Julie Thompson Klein, "Reprint of 'Discourses of Transdisciplinarity: Looking Back to the Future,'" *Futures* 65 (January 2015): 10–16, https://doi.org/10.1016/j.futures.2015.01.003.

[90] Klein, *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities*.

2.1.1 *Multi*-disciplinarity

Simply put, '*multidisciplinarity"* has manifested as "a conglomeration of disciplinary components,"[91] in which a single problem or boundary object of interest brings together experts from different fields, but mostly to study it rather than to solve it.[92] Visually, the problem/boundary object is the axis that connects the spokes of different disciplines. The methodology is based on parallel cooperation and coordination rather than collaboration.[93]

2.1.2 *Cross*-disciplinarity

While '*cross-disciplinarity'* tends to be used interchangeably with '*interdisciplinarity,'* although some scholars make a subtle distinction that pertains to perspective—that of the practitioners themselves. In this understanding of cross-disciplinarity, particular researchers or boundary objects leave one field and join a new one almost entirely; for instance, psychologists bringing their expertise to economics, prompting behavioral economics. In this mode, a spoke from one wheel attaches to another wheel.

2.1.3 *Inter*-disciplinarity

The term *'interdisciplinary'*, while it has particular elements that characterize it, at the same time remains "the generic all-encompassing concept and includes all activities which

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[91] Katri Huutoniemi et al., "Analyzing Interdisciplinarity: Typology and Indicators," *Research Policy* 39, no. 1 (February 2010): 79–88, https://doi.org/10.1016/j.respol.2009.09.011.

[92] Philip W. Balsiger, "Supradisciplinary Research Practices: History, Objectives and Rationale," *Futures* 36, no. 4 (May 2004): 407–21, https://doi.org/10.1016/j.futures.2003.10.002.

[93] In this context, *parallel coordination* and *cooperation* refer to tasks that are executed independently (e.g., little interaction between the workers) from each other even though they're related, whereas *collaboration* entails a more interdependent mode of working through tasks.

juxtapose, apply, combine, synthesize, integrate or transcend parts of two or more disciplines."[94] Interdisciplinarity and transdisciplinarity also tend to be clumped together for matters of funding and of research on their antecedents, facilitators, outcomes, and practices.[95] For purposes of specificity and differentiation, *'interdisciplinarity'* herein means a mode of knowledge production characterized by:

- performance done exclusively by researchers/agents of formal institutions and departments;
- crossing of institutional departments and domains of expertise without abandoning their specific discipline(s);[96]
- sharing tools, perspectives, concepts, data, techniques, from two or more disciplines;[97]
- requiring joint work and collaboration;[98]
- answering questions that cannot be satisfactorily addressed using single methods or approaches.[99]

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[94] Raymond C Miller and Raymond C Miller, "Varieties of Interdisciplinary Approaches in the Social Sciences: A 1981 Overview," *Issues in Interdisciplinary Studies*, 1982.

[95] Bianca Vienni Baptista et al., "SHAPE-ID: Shaping Interdisciplinary Practices in Europe Deliverable 2.1: Preliminary Report of Literature Review on Understandings of Interdisciplinary and Transdisciplinary Research Project Information," 2020, n.d.

[96] Rosenfield (1992).

[97] Susannah Paletz, Laurel Smith-Doerr, and Itai Vardi, *National Science Foundation Workshop Report: Interdisciplinary Collaboration in Innovative Science and Engineering Fields* (Boston, MA, 2010); Committee on Facilitating Interdisciplinary Research, National Academy of Sciences, and National Academy of Engineering, *Facilitating Interdisciplinary Research* (National Academies Press, 2004); Sally W Aboelela et al., "Defining Interdisciplinary Research: Conclusions from a Critical Review of the Literature," *Health Services Research* 42, no. 1 Pt 1 (February 2007): 329–46, https://doi.org/10.1111/j.1475-6773.2006.00621.x.

[98] Rosenfield (1992).

[99] Klein (1990), p. 196

2.1.4 *Trans*-disciplinarity

When put on a continuum, *'transdisciplinarity'* emerges at the far end of the integration spectrum aiming towards a certain unity of the knowledge produced. Regardless of process or philosophical nuances pointed out by scholars, a '*transdisciplinary'* understanding of knowledge production (and used uniformly herein) entails including agents and perspectives from across stakeholder communities and sectors of society[100] while integrating conceptual frameworks.[101] The rest of this chapter further explores and problematizes the complexities, nuances, and overlaps with interdisciplinarity of this phenomenon in all of its multidimensionality and historicity.

2.1.5 *Post*-disciplinarity

In addition to these widely recognized (albeit diversely understood) modes of disciplinarity, other categorizations and definitions, at times more radical, have been proposed by a few scholars in the '*post*-everything' era of knowledge, including '*alterplinarity,'*[102] *'supradisciplinarity,'*[103] *anti-disciplinarity,*[104]and *'integration and implementation sciences'*

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[100] Allen F. Repko, *Interdisciplinary Research: Process and Theory* (SAGE, 2008).

[101] Patricia L Rosenfield, "The Potential of Transdisciplinary Research for Sustaining and Extending Linkages between the Health and Social Sciences," *Social Science & Medicine* 35, no. 11 (1992): 1343–57; Michal Mitrany and Daniel Stokols, "Gauging the Transdisciplinary Qualities and Outcomes of Doctoral Training Programs," *Journal of Planning Education and Research* 24, no. 4 (June 2005): 437–49, https://doi.org/10.1177/0739456X04270368.

[102] Paul Rodgers and Craig Bremner, "Alterplinarity–'Alternative Disciplinarity'in Future Art and Design Research Pursuits," *Studies in Material Thinking* 6 (2011): 1–16.

[103] Balsiger, "Supradisciplinary Research Practices."

[104] Joichi Ito, "The Antidisciplinary Approach," *Research-Technology Management* 60, no. 6 (November 2, 2017): 22–28, https://doi.org/10.1080/08956308.2017.1373047; Jer-Ming Chen and Johannes M Luetz, "Mono-/Inter-/Multi-/Trans-/Anti-Disciplinarity in Research," *Quality Education, Encyclopedia of the UN Sustainable Development Goals. Springer Nature, Cham, Switzerland*, 2020, 1–16.

(I2S).[105] Although all of those approaches present sound critiques and promising alternatives to the traditional disciplinary perspectives, these attempts could be considered ouroboric in nature and execution, for they necessitate the pre-existence and hegemony of the disciplines in order to disrupt them rather than transform or transcend them altogether in the first place. Furthermore, due to both their nicheness and the fact that those proposed approaches still originate and get defined by how they differ, subvert, or oppose disciplinary views of research and knowledge, further examination of their specifics herein stands outside the scope of study and interest.

2.1.6 The History of Transdisciplinarity

Transdisciplinarity and interdisciplinarity have had an entangled history, which could be understood as a joint and the most current chapter in the history of the disciplines themselves.

Emerging in parallel during the 1970s-1990s, interdisciplinarity and transdisciplinarity in knowledge production across the world attempted to respond to the rising problems and challenges posed by a progressively complex reality, exacerbated by globalization, technological advances, and geopolitical shifts of the period—the aforementioned wicked problems. As mapped in several occasions by Julie Thompson Klein,[106] this transitional epoch consisted of a series of milestones and trends aimed at studying or solving such issues, which eventually justified the formalization of interdisciplinarity and transdisciplinarity at least as terms. One

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[105] Gabriele Bammer, *Disciplining Interdisciplinarity: Integration and Implementation Sciences for Researching Complex Real-World Problems* (ANU E Press, 2013).

[106] Klein, *Interdisciplinarity*; Julie Thompson Klein, "Reprint of 'Discourses of Transdisciplinarity: Looking Back to the Future,'" *Futures* 65 (2015): 10–16, https://doi.org/10.1016/j.futures.2015.01.003; Klein and Schneider, *Creating Interdisciplinary Campus Cultures*; Klein, *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities*; Robert Frodeman, Julie Thompson Klein, and Roberto Carlos Dos Santos Pacheco, *The Oxford Handbook of Interdisciplinarity* (Oxford University Press, 2017).

example of interdisciplinarity from the 1970s provided by Klein is the wave of establishing new 'environmental sciences' programs throughout the United States (and of which the recently inaugurated University of Texas at Dallas [1969] was a part[107]) that gathered elements from across multiple disciplinary departments such as geology, biology, geography, zoology, political science, and economics. Transdisciplinarity, on the other hand, first appeared formally in 1970 during talks given by astrophysicist Erich Jantsch and philosopher Jean Piaget as part of an international workshop about research and education hosted by the Organization for Economic Cooperation and Development (OECD) in Nice, France.[108] Echoing the suggestions of the pioneers of quantum physics since the turn of the century (specifically Erwin Schrödinger,[109] Niels Bohr,[110] Werner Heisenberg,[111] and David Bohm[112], who argued for the reintegration of the arts and sciences amidst rampant specialization, and all of whom had lifelong artistic avocations [such as music] and more than enough education in poetry and philosophy during their early years to complement and contribute to their mathematical training[113]), the talk urged for a new

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[107] More in Section 3.3.

[108] Basarab Nicolescu, "Transdisciplinarity - Past, Present and Future," 2005, 24.

[109] Erwin Schrödinger, *The Interpretation of Quantum Mechanics: Dublin Seminars (1949-1955) and Other Unpublished Essays* (Ox Bow Press, 1995).

[110] Niels Bohr, *Essays 1958-1962 on Atomic Physics and Human Knowledge* (Ox Bow Press, 1963); Niels Bohr, *Essays 1932-1957 on Atomic Physics and Human Knowledge* (Ox Bow Press, 1958); Niels Bohr, *Atomic Theory and the Description of Nature: Four Essays with an Introductory Survey* (Cambridge University Press, 2011); Niels Bohr, *Causality and Complementarity: Supplementary Papers* (Ox Bow Press, 1998). Bohr, *Essays 1958-1962 on Atomic Physics and Human Knowledge*; Bohr, *Essays 1932-1957 on Atomic Physics and Human Knowledge*; Bohr, *Atomic Theory and the Description of Nature*; Bohr, *Causality and Complementarity*.

[111] Werner Heisenberg, *Philosophic Problems of Nuclear Science: Eight Lectures* (Faber, 1952); Werner Heisenberg, *Across the Frontiers* (Ox Bow Press, 1990).

[112] David Bohm, *On Dialogue* (Routledge, 2013); David Bohm and F. David Peat, *Science, Order, and Creativity* (Toronto ; New York: Bantam Books, 1987); David Bohm and Basil J. Hiley, *The Undivided Universe: An Ontological Interpretation of Quantum Theory* (Routledge, 2006).

[113] Manjit Kumar, *Quantum: Einstein, Bohr and the Great Debate About the Nature of Reality* (Icon Books Ltd, 2008).

way of knowledge production "without stable boundaries between the disciplines"[114]—an ideal of re-integrating all of knowledge production that the proponents of transdisciplinarity (including philosophers, sociologists of knowledge, and others) would develop and carry well through the 1980s, 1990s, 2000s, and 2010s,[115] including the 1994 Charter of Transdisciplinarity signed at the First World Congress of Transdisciplinarity in held in Portugal.[116] Also during the same 1970s-1990s timeframe, the community of hybrid practitioners and experts at the intersection of arts, science, and technology found a stage to share their knowledge production efforts with the publication of the *Leonardo* journal—the first one to focus exclusively on showcasing inter- and transdisciplinary knowledge.[117]

Ultimately, transdisciplinarity[118] has differentiated itself from interdisciplinarity by two main characteristics of its manifestation: first, its special attention to solving wicked problems, which "transcend the resources for any single disciplinary or even traditional interdisciplinary approach;" and second, its "tendency to think laterally, imaginatively, and creatively not only about solutions to problems but to the combination of factors that need to be considered" [119]—a principle that has been applied to the understanding of transdisciplinarity and knowledge

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[114] Ibid. 17 above, page 1.

[115] Bernstein, "Disciplinarity and Trandisciplinarity in the Study of Knowledge"; Jay H. Bernstein, "Transdisciplinarity: A Review of Its Origins, Development, and Current Issues," *Journal of Research Practice* 11, no. 1 (2015): 17.

[116] Nicolescu, "Transdisciplinarity - Past, Present and Future."

[117] Alex Garcia Topete et al., "ArtSciLab: Experimental Publishing & Knowledge Production in Collaborative Transdisciplinary Practices," in *Routledge International Handbook of Art, Science, and Technology Studies*, ed. Hannah Rogers et al. (United Kingdom: Taylor & Francis, 2021), 11.

[118] The Mode 2 knowledge production of Section 1.8.

[119] Bernstein, "Transdisciplinarity: A Review of Its Origins, Development, and Current Issues."

themselves as they continue to evolve, as well as be studied, theorized, and experienced, throughout our times.

2.1.7 Theories of Transdisciplinarity

Since its emergence in the 1970s, transdisciplinarity as a phenomenon has been studied and theorized about with increasing interest, cases, and evidence. However, the studies and theories of transdisciplinarity have been relevant and framed mostly for academically-bound research and educational settings.

Regardless, the theories of transdisciplinarity span three areas familiar to philosophical explorations: epistemological, ontological, and axiological.

From the epistemological angle, the Nicolescuan theory of transdisciplinarity not only laid the foundations for many other takes and studies, but it also added to the nuances and complexities of transdisciplinarity by interpreting the phenomenon beyond the veneer of existing practices and classifications while contextualizing its historical positioning.[120] The key principles to Nicolescuan transdisciplinarity have quantum mechanics and metaphysical influences: *levels of reality,* stating that the universe/world comprises multiple layers, and that such structuring defies simplifications or explanations that claim univocal truth; *the included middle/hidden third*, proposing that the overlooked/obviated in-betweens among points of reality or knowledge exist as liminal/transition spaces between both points ('T is A and non-A'); and *the axiom of complexity*, which underscores the 'complexity of complexity'—the more levels of reality are

[120] Hans Dieleman, "Transdisciplinary Hermeneutics: A Symbiosis of Science, Art, Philosophy, Reflective Practice, and Subjective Experience," n.d., 30; Hans Dieleman, Basarab Nicolescu, and Atila Ertas, eds., *Transdisciplinary & Interdisciplinary Education and Research* (theATLAS Publishing, 2017).

crossed, the more interconnections and 'hidden thirds' there will be.[121] The works of Max-Neef later built upon and clarified this understanding, proposing levels and categorizations for disciplines in order to identify *weak* and *strong* transdisciplinarity (also borrowing such terms from quantum mechanics).[122]

The ontological angle of transdisciplinarity has been labeled *the Zurich approach*, after the March 2000 international congress held in the Swiss city. This approach derives from Mode-2 knowledge production constructs, and focuses on practices, structures, and incentives that lead or stem from transdisciplinarity.[123] Within this umbrella, a diversity of proposed understandings and ways to analyze transdisciplinarity have emerged, ranging from re-entrenchments of binding together interdisciplinary research as transdisciplinarity,[124] to adding self-explanatory qualifiers to transdisciplinarity, such as *consulting* transdisciplinarity[125] and *transdisciplinary co-production.*[126] The list of proposed constructs grows with every passing conference and journal publishing cycle.

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[121] Basarab Nicolescu, "Methodology of Transdisciplinarity," *World Futures* 70, no. 3–4 (May 19, 2014): 186–99, https://doi.org/10.1080/02604027.2014.934631; Nicolescu, "Transdisciplinarity - Past, Present and Future"; Basarab Nicolescu, "The Transdisciplinary Evolution of Learning," 1996, 11.

[122] Manfred A. Max-Neef, "Foundations of Transdisciplinarity," *Ecological Economics* 53, no. 1 (April 2005): 5–16, https://doi.org/10.1016/j.ecolecon.2005.01.014.

[123] "The Nicolescu and Zurich Approaches to Transdisciplinarity," accessed June 9, 2021, http://integralleadershipreview.com/13135-616-the-nicolescuian-and-zurich-approaches-to-transdisciplinarity/.

[124] Olivia Bina, Marta Varanda, and Marite Guevara, eds., *INTREPID Knowledge. Interdisciplinary & Transdisciplinary Research and Collaboration* (COST Action TD1408, 2019), http://intrepid-cost.ics.ulisboa.pt; Robert T. Croyle, "The National Cancer Institute's Transdisciplinary Centers Initiatives and the Need for Building a Science of Team Science," *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S90–93, https://doi.org/10.1016/j.amepre.2008.05.012.

[125] Malin Mobjörk, "Consulting versus Participatory Transdisciplinarity: A Refined Classification of Transdisciplinary Research," *Futures* 42, no. 8 (October 2010): 866–73, https://doi.org/10.1016/j.futures.2010.03.003.

[126] Merritt Polk, "Transdisciplinary Co-Production: Designing and Testing a Transdisciplinary Research Framework for Societal Problem Solving," *Futures* 65 (2015): 110–22, https://doi.org/10.1016/j.futures.2014.11.001.

Lastly, the axiological angle of transdisciplinarity has been explored by a handful of scholars, and thus far most eloquently argued by Sue L.T. McGregor. At its core, this take of transdisciplinarity focuses on values and worldviews, for these two affect all the judgment calls endemic to transdisciplinarity: what problems to study/solve, who has legitimate claims to the work, and what processes are more adequate/proper for a particular task (just to name a few). Overlooking transdisciplinary axiology, McGregor argues, "may unintentionally disrespect the value-laden character of the world's pressing problems and deeply compromise their resolution, or lead to insufficient solutions."[127]

2.1.8 Types of Transdisciplinarity

More recently, a discreet typology of transdisciplinarity has been proposed by E.U.-sponsored researchers in order to distinguish the characteristics of interdisciplinary and transdisciplinary research projects and be able to target funding programs and calls-for-proposals more purposefully.[128] The basis for the typology became the intentions and aspirations of researchers/practitioners, which sieve out in the following three types of transdisciplinarity: *transcendental*, which aims simply to accomplish a breakthrough beyond the boundaries of a single discipline; *transformative*, concerned with solving a particular, complex issue (usually a *wicked problem* such as climate change); and *transgressive*, intent on showing deficiencies,

[127] Sue LT McGREGOR, "Transdisciplinary Axiology: To Be or Not to Be," *Integral Leadership Review* 11, no. 3 (2011).

[128] Bianca Vienni Baptista et al., "SHAPE-ID: Shaping Interdisciplinary Practices in Europe Deliverable 2.3: Final Report on Understandings of Interdisciplinary and Transdisciplinary Research and Factors of Success and Failure Project Information," 2020.

flaws, or injustices in/of a particular setting.[129] This typology becomes especially useful for practitioners themselves when defining the overall goal and desired outcomes of transdisciplinary project, for their choices of processes, partners, and outputs depend on those desirable future outcomes.

2.1.9 Antecedents & Barriers to Transdisciplinarity

Part of the efforts of the Zurich approach to transdisciplinarity has been to identify clearly what 'ingredients' are necessary for transdisciplinary practice (antecedents), and what factors hinder said practices (barriers).

The critical antecedents to transdisciplinary practice with which several studies agree include: a facilitating and flexible *leadership;*[130] a team with a *heterogeneous composition*,[131] as

[129] It's worth noting that the researchers of this typology found that artists and humanities scholars disproportionately favor the transgressive, even trying to propose projects of that sort to problem-solving funding opportunities (to no avail). This predilection contrasts with social scientists and natural scientists, who routinely team up for transcendental and transformative projects—from which the few participating artists and humanities scholars may drop out eventually if they participate at all.

[130] Barbara Gray, "Enhancing Transdisciplinary Research Through Collaborative Leadership," *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S124–32, https://doi.org/10.1016/j.amepre.2008.03.037; Elina Mäkinen, "Complexity Leadership Theory and the Leaders of Transdisciplinary Science," *Informing Science: The International Journal of an Emerging Transdiscipline* 21 (2018): 133–55, https://doi.org/10.28945/4009; Maritza Salazar and Theresa Lant, "Facilitating Innovation in Interdisciplinary Teams: The Role of Leaders and Integrative Communication," *Informing Science: The International Journal of an Emerging Transdiscipline* 21 (2018): 157–78, https://doi.org/10.28945/4011; Sue L. T. McGregor and Gabrielle Donnelly, "Transleadership for Transdisciplinary Initiatives," *World Futures* 70, no. 3–4 (May 19, 2014): 164–85, https://doi.org/10.1080/02604027.2014.934625.

[131] Wouter P.C. Boon, Maryse M.H. Chappin, and Jaap Perenboom, "Balancing Divergence and Convergence in Transdisciplinary Research Teams," *Environmental Science & Policy* 40 (June 2014): 57–68, https://doi.org/10.1016/j.envsci.2014.04.005; Ibrahim Halloun, "Differential Convergence Education from Pluridisciplinarity to Transdisciplinarity," n.d., 33; Talita Moreira de Oliveira, Livio Amaral, and Roberto Carlos dos Santos Pacheco, "Multi/Inter/Transdisciplinary Assessment: A Systemic Framework Proposal to Evaluate Graduate Courses and Research Teams," *Research Evaluation*, May 17, 2018, https://doi.org/10.1093/reseval/rvy013; Patricia E. Norris et al., "Managing the Wicked Problem of Transdisciplinary Team Formation in Socio-Ecological Systems," *Landscape and Urban Planning* 154 (October 2016): 115–22, https://doi.org/10.1016/j.landurbplan.2016.01.008.

well as with adequate personalities/dispositions towards *curiosity*, *learning*,[132] *humility*,[133] and overall *transdisciplinary orientation;*[134] a structure that can organize and accommodate the *team size;*[135] and systems/practices that strive for or facilitate *learning*, *collaboration*, and *coordination.*[136]

In terms of barriers, plenty of research advises against the following: institutional misalignment,[137] such as *lack of funding mechanisms*, poor commitment from leaders, and mismatched incentives (e.g. tenure-track requirements not including TD projects);[138] wanton disrespect or lack of *trust* (whether among team members or from project stakeholders);[139]

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[132] Mirjam Brassler and Jan Dettmers, "How to Enhance Interdisciplinary Competence—Interdisciplinary Problem-Based Learning versus Interdisciplinary Project-Based Learning," *Interdisciplinary Journal of Problem-Based Learning* 11, no. 2 (July 31, 2017), https://doi.org/10.7771/1541-5015.1686.

[133] Davina Boyd et al., "Prompting Transdisciplinary Research: Promising Futures for Using the Performance Metaphor in Research," *Futures* 65 (January 2015): 175–84, https://doi.org/10.1016/j.futures.2014.10.014; Andrea Armstrong and Douglas Jackson-Smith, "Forms and Levels of Integration: Evaluation of an Interdisciplinary Team-Building Project," n.d., 19.

[134] S Misra, D Stokols, and L Cheng, "The Transdisciplinary Orientation Scale: Factor Structure and Relation to the Integrative Quality and Scope of Scientific Publications," *Journal of Collaborative Healthcare and Translational Medicine* 3, no. 2 (2015): 1042.

[135] Armstrong and Jackson-Smith, "Forms and Levels of Integration: Evaluation of an Interdisciplinary Team-Building Project."

[136] Brassler and Dettmers, "How to Enhance Interdisciplinary Competence—Interdisciplinary Problem-Based Learning versus Interdisciplinary Project-Based Learning"; Research, Sciences, and Engineering, *Facilitating Interdisciplinary Research*; Bridle et al., "Preparing for an Interdisciplinary Future."

[137] Wayde Cameron Morse et al., "Bridges and Barriers to Developing and Conducting Interdisciplinary Graduate-Student Team Research," *Ecology and Society* 12, no. 2 (2007): art8, https://doi.org/10.5751/ES-02082-120208; Jamal Shahin et al., "Building Bridges, Breaking Barriers. The Smart Approach to Distance Between Disciplines in Research Projects" (European Commission, 2014).

[138] Maria Helena Guimarães et al., "Who Is Doing Inter- and Transdisciplinary Research, and Why? An Empirical Study of Motivations, Attitudes, Skills, and Behaviours," *Futures*, July 2019, 102441, https://doi.org/10.1016/j.futures.2019.102441.

[139] Frances Harris and Fergus Lyon, "Transdisciplinary Environmental Research: Building Trust across Professional Cultures," *Environmental Science & Policy* 31 (August 2013): 109–19, https://doi.org/10.1016/j.envsci.2013.02.006.

conflicting *communication styles*[140] and *language differences;*[141] and misconceptions of *time* (not enough to build the team and achieve the outcome, or longer than team members' needs/expectations).[142]

Both types of research, nonetheless, caution that their findings, while critical to the practice of transdisciplinarity, are neither singularly primeval nor mutually exclusive—in accordance to the Nicolescuan 'levels of reality' axiom.

2.1.10 Transdisciplinary Process Models

Another stream of Zurich-approach transdisciplinarity scholarship has attempted to accurately model the shape or parts which comprise a transdisciplinary process. Some propose discreet activities or elements of implementation without regards for sequence, such as *reflection* and *problem definition.*[143] Other researchers have proposed cyclical/loop models, in which knowledge flows among activities, levels, and actors of the project, fluidly and iteratively.[144]

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[140] Kimberley Robasky et al., "How to Launch Transdisciplinary Research Communication" (RTI Press, April 17, 2020), https://doi.org/10.3768/rtipress.2020.rb.0022.2004; Giampero Dalai, Berta Martini, and Luciano Perondi, "Beyond the Discipline: A Metadisciplinary Approach for the Didactics of Communication Design," n.d., 31; Thomas Aenis, "A Communication Model for Transdisciplinary Consortium Research," 2010, 10.

[141] Sixian Hah, "Valuation Discourses and Disciplinary Positioning Struggles of Academic Researchers—A Case Study of 'Maverick' Academics," *Palgrave Communications* 6, no. 1 (December 2020): 51, https://doi.org/10.1057/s41599-020-0427-2; Magoroh Maruyama, "Paradigmatology and Its Application to Cross-Disciplinary, Cross-Professional and Cross- Cultural Communication," *Dialectica* 28, no. 3/4 (1974): 135–96.

[142] Alan L. Porter and Ismael Rafols, "Is Science Becoming More Interdisciplinary? Measuring and Mapping Six Research Fields over Time," *Scientometrics* 81, no. 3 (December 2009): 719–45, https://doi.org/10.1007/s11192-008-2197-2.

[143] F. Wickson, A.L Carew, and A.W. Russell, "Transdisciplinary Research: Characteristics, Quandaries and Quality," *Futures* 38, no. 9 (November 2006): 1046–59, https://doi.org/10.1016/j.futures.2006.02.011.

[144] Thomas Jahn, "Transdisciplinarity in the Practice of Research," *Transdisziplinäre Forschung: Integrative Forschungsprozesse Verstehen Und Bewerten. Campus Verlag, Frankfurt/Main, Germany*, 2008, 21–37; Christian Pohl et al., "Conceptualising Transdisciplinary Integration as a Multidimensional Interactive Process," *Environmental Science & Policy* 118 (April 2021): 18–26, https://doi.org/10.1016/j.envsci.2020.12.005.

Some of the more ambitious scholars have proposed predefined phases to the process, with specific activities and duties to fulfill in each before advancing to the next stage.[145]

2.1.11 Measurements of Transdisciplinarity

One of the most pressing goals of transdisciplinarity studies has been to develop a standardized and reliable way to measure transdisciplinary projects—and it's been urgent because of the funding and legitimacy implications that such measurements afford. Like research itself, the proposed approaches to measuring transdisciplinarity can be classified as either quantitative or qualitative metrics. In the quantitative camp, two approaches dominate: one that relies on bibliometrics,[146] and another that applies a complex mathematical model to the practitioners themselves—and because of what these measure (academic publications and/or earned degrees), they remain useful solely for research and educational settings. The qualitative metrics, while helplessly subjective, tend to be more inclusive, creative, and multifunctional in their approaches, ranging from context-adaptive rubrics,[147] to case-specific tools (such as

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[145] Kara L. Hall et al., "A Four-Phase Model of Transdisciplinary Team-Based Research: Goals, Team Processes, and Strategies," *Translational Behavioral Medicine* 2, no. 4 (December 2012): 415–30, https://doi.org/10.1007/s13142-012-0167-y; Daniel J. Lang et al., "Transdisciplinary Research in Sustainability Science: Practice, Principles, and Challenges," *Sustainability Science* 7, no. S1 (February 2012): 25–43, https://doi.org/10.1007/s11625-011-0149-x.

[146] Loet Leydesdorff, Caroline S. Wagner, and Lutz Bornmann, "Betweenness and Diversity in Journal Citation Networks as Measures of Interdisciplinarity–A Tribute to Eugene Garfield–," *ArXiv Preprint ArXiv:1705.03272*, 2017; Ronald Rousseau, "On the Leydesdorff-Wagner-Bornmann Proposal for Diversity Measurement," *Journal of Informetrics* 13, no. 3 (August 2019): 906–7, https://doi.org/10.1016/j.joi.2019.03.015.

[147] Pohl et al., "Conceptualising Transdisciplinary Integration as a Multidimensional Interactive Process"; Julie T. Klein, "Evaluation of Interdisciplinary and Transdisciplinary Research," *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S116–23, https://doi.org/10.1016/j.amepre.2008.05.010; Chris L S Coryn and John A Hattie, "The Transdisciplinary Model of Evaluation," 2008, 8.

measuring doctoral projects & committees[148]), to measures based on outcomes and impacts.[149] Nevertheless, measuring transdisciplinarity accurately in order to gauge its value continues to challenge practitioners, supporters, and stakeholders alike.

2.1.12 Insightful Transdisciplinarity

In studying and learning from all the existing research, scholarship, and discourses about and around transdisciplinary knowledge production, my own experience as a multi-hyphenate practitioner compelled me to consider this existing compendium as incomplete at best (which many of the authors recognize, per their particular close-but-narrow examination of transdisciplinary elements) or dangerously self-absorbed at worst, more concerned with the peculiarities of transdisciplinary propositions than with their essential commonalities and overarching implications when encountering reality. In other words, these works either study transdisciplinarity in too-specialized contexts, or mostly discuss conceptual rather than factual considerations of transdisciplinarity. That kind of self-absorption thus leads to community projects in which complex, quantum-philosophical explanations of transdisciplinarity can barely make an appearance without confusing or alienating the projects participants, or to cases in which the urgency of transformative approaches ignores or by-passes the intents and contributions of overzealous transgressive practitioners, dooming efforts to future shortcomings and emergent inequities.

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[148] Mitrany and Stokols, "Gauging the Transdisciplinary Qualities and Outcomes of Doctoral Training Programs."

[149] Cynthia Mitchell, Dana Cordell, and Dena Fam, "Beginning at the End: The Outcome Spaces Framework to Guide Purposive Transdisciplinary Research," *Futures* 65 (2015): 86–96, https://doi.org/10.1016/j.futures.2014.10.007; Mandy M Archibald et al., "Transdisciplinary Research for Impact: Protocol for a Realist Evaluation of the Relationship between Transdisciplinary Research Collaboration and Knowledge Translation," *Open Access*, 2018, 8.

In my experience in filmmaking, social impact startups, and research partnerships, however, the critical factor conducing to a harmonious, holistic, and at times successful practice of transdisciplinary knowledge production, and the missing link in and among most of the transdisciplinary discourses, has manifested as a phenomenological *grasp* of transdisciplinarity—*grasp* in its multiple senses of understanding, of reaching for the beyond, of taking circumstances into account, of touching *Otherness*,[150] and of handling one's being and the world's. This phenomenological grasp entails pausing all assumptions and preconceptions in order to sojourn the nuances of our subjectivity,[151] going from the *ego-logical* to the *ecological*: from a self-referential and ego-based grasp of the world, to one of inter-relatedness, inter-dependence, and inter-action.[152] Part of the sojourn means acknowledging that transdisciplinarity and knowledge production, as human phenomena, exist and manifest in a four-dimensional unfolding in which *time* seldom gains attention or proper consideration except in negative conditions such as framing the failure of a transdisciplinary effort—not enough time to train, to trust, to talk things through, or to triumph together in finding truths, solutions, or a better future. Time ought to be more than just "a given" or a mere measurement of projects and efforts; rather, time ought to be taken seriously and grasped as a fundamental force that *conditions*[153] human experiences, subjectivity, and transdisciplinarity.

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[150] E. Levinas, *Totality and Infinity: An Essay on Exteriority* (Springer Science & Business Media, 1979). p. 33-52, 175-183.

[151] More on that in Chapter 4, Section 4 herein.

[152] Will W. Adams, "The Primacy of Interrelating: Practicing Ecological Psychology with Buber, Levinas, and Merleau-Ponty," *Journal of Phenomenological Psychology* 38, no. 1 (2007): 24–61, https://doi.org/10.1163/156916207X190238; Allan Parsons, "The Ego-Logical and the Eco-Logical," *Poiesis and Prolepsis* (blog), 2013, http://prolepsis-ap.blogspot.com/2013/04/the-ego-logical-and-eco-logical.html.

[153] Latin *com-dicere:* speak together.

Resulting from this phenomenological grasp comes a recognition of the essential archetype emanating from the current typology of transdisciplinarity—that of an *insightful*[154] *transdisciplinarity*, for all categories of transdisciplinary knowledge production strive for insights albeit of different kinds: finding insights beyond the boundaries of what's known (transcendental), insights that bridge over the gaps of our reality and the future (transformative), and insights that unveil the fault-lines between what we know, what *is*, and what *should be* (transgressive). Insights, therefore, become the essence, cornerstone, and lens through which to grasp, construct, and measure transdisciplinary knowledge production, from its actors and networks to its outcomes and effects.[155]

Insights as Cognitive-Cultural Bridges

Cultural differences represent the most complex barrier to transdisciplinary knowledge production.[156] In addition to the biases and conflicts that may arise between communities, the cultural gaps and conflicts between the broader cultures in which members of those communities are embedded also interfere and hinder with knowledge production. The specific issue of language stands out as the most prominent: while English is the dominant language and the de facto *lingua franca* in the transdisciplinary space, the exchange of knowledge between English sources and other languages remains largely one-way. English works get routinely translated into other languages so that everyone in the discipline/community stays abreast of the intellectual

[154] German *ein-sicht:* sight into; a penetrating understanding into character or hidden nature (Online Etymology Dictionary).

[156] Paul Wildman, "From the Monophonic University to Polyphonic Multiversities," *Futures* 30, no. 7 (September 1998): 625–33, https://doi.org/10.1016/S0016-3287(98)00070-6; Harris and Lyon, "Transdisciplinary Environmental Research"; Frank Kessel and Patricia L. Rosenfield, "Toward Transdisciplinary Research," *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S225–34, https://doi.org/10.1016/j.amepre.2008.05.005.

trends, but foreign works rarely get translated into English, except for a few special cases in French and German. This causes entire populations and reserves of transdisciplinary intellectual capital to be isolated from each other; for instance, China, Spanish-speaking Latin America, and Portuguese-speaking Brazil have each developed quasi-independent versions of ArtScience literature which has been somewhat influenced by the Anglophone and Francophone traditions, but which has hardly even been noticed in those same communities due to the lack of translation.[157] And even if the solution to this is obvious (more translation into English from the languages of interest), the task of publishing translation always remains unstable, challenging and costly.[158]

Coupled with language barriers, the issue of ethno-national cultural nuances poses another, more subtle threat to transdisciplinary knowledge production, particularly the divide between East and West traditions. After all, such cultural nuances have been documented to be so powerful as to cause cognitive biases in entire populations, such as the almost instinctive affinity of the West to favor individualism and of the East to lean towards collectivism.[159] As Don Ihde expressed throughout his Peking lectures,[160] even the ways Eastern and Western cultures envision history and technologies demonstrate cultural gaps and potential points of

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[157] João Ricardo Aguiar da Silveira, Roger F. Malina, and Denise Lannes, "Arteciência: Um Retrato Acadêmico Brasileiro," *Ciência e Cultura* 70, no. 2 (April 2018): 46–55, https://doi.org/10.21800/2317-66602018000200013.

[158] Lawrence Venuti, *The Translator's Invisibility: A History of Translation* (London; New York: Routledge, 1995), http://site.ebrary.com/id/10097452; Emily Apter, *The Translation Zone: A New Comparative Literature* (Princeton University Press, 2011); Doris Bachmann-Medick, "Translational Turn," in *Handbook of Translation Studies*, ed. Yves Gambier and Luc van Doorslaer, vol. 4 (Amsterdam: John Benjamins Publishing Company, 2013), 186–93, https://doi.org/10.1075/hts.4.tra17; Susan Bassnett, *Translation Studies, Third Edition*, n.d.

[159] William B. Gudykunst, *Cross-Cultural and Intercultural Communication* (SAGE, 2003).

[160] Ihde, *Postphenomenology and Technoscience*.

conflict, including the Western-centric master narrative of history in which almost all significant advances in knowledge and technology have occurred in Europe and the United States, from philosophy to astronomy, even if there are small acknowledgements and mounting evidence that Asian civilizations (and a few Native American ones) were a few centuries ahead from Western civilizations for most of human history. At the same time, cultural dimensions of the Eastern tradition may pose extra challenges for transdisciplinary collaboration, such as views on authority, incentives to deviate from the norm/innovate, and the assumption of risk.[161] The solution to this issue involves a concerted effort towards, first, *cultural intelligence,* meaning training people to identify nuances and have the cultural sensitivity and awareness to assuage conflicts.[162] Transdisciplinary knowledge production requires a certain type of cultural intelligence training, one that equips practitioners with enough knowledge not only about ethno-national cultural differences but also meta-disciplinary differences in thinking and knowing that manifest across communities of practice. In other words, TDKP demands the recognition of all dimensions of culture that it entails when collaborating beyond the boundaries of single communities, areas of expertise, professions, industries, and nations.

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[161] Geert Hofstede, "The Cultural Relativity of Organizational Practices and Theories," *Journal of International Business Studies* 14, no. 2 (June 1, 1983): 75–89, https://doi.org/10.1057/palgrave.jibs.8490867; Zeynep Aycan, Rabindra N. Kanungo, and Jai B. P. Sinha, "Organizational Culture and Human Resource Management Practices: The Model of Culture Fit," *Journal of Cross-Cultural Psychology* 30, no. 4 (July 1999): 501–26, https://doi.org/10.1177/0022022199030004006; Robert N. Bontempo, William P. Bottom, and Elke U. Weber, "Cross-Cultural Differences in Risk Perception: A Model-Based Approach," *Risk Analysis* 17, no. 4 (August 1997): 479–88, https://doi.org/10.1111/j.1539-6924.1997.tb00888.x; Marwan M. Kraidy, "Cultural Hybridity and International Communication," in *Hybridity, or the Cultural Logic of Globalization* (Temple University Press, 2005), 1–14, http://www.jstor.org/stable/j.ctt1bw1k8m.5; William B. Gudykunst, Bella Mody, and Molefi Kete Asante, *Handbook of International and Intercultural Communication* (SAGE, 2002).

[162] Soon Ang and Linn Van Dyne, *Handbook of Cultural Intelligence* (Routledge, 2015); Hossein Dadfar and Peter Gustavsson, "Competition by Effective Management of Cultural Diversity: The Case of International Construction Projects," *International Studies of Management & Organization* 22, no. 4 (1992): 81–92; Gudykunst, *Cross-Cultural and Intercultural Communication*.

2.2 Dimensions of Culture

Culture has manifold meanings as a word and concept, many of which still stirs debates in philosophical, historical, and artistic circles. In the context of expertise, disciplines, and knowledge production, culture ought to be understood as a phenomenon—that which unfolds and reveals only through experience. Such understanding, shared and constructed by several fields within the social sciences, entails five interrelated dimensions:

1) a set of shared values, ideas, and symbolic systems that shape behavior;[163]

2) a pattern of assumptions and beliefs that endure through time and are hard to change;[164]

3) a collective mental programming;[165]

4) a complex system[166] entailing the utilization of resources and processes according to a set of priorities;[167]

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[163] Clifford Geertz, "The Way We Think Now: Toward an Ethnography of Modern Thought," in *Local Knowledge: Further Essays in Interpretive Anthropology* (Basic Books, 2000); Alfred Louis Kroeber and Clyde Kluckhohn, "Culture: A Critical Review of Concepts and Definitions.," *Papers. Peabody Museum of Archaeology & Ethnology, Harvard University*, 1952.

[164] Edgar H. Schein, "Culture: The Missing Concept in Organization Studies," *Administrative Science Quarterly* 41, no. 2 (June 1996): 229, https://doi.org/10.2307/2393715.

[165] Hofstede, "The Cultural Relativity of Organizational Practices and Theories."

[166] Kenneth A. Frank and Kyle Fahrbach, "Organization Culture as a Complex System: Balance and Information in Models of Influence and Selection," *Organization Science* 10, no. 3, (n.d.), http://www.jstor.org/stable/2640331.

[167] Clayton M Christensen, *How Will You Measure Your Life?(Harvard Business Review Classics)* (Harvard Business Review Press, 2017).

5) and as an emergent phenomenon that may be designed yet not controlled.[168]

Disciplinary experts, individually and collectively, embody and experience all of these dimensions, from their interior and professional lives to the constitution and functioning of their disciplinary communities of practice. Disciplinary experts have foundational texts and key concepts (both symbols) that inform the knowledge interests (values) and the 'perspectival universality' of their field.[169] They have codes of conduct, standards of professionalism, preferences for certain knowledge production methods, and even official certifications and memberships to upkeep, all which shapes behavior to the point of becoming engrained in cognitive labor and biases.[170] They adhere to, defend or oppose, and contribute to knowledge traditions and lineages (patterns and assumptions), be that intellectual, paradigmatic, or academic, and which manifest as mentorship lines, bibliographic references, and institutional heritage, such as the Frankfurt School, the Impressionists, or Freudians & Jungians. Disciplinary experts achieve their status, in part, by deliberately participating in (or challenging) the practices of their community to the point of primal automaticity that purports "that's what we do/how we do things" (collective mental programming). Disciplinary experts also exist and work in interconnected ecosystems beyond academic silos,[171] ranging from universities to governmental

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[168] Anne Balsamo, *Designing Culture: The Technological Imagination at Work* (Duke University Press, 2011).

[169] Ananta Kumar Giri, "The Calling of a Creative Transdisciplinarity," *Futures* 34, no. 1 (February 2002): 103–15, https://doi.org/10.1016/S0016-3287(01)00038-6.

[170] Frank Keil et al., "Discerning the Division of Cognitive Labor: An Emerging Understanding of How Knowledge Is Clustered in Other Minds," *Cognitive Science: A Multidisciplinary Journal* 32, no. 2 (March 2008): 259–300, https://doi.org/10.1080/03640210701863339.

[171] Gillian Tett, *The Silo Effect: The Peril of Expertise and the Promise of Breaking down Barriers* (Simon and Schuster, 2015).

agencies to corporations to other types of institutions and organizations to entire industries bounded by shared knowledge and practices[172] (complex system); the ecological networks and their entities comprise knowledge, technology, personnel, publics, and funding meant for the development and advancement (whole or in parts) of the sociotechnical network[173] according to complementary and competing motivations and interests (resource allocation and priorities). Finally, disciplinary experts, overall, develop and define their communities and cultures without predesign or predestination; rather, a combination of happenstance, discoveries, shifts, and disruptions incrementally and eventually lead to the establishment of said communities, such as it occurred with the fragmented formalization of psychology[174] or the validation of film studies after decades of disciplinary derision[175] (emergent phenomenon). Regardless of the discipline to analyze under this lens (grand or niche, ancient or modern), the traits and implications of culture gain their due magnitude in the affairs of knowledge production.

2.3 The Seven Meta-Disciplines

While transdisciplinary knowledge production exists as a critical feature of all industries, the phenomenon itself and its particulars don't manifest the same across different contexts. In reality, there are disciplinary cultures that heavily influence and inform how TDKP unfolds in

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[172] Martin Ruef, "The Emergence of Organizational Forms: A Community Ecology Approach," *American Journal of Sociology* 106, no. 3 (November 2000): 658–714, https://doi.org/10.1086/318963.

[173] Ali Mostashari, "Sociotechnical Systems: A Conceptual Introduction," in *Socio-Technical Networks*, ed. Jiang Xie (CRC Press, 2010), 1–11, https://doi.org/10.1201/b10327-2.

[174] Joseph Ben-David and Randall Collins, "Social Factors in the Origins of a New Science: The Case of Psychology," *American Sociological Review* 31, no. 4 (August 1966): 451, https://doi.org/10.2307/2090769.

[175] Grieveson and Wasson, *Inventing Film Studies*.

the workings of any single industry. Namely, the very distinct and foundational disciplinary cultures of scientists, engineers, designers, artists, humanities scholars, entrepreneurs, and educators make up the worldviews and 'lifeworlds'[176] through which TDKP happens within industries. 'Disciplinary' in this context must be understood as related to 'disciplines' in its multiplicity of senses (as explained in Sections 1.3-1.6) simultaneously: as fields of knowledge, as institutional structures with ranks and systems for rewards and punishment,[177] and as cultural groups with an established membership that shares experiences and values.[178] These disciplinary cultures, and their differences in particular, have been independently identified and studied by a diversity of scholars for decades, which will be surveyed in the next subsections. When analyzed through this lens of cultural diversity, these seven disciplinary cultures, in greater or lesser degrees, make up the cultural fabric of all disciplines, subdisciplines, and industries, mixing and matching their values, beliefs, languages, and overall worldview, hence affecting TDKP whether by design or by happenstance. The traits and differences among all of these 'meta-disciplinary' cultures or 'ways of knowing,' including methods and goals, have been summarized in Table 1 for ready comparison.[179]

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[176] Gloria Dall'Alba, "Reframing Expertise and Its Development: A Lifeworld Perspective," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 33–39, https://doi.org/10.1017/9781316480748.003.

[177] As suggested by Michel Foucault throughout his works: Michel Foucault, "History of Systems of Thought," *Language, Counter-Memory, Practice*, 1980, 199–205; Michel Foucault, "The Discourse on Language," in *Truth*, ed. Jos Medina and David Wood (Ames, Iowa, USA: Blackwell Publishing, 2005), 315–35, https://doi.org/10.1002/9780470776407.ch20; Michel Foucault, *The Order of Things* (Routledge, 2005); Michel Foucault, *The Archaeology of Knowledge* (Vintage, 2012).

[178] Wallerstein, *The Uncertainties of Knowledge*.

[179] Alex Garcia Topete, "Transdisciplinary Intelligence: Training Hybrids and Amphibians," 10.13140/RG.2.2.30915.96805/1.

Table 1: Meta-Disciplinary Cultures / Ways of Knowing

	Science	**Engineering**	**Design**	**Art**	**Humanities**	**Entrepre-neurship**	**Education**
Phenomenon/ Lens	Natural world	Systems and processes	Artificial world	Human experience	Human condition	Value creation	Human learning
Methods	Controlled experiment, classification, analysis, peer review.	Diagramming, prototyping, testing.	Modelling, pattern-formation, Synthesis.	Analogy, metaphor, Performance.	Evaluation, critique, discourse	Focus groups, competition, validation.	Mentorship, apprenticeship, assessment.
Values	Objectivity, rationality, neutrality, and a concern for 'truth'	Problem-solving, standards, efficiency, and a concern for "effective-ness"	Practicality, ingenuity, empathy, and a concern for 'appropriate-ness'	Subjectivity, imagination, commitment, and a concern for 'authenticity'	Questioning, interpretation, context, and a concern for "justice"	Innovation, dissemination, risk, and a concern with "improve-ment".	Formation, engagement, training, and a concern with "caring"
Product	Knowledge	Applications	Solutions	Meanings	Understanding	Value	Learning

2.3.1 The Old Debate: Art vs. Science

There's one thing on which artists and scientists all can agree upon—the insistence that their professions, priorities, practices, and identities are vastly different from one another. C.P. Snow, one of the inaugural contributors of the aforementioned *Leonardo* (himself a literary writer and scientist), has been one of the most prominent heralds for the divide of 'the two cultures,'[180] an impression and a moniker used and abused by plenty of others, particularly those

[180] C. P. Snow, "The Two Cultures," *Leonardo* 23, no. 2/3 (1990): 169, https://doi.org/10.2307/1578601; C. P. Snow, *The Two Cultures*, Canto ed (London ; New York: Cambridge University Press, 1993).

advocating for a 'third culture' of some kind, whether an integration of the two or the inclusion of a whole other discipline in the trinity.[181]

The view of this issue as a matter of culture, however trite, does allow for a more accurate understanding of the disparities between the two communities, and even among artists, scientists, and other disciplinary experts.[182] Closer examination of the art-science divide has yielded the realization that the assertion is only partially true, although the differences that do exist are significant enough to eclipse most of the commonalities. The work of anthropologist James Leach has been particularly insightful in this regard.[183] For instance, despite the commonality of artists and scientists acknowledging their work as a creative endeavor, scientists consider their efforts as an objective, outside-of-themselves by-product, while artists conceive their work as an extension of their selves and their identity. Moreover, while both troupes recognize their own and their counterparts' contributions the world (even if not of equal value), scientists express themselves more in terms of 'producing knowledge', as opposed to artists' claims of 'revealing/constructing truth.' Simply put, artists feel a higher degree of "ownership" of their work than equally-passionate scientists may have.

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[181] Stacie Friend, "Collaboration in the Third Culture," *Projections* 12, no. 2 (December 1, 2018): 39–49, https://doi.org/10.3167/proj.2018.120206; Bradd Shore, "Unconsilience: Rethinking Two-Cultures Conundrum Anthropology," n.d., 19; Jerome Kagan, *The Three Cultures: Natural Sciences, Social Sciences, and the Humanities in the 21st Century* (Cambridge University Press, 2009).

[182] Tony Becher, "The Significance of Disciplinary Differences," *Studies in Higher Education* 19, no. 2 (January 1994): 151–61, https://doi.org/10.1080/03075079412331382007.

[183] James Leach, "The Self of the Scientist, Material for the Artist: Emergent Distinctionsin an Interdisciplinary Collaboration," *Social Analysis* 55, no. 3 (January 1, 2011), https://doi.org/10.3167/sa.2011.550308; James Leach, "'Being in Between': Art-Science Collaborations and a Technological Culture," *Social Analysis* 49, no. 1 (2005): 141–62; James Leach, "Leaving the Magic Out: Knowledge and Effect in Different Places," *Anthropological Forum* 22, no. 3 (November 2012): 251–70, https://doi.org/10.1080/00664677.2012.723611; James Leach, "Modes of Creativity and the Register of Ownership," *CODE: Collaborative Ownership and the Digital Economy* 29 (2005): 38.

The most grievous cultural and epistemological rift between artists and scientists may not be a matter of language or worldview but a matter of parochialism, bias, and respect.[184] At their core, each of the cultures has a bias of enthroning themselves as the nobler cause, the more worthwhile endeavor, and the more valuable or legitimate source of knowledge. As noted tangentially by Leach, even if one side holds the other in good regard, it will usually be in a hierarchical fashion lacking the respect of equals: a scientist may admire an artist, but never consider them a legitimate peer in the realm of knowledge production, just as that artist may prize the work of the scientist but hardly consider it a vital truth. These disparity and bias come through even among proponents of transdisciplinarity, such as O. Wilson's championing of integrating arts and sciences to the service and advancement of science rather than the benefit of knowledge production as a whole.[185]

When there's enough respect and cultural sensitivity, artists and scientists can then build an affinity that prompts them to overcome differences and recognize commonalities—a first step towards transdisciplinary knowledge production.

In addition to the ontological similarities identified by Leach, including creativity, curiosity, and a sense of vocational calling, the cultures of scientists and artists resemble each other in significant ways in terms of sociology, impact, and history.

Finally, the histories of art and science not only echo each other through time, but they frequently intersect at the individual and collective levels. For instance, the Renaissance, the

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[184] Mieke Boon and Sophie Van Baalen, "Epistemology for Interdisciplinary Research – Shifting Philosophical Paradigms of Science," 2018, 35.

[185] E. O. Wilson, *Consilience: The Unity of Knowledge* (Knopf Doubleday Publishing Group, 2014).

Enlightenment, and the *Golden Ages* of India, China, and Japan (just to name a few) are prized historically because they meant collective leaps and accumulations of scientific breakthroughs and artistic revolutions.[186] Furthermore, within and without golden ages, a cornucopia of historical figures have represented embodied intersections of art and science, from the polymath geniuses of Leonardo Da Vinci and Alexander Von Humboldt, to the complementary artistic avocations of most Nobel Prize winners in the sciences.[187] What disciplinary tradition tries to keep apart, history unites time and again—art and science.

2.3.2 Engineering

As disciplines and professions institutionalized during the 19th century, industrialization brought to the fore the particular orientation of engineering as distinct from their closely-related scientist colleagues—an cultural identity based on engineering that superseded national cultures, for instance, among engineers in the United States, Britain, France, and beyond.[188] This cultural identity focused on the empirical, the technical, and the practical, instead of centering theory and truth as scientists would. This distinction in particular manifested in the emerging tech industry (including the Bell Labs examined in Chapter 3), such as in the workshops of Thomas Edison's would-be General Electric, in which discoveries and artifacts were made not from standard

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[186] Eric Weiner, *The Geography of Genius: A Search for the World's Most Creative Places from Ancient Athens to Silicon Valley* (Simon and Schuster, 2016).

[187] Robert Scott Root-Bernstein and Michèle Root-Bernstein, *Sparks of Genius: The Thirteen Thinking Tools of the World's Most Creative People* (Houghton Mifflin Harcourt, 2001).

[188] Gary Lee Downey and Juan C. Lucena, "Knowledge and Professional Identity in Engineering: Code-switching and the Metrics of Progress," *History and Technology* 20, no. 4 (December 2004): 393–420, https://doi.org/10.1080/0734151042000304358; Gary Lee Downey and Juan C. Lucena, "National Identities in Multinational Worlds: Engineers and 'Engineering Cultures,'" *International Journal of Continuing Engineering Education and Life-Long Learning* 15, no. 3/4/5/6 (2005): 252, https://doi.org/10.1504/IJCEELL.2005.007714.

scientific research but from rigorously empirical, trial-and-error engineering. All throughout the first half of the 20th century, science and engineering were considered more distinct than they are today, even in the writings of Vannevar Bush,[189] godfather of contemporary government-funded 'big research' and who argued for support for both meta-disciplines. Today, the distinction between science and engineering becomes evident and explicit in categorizations such as 'applied research' and *Pasteur's Quadrant*[190] (and its derivations).

2.3.3 Design

The fourth section of Pasteur's Quadrant belongs to *design*¸ the discipline at the frontier of engineering and art and which has claimed its own domain throughout the 20th century. 'Designerly' culture has been proposed and defended most notably by David Cross,[191] who has tried to position design as the 'third culture' implied by the science-versus-art debate. Among the characteristics of design stand out its focus on artifacts and material things, its concerns for usability and empathy, and its use of patterns and aesthetics. The distinction of design as a culture[192] has become so accepted that design is routinely paired up or framed as a 'specialized collaborator' with other disciplines, [193] such as industrial design or user-experience design.

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[189] Vannevar Bush, *Science Is Not Enough* (Morrow, 1967); Vannevar Bush, *Endless Horizons* (Literary Licensing, LLC, 2012).

[190] Donald E. Stokes, *Pasteur's Quadrant: Basic Science and Technological Innovation* (Brookings Institution Press, 2011).

[191] Nigel Cross, "Designerly Ways of Knowing," *Design Studies* 3, no. 4 (1982): 221–27.

[192] Guy Julier, "From Design Culture to Design Activism," *Design and Culture* 5, no. 2 (July 2013): 215–36, https://doi.org/10.2752/175470813X13638640370814.

[193] Thomas H. Dykes, Paul A. Rodgers, and Michael Smyth, "Towards a New Disciplinary Framework for Contemporary Creative Design Practice," *CoDesign* 5, no. 2 (June 2009): 99–116, https://doi.org/10.1080/15710880902910417.

2.3.4 Humanities

The humanities, as a meta-disciplinary culture, has often been obviated as a twin to 'the arts;' most universities and colleges tend to bound them together still as a singular department. Nonetheless, their proximity has not voided their distinction but rather merely reinforced the interrelatedness and overlap of practitioners—meaning that school-educated artists learn cultural traits and practices of and from humanities practitioners due to their intellectual proximity. The rise of *digital humanities*[194] has helped make more apparent the main elements of a humanities-oriented way of knowing: the primacy of critique and interpretation, the concern for the human condition and justice, and a focus on texts (understood as more than just documents), contexts, and histories. Even in the age of Big Data, the humanities stand as the meta-disciplinary culture guarding the uses and abuses of Internet technologies[195] through questioning and interpretation.

2.3.5 Education

Closely related to the humanities, professionalization, and the institutionalization of the disciplines themselves, education has developed a distinct way of experiencing the world,[196] particularly in terms of the thinking and the teaching done by educators.[197] Simply put, *learning*

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[194] Gary Hall, *Pirate Philosophy: For a Digital Posthumanities* (MIT Press, 2016); Cathy N. Davidson and David T. Goldenberg, "A Manifesto for the Humanities in the Digital Age," *The Chronicle of Higher Education* 50, no. 23 (2004): 6; M. G. Cooper and J. Marx, "Crisis, Crisis, Crisis: Big Media and the Humanities Workforce," *Differences* 24, no. 3 (January 1, 2013): 127–59, https://doi.org/10.1215/10407391-2391977.

[195] Wendy Hui Kyong Chun, *Control and Freedom: Power and Paranoia in the Age of Fiber Optics:*, vol. 195, 2007, https://insights.ovid.com/crossref?an=00005053-200703000-00024.

[196] Gasset, *Misión de la universidad y otros ensayos sobre educación y pedagogía*; John Dewey, *Democracy and Education: An Introduction to the Philosophy of Education* (Macmillan, 1923); John Dewey, *How We Think* (Standard Publications, Incorporated, 1935).

[197] Dewey, *How We Think.*

and *care* serve as the cornerstones of this meta-disciplinary culture: care for the learning of others, care for one's own learning, and care for the proper training and development of thinking prowess. In other words, this meta-disciplinary culture concerns itself with the dissemination and absorption of knowledge all levels of society.

2.3.6 Entrepreneurship

While entrepreneurship has been recognized since the 1980s as a disciplinary phenomenon by the fields of sociology of management,[198] it has manifested for much longer (usually under the names business or commerce) as a purposeful "deliberate practice" and mode of worldly expertise,[199] albeit one recognized negatively by other disciplines. For instance, artists who get involved with entrepreneurial endeavors consider it 'selling out,' while humanities scholars have criticized it as 'mercantilism,' 'capitalism,' and other 'isms' depending on the era. Its main characteristics are clear: a focus on value (its creation and management), concerns for risk and innovation, and a worldview based on competition and markets. Crudely put, entrepreneurship *has* to be its own meta-disciplinary culture if only because *no other* meta-disciplinary culture will admit it in their ranks due to negative connotations.

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[198] Scott Shane and S. Venkataraman, "The Promise of Enterpreneurship as a Field of Research," *The Academy of Management Review* 25, no. 1 (January 2000): 217, https://doi.org/10.2307/259271.

[199] Nicholas Dew et al., "Toward Deliberate Practice in the Development of Entrepreneurial Expertise: The Anatomy of the Effectual Ask," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 389–412, https://doi.org/10.1017/9781316480748.022.

2.3.7 Disciplinary Counterpoints

Perhaps the best way to illustrate the particularity of each of these meta-disciplinary cultures is by using them to break down some outstanding (and historically dominant) fields/disciplines that don't make the cut: medicine, theology, and law. Theology, in its search for systematizing the understanding of the Divine, blends concerns from Art (meaning) and Science (truth), with practices from Education (formation) and Humanities (critique, hermeneutics, history). Law, in its attempt to govern society and influence human behavior, expresses Engineering values (standard, problem-solving) and Design values (empathy, appropriateness), all while balancing Humanities methods (interpretation, evaluation) and an Engineering goal (application). Medicine mixes aspects of all seven meta-disciplinary cultures,[200] from the truth-seeking methods of Science, to the problem-solving values of Engineering, to the empathy concerns of Design, to the performative subjectivity of Art, to the interpretation and understanding of Humanities, to the value concern of Entrepreneurship, to the care and mentoring of Education… The elements and traits of the meta-disciplinary cultures help deconstruct and explain broad fields and specialized subfields alike, no matter how fundamental or historical they may be in relation to our modern transdisciplinary knowledge production.

2.4 Understandings of Intelligence

If culture is a cognitive dimension that manifests inward from the collective to the individual, it's cognitive inverse and complement is intelligence, which manifests outwardly

[200] Unsurprisingly, medicine tends to be a transdisciplinary endeavor by default.

from the individual to the collective. Intelligence itself, just as culture to which it's closely interrelated,[201] has a multidimensional nature "displayed in places other than the classroom;"[202] the general definition of its dimensions can be summarized as "the capability of an individual to function effectively in situations" of a particular domain,[203] therefore resulting in multiple recognizable intelligences ranging from the linguistic and mathematical to the musical, spatial, kinesthetic, social, creative, critical, collective, emotional, and cultural, to name a few.[204] The latter, cultural intelligence, refers to effective functioning in situations of cultural diversity,[205] which connects directly (albeit tacitly) to the matter of transdisciplinary collaboration and disciplinary cultures.

Cultural intelligence, same as other intelligences, includes four general dimensions: metacognitive (processes to acquire and understand knowledge, such as awareness and reflections during intercultural interactions), cognitive (knowledge and structures, such as cultural norms, practices, and conventions), motivational (focus on a task or situation, including the enjoyment of intercultural situations), and behavioral (overt actions, such as non-verbal cues and speech itself).[206] In terms of disciplinary cultures and transdisciplinary collaboration, this entails that collaborators require a certain level of cultural intelligence regarding their own disciplinary culture and that of their collaborators and publics in order to function effectively—

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[201] Robert J Sternberg, "Culture and Intelligence.," *American Psychologist* 59, no. 5 (2004): 325.

[202] Robert J Sternberg and D.K. Detterman, *What Is Intelligence? Contemporary Viewpoints on Its Nature and Definition.* (Norwood, NJ: Ablex., 1986).

[203] Ang and Dyne, *Handbook of Cultural Intelligence*.

[204] Katie Davis et al., "The Theory of Multiple Intelligences," *The Cambridge Handbook of Intelligence*, n.d., 19.

[205] Ang and Dyne, p. 3-15.

[206] Ang and Dyne, p. 4-7.

an intelligence that goes beyond the obvious knowledge of another discipline's language and preferred methods, but that also demands self-reflection and self-awareness about biases and conflicts, an intrinsic motivation (perhaps even enjoyment) to learn about and understand other cultures, and enough self-regulation of behavior to prevent conflict and instead facilitate collaboration. In other words, neither intelligence in one domain, nor expertise in one discipline, guarantees successful transdisciplinary outcomes in knowledge production; in fact, in the absence (or poorness) of cultural intelligence, expertise and academic intelligence most likely jeopardize the collaborative effort in the face of diversity.

2.4.1 Heterogeneity and Diversity

Many studies across disciplines support the idea that heterogeneous groups outperform the productivity, creativity, and critical thinking of homogenous ones in the long term, particularly when there's heterogeneity in terms of personal backgrounds, knowledge, and cultures.[207] Heterogeneity, nonetheless, ought to be understood as diversity in its three dimensions: separation (e.g. liberal-conservative spectrum), variety (e.g. disciplinary expertise, age, ethnicity), and disparity (e.g. seniority, socioeconomic status).[208] The threats of conflict and

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[207] Efrat Elron, "Top Management Teams within Multinational Corporations: Effects of Cultural Heterogeneity," *The Leadership Quarterly* 8, no. 4 (December 1, 1997): 393–412, https://doi.org/10.1016/S1048-9843(97)90021-7; Heather Carey, Rebecca Florisson, and Lesley Giles, "Skills, Talent and Diversity in the Creative Industries," n.d., 72; W. E. Watson, K. Kumar, and L. K. Michaelsen, "Cultural Diversity's Impact On Interaction Process And Performance: Comparing Homogeneous And Diverse Task Groups.," *Academy of Management Journal* 36, no. 3 (June 1, 1993): 590–602, https://doi.org/10.2307/256593; Dong Huo, Kazuyuki Motohashi, and Han Gong, "Team Diversity as Dissimilarity and Variety in Organizational Innovation," *Research Policy* 48, no. 6 (July 2019): 1564–72, https://doi.org/10.1016/j.respol.2019.03.020; Günter K. Stahl et al., "A Look at the Bright Side of Multicultural Team Diversity," *Scandinavian Journal of Management* 26, no. 4 (December 2010): 439–47, https://doi.org/10.1016/j.scaman.2010.09.009; Stahl et al.

[208] David A. Harrison and Katherine J. Klein, "What's the Difference? Diversity Constructs as Separation, Variety, or Disparity in Organizations," *Academy of Management Review* 32, no. 4 (October 2007): 1199–1228, https://doi.org/10.5465/amr.2007.26586096.

failure, as well as the opportunities for breakthrough insights and inclusive outcomes, posed by these dimensions of heterogeneity/diversity have been well documented by the research on inter- and transdisciplinary collaborations—all which tend to ameliorate proportionately to the length of a collaboration's timeframe that ensures team members can overcome conflicts and exploit opportunities.[209] Therefore, a multidimensional examination of heterogeneity/diversity stands out as a critical component of an accurate and holistic understanding of collective intelligence, cultural intelligence, and most importantly, of transdisciplinary knowledge production at the intersections of disciplinary cultures.

2.5 Hybrids & Amphibians

In order to further examine and more deeply understand transdisciplinary knowledge production as a phenomenon, the people who embody and experience the phenomenon ought to be understood first, not merely at a contextual level of job titles and disciplinary accolades, or even at the performative level of skills, motivations, and attitudes for which some modest amount of research already exists,[210] but at the cognitive/developmental level that informs the lifeworlds and disciplinary cultures of the individuals involved. In cognitive psychology terms, such deeper understanding entails matters of identity, and in the context of transdisciplinary knowledge production, the research of Sarabeth Berk focusing on hybridity and professional

[209] David A Harrison et al., "Time, Teams, and Task Performance: Changing Effects of Surface-and Deep-Level Diversity on Group Functioning," *Academy of Management Journal* 45, no. 5 (2002): 1029–45.

[210] Guimarães et al., "Who Is Doing Inter- and Transdisciplinary Research, and Why?"

identities[211] provides a solid foundation for framing disciplinary culture for individuals. Berk's work builds upon three conceptual foundations: identity development, cultural hybridity, and intersectionality, which intertwine in ways that correlate to several aspects of transdisciplinary theory and disciplinary cultures.

First, for the development of professional identity, Berk expands on the theories of constructivist developmental psychologist Robert Kegan[212] to explain how individuals construct their self-understanding of who they are according to what they do. Whereas Kegan's five orders of consciousness development pertain to the construction of a person's level of understanding, from the self to the world and eventually to its complexities, Berk adapts the framework for a person's professional identity:

> *Our professional identities are greatly influenced and defined by how others see us and how we think we're supposed to act rather than how we perceive ourselves and who we want to be as professionals. This is because our consciousness is still at a stage where we're self-conscious and we idealize who we're supposed to be. In post-adolescence, we build interpersonal relationships and notice how our relationships to desires and interests affect our work. Kegan considers this to be third-order consciousness, which is a focus between "what I am doing" and "what they expect me to do." In fourth-order consciousness, which typically occurs in adulthood before forty years of*

[211] Sarabeth Berk, *More Than My Title: The Power of Hybrid Professionals in a Workforce of Experts and Generalists* (Networlding Publishing, 2020).

[212] Robert Kegan, *The Evolving Self* (Harvard University Press, 1982).

age, professionals have a strong sense of self - authorship and individuation in how they do their work. The main difference between the third and fourth - order consciousness is that professionals who reach the fourth order can perceive the role they are supposed to play and faithfully adhere to it, but also understand that they can play a part in the actual creation and regulation of their role…Professionals who reach the fifth order of consciousness are people who bring a trans-system or cross-form way of organizing reality. This means they can experience, in Kegan's words, multipleness. They see themselves as part of systems that interact and share with other systems. Kegan remarks that fifth-order consciousness is the "recognition of our multiple selves." Professionals who reach this fifth order of consciousness rarely give a damn about how they work…They just do what they do while still meeting expectations demanded of them. This mindset isn't coming from an attitude of disrespect or rebelliousness; rather these professionals are versatile in achieving outcomes by following their hybrid methods as opposed to the conventional standards set forth by one professional identity.[213]

Second, the concept of hybridity derives from Homi Bhabha's propositions regarding cultural hybridity.[214] Bhabha's work focuses on colonialism and culture, interrogating the collisions and spatial overlaps of culture, hierarchies, and identities between colonizers and the

[213] Berk, p. 108-109.

[214] Homi K Bhabha, *The Location of Culture* (routledge, 2012).

colonized; in such context, cultural hybrids are those who entertain or possess two identities in balance. Berk uses this lens to understand hybridity as "the interstitial space between fixed identities describes that new potential exists that doesn't conform to the rules or hierarchies of either identity…an emboldened space that allows differences to collide."[215]

Third, Berk applies the critical lens of intersectionality, borrowing heavily from Kimberlé Williams Crenshaw[216] and Leslie McCall,[217] to explain and value hybridity in professional contexts as "a place where deep knowing, making, and doing occur."[218] In line with the feminist and critical origins of intersectionality as a movement and theory, Berk proposes that professional hybridity, as a type of intersectional identity, has been overlooked, undervalued, and even suppressed in the workplace to the detriment and marginalization of hybrid professionals and the "many positive feelings [they experience] when they're working in their hybridity that are noticeably different from when they're not."[219]

Ultimately, the combination of these developmental, sociological, and critical implications means for Berk that professional identity has three types to be acknowledged and fostered: "singularity, multiplicity, and hybridity," which respectively encompass "experts or specialists," "generalists [and] multitalented professionals," and "people who have two or more

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[215] Berk, p. 29.

[216] Kimberle Crenshaw, "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics," *U. Chi. Legal F.*, 1989, 139.

[217] Leslie McCall, "The Complexity of Intersectionality," *Signs: Journal of Women in Culture and Society* 30, no. 3 (2005): 1771–1800.

[218] Berk, p. 119.

[219] Berk, p. 126.

professional identities that intersect, like in a Venn diagram"[220]—types that map to the disciplinarity, multi- or interdisciplinarity, and transdisciplinarity recognized in research and knowledge production. Simply put, being a hybrid professional means being an expert "who integrates multiple professional identities together, working from the intersections of those identities."[221]

It's worth noting that Berk's research interests were inspired by her own experience working for years in collaborative knowledge production at the intersection of art, education, and entrepreneurship,[222] meaning that her professional hybridity theory has a clear and explicit transdisciplinary origin.

Transdisciplinary inculturation and collaborative knowledge production both require and involve the type of hybridity proposed by Berk, either in an ideal form in which everyone involved in the collaboration embraces and understands the implications and nuances of their professional hybridity and disciplinary cultures, or in the more common form of hybrid professionals acting as knowledge brokers who bridge the gaps in understanding among collaborators and between the groups and outside publics.[223] In such contexts, both the

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[220] Berk, p. 24.

[221] Berk, p. 4.

[222] Sarabeth G Berk, "The ABC's of Art Teacher Professional Identity: An A/r/Tographic Investigation into the Interstitial Spaces," n.d., 266.

[223] Ronald S. Burt, "Structural Holes and Good Ideas," *American Journal of Sociology* 110, no. 2 (September 2004): 349–99, https://doi.org/10.1086/421787; Kevin Crowston et al., "Perceived Discontinuities and Continuities in Transdisciplinary Scientific Working Groups," *Science of The Total Environment* 534 (November 2015): 159–72, https://doi.org/10.1016/j.scitotenv.2015.04.121; Sujin Jang, "The Most Creative Teams Have a Specific Type of Cultural Diversity," 2018, 4; Nicky Priaulx and Martin Weinel, "Connective Knowledge: What We Need to Know about Other Fields to 'Envision' Cross-Disciplinary Collaboration," *European Journal of Futures Research* 6, no. 1 (December 2018), https://doi.org/10.1186/s40309-018-0150-z.

'knowledge of' and the 'knowledge about' other disciplines and other hybrids' intersections become fundamental for the performance and success of hybrid experts; in the former, the degree of individual hybridity and personal awareness enhance the collective hybridity of the group, which then dictates the transdisciplinary effectiveness of the collaboration; in the latter, rather than on a degree of collective hybridity, the entire transdisciplinary effort of the group hinges upon the facilitation by the hybrid broker(s) acting successfully as both peer collaborators and knowledge translators.[224]

However, from the ecological perspective of transdisciplinarity, hybridity, whether collective or individual, does not suffice for groups or individual experts to thrive, for transdisciplinary industries and knowledge production networks tend to be more complex than the hybridity of people, and therefore also more adverse in conditions for success (as all the research about transdisciplinary barriers has shown). Instead, thriving in that ecology demands skills and knowledge beyond hybridity—it demands a certain level of amphibious behavior[225] that allows transdisciplinary hybrids not only to ascertain their expertise within their intersectional expertise, but also to adapt by transposing their knowledge smartly when crossing in and out the boundaries of institutions, industries, circles of society, publics, and even their own hybrid communities of practice. In other words, hybrids succeed by becoming amphibians within their professional ecosystems, capable of exercising their professional hybridity

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[224] Andi Hess, "Interdisciplinary Translation and Integration Science Initiative" (Oral Presentation, Science of Team Science 2018 Conference, Clearwater Beach, FL., May 23, 2018), https://teamsciencetoolkit.cancer.gov/Public/TSResourceBiblio.aspx?tid=3&rid=4751.

[225] Kurt Sandholtz and Walter W Powell, "Amphibious Entrepreneurs and the Origins of Invention," in *Oxford Handbook on Entrepreneurship and Collaboration*, ed. Jeffrey Reuer and Sharon Matusik, 2018, 45.

regardless of its suitableness to the surrounding environment. For instance, biotech industry pioneers who hold widely respected reputations for their expertise in that intersection, recognized equally by entrepreneurs and business leaders, bioengineering researchers, policymakers, and the public at large epitomize the notion of transdisciplinary amphibians, for they have thrived both in their hybrid 'homes' and in their rewarded-rather-than-punished 'intrusions' into foreign domains. Similarly, ArtScience groups who can as easily be welcomed to participate in international research projects, art fairs, social-impact conferences, and business expos manifest a certain level of collective amphibianism that most scientific teams and artistic groups either lack, ignore, or renege upon.

Understanding hybridity and amphibianism in terms of professional identity and disciplinary cultures leads not only to a better grasp of transdisciplinarity as a collective phenomenon with deep cognitive, subjective, and intrapersonal roots, but also to a resounding conclusion: that a true, holistic transdisciplinary experience endorses and calls for a particular class of intelligence instrumented around the intersections of culture, identity, expertise, knowledge, impact, and collaboration.

2.6 The Transdisciplinary Intelligence (TDI) Framework

Aligned with a phenomenological grasp of insightful transdisciplinarity, I define *transdisciplinary intelligence* (TDI) as the capacity to understand and collaborate with multiple experts and publics in knowledge production and exchange beyond a single field, as well as

thrive within diverse professional environments.[226] Given that intelligence of any kind formally encompasses knowledge, skills, and aptitudes, the following subsections provide an overview of the array of constructs comprising the TDI framework, all which will be explored further in Chapters 4 & 5.

2.6.1 Transdisciplinary Knowledge

Transdisciplinary Knowledge (TDK) entails an individual's capacity to identify and discern basic concepts integral to particular meta-disciplinary ways of knowing and disciplinary cultures. TDK is measured as a composite score represented in a spider chart (Sections 4.2-4.3).

2.6.2 Transdisciplinary Aptitude

Transdisciplinary Aptitude (TDA) refers to the cognitive and behavioral inclinations of an individual towards the beliefs and principles of particular meta-disciplinary ways of being and disciplinary cultures. TDA is measured as a composite score represented in a spider chart (Sections 4.2-4.3).

2.6.3 Collaborative Skills & Traits

Collaborative Skills & Traits (CST) refer to an anthology of character dispositions, modes of being, habits, and practices which tend to be disciplinarily agnostic in nature, but which facilitate transdisciplinary with others and usually enable overcoming the pitfalls of collaboration, such as having a growth mindset, compassion, empathy, and a capacity for

[226] Garcia Topete, "Transdisciplinary Intelligence: Training Hybrids and Amphibians."

multiple perspectives. While the meticulous measurement of CST is beyond the scope of my research, the identification and intentional training of CST are the core of Section 4.5 and Chapter 5, respectively.

2.6.4 Individual Transdisciplinary Intelligence Quotients

Individual Transdisciplinary Intelligence Quotients refer to calculated scores and graphic representations (spider charts) of the results from measuring TDK and TDA. An individual's *Transdisciplinary Aptitude Quotient* [TDAQ] (with a possible top score of 7) is calculated via a harmonic mean intended to avoid mismeasurements due to extreme variation of a single field; at the same time, negative and 0 scores in a field are omitted from the harmonic mean for math/statistical purposes, but their effect in the overall profile of the individual and the collective can be seen in the graphic representations. An individual's *Transdisciplinary Knowledge Quotient* [TDKQ] (with a possible top score of 7) is calculated with the following formula: the sum of disciplinary scores, divided by the absolute deviation of the scores, divided by 7.

2.6.5 Transdisciplinary Balance

Transdisciplinary Balance (TDB) means the combination of the results of the TDK and TDA lead to an individual score, which measures the overall percentage of transdisciplinarity manifested by the individual, achieved with the formula:

$$1 - (TDKQ / (Average\ of\ Aptitude\ Scores) \times TDAQ) \times 100$$

The individual results of TDAQ and TDKQ can be compared to the following table of ranges:

Table 2: Transdisciplinary Ranges

Traditional/Monodisciplinary	Hybrid	Amphibian
0.00 – 1.99	2.00 – 3.99	4.00 – 7.00

2.6.6 Transdisciplinary Intelligence Inventory

The *Transdisciplinary Intelligence Inventory* (TD2I) is an assessment tool to identify and measure the collective, structural, and interrelated features, practices, and dispositions that enable (or hinder) transdisciplinary collaboration (Appendix B). The assessment adapts the approach of the Individual-Relationship-Organization-Context (IROC) model developed for trust and leadership training,[227] building upon it with the concerns and factors particular to transdisciplinarity and collaboration as described before in Section 2.1, and listed in Table 3.

Table 3: Items of the Transdisciplinary Intelligence Inventory

Resilience	Dimensions of Diversity	Trust & Respect	Time considerations
Learning Disposition	Goal Alignment	Shared Language	Culture
Leadership Opportunities	Stakeholders	Character Strengths	Shared Values
Mentoring	Space considerations	Collaboration Styles	Leadership Styles
Knowledge Brokers	Knowledge management	Processes, policies & procedures	Communication

Items are scored individually, then cumulatively for a more holistic understanding of the inventory. The assessment is designed with a "fractal" implementation in mind, meaning that it's meant to function for individuals, groups, whole institutions/organizations, and

[227] Patrick Sweeney, Michael D. Matthews, and Paul B. Lester, "Trust," in *Leadership in Dangerous Situations: A Handbook for the Armed Forces, Emergency Services, and First Responders* (Naval Institute Press, 2011), 163–81.

networks/communities in order to measure their transdisciplinary intelligence "readiness" at the situated, collective, organizational, and ecological levels.

2.6.7 Situated Transdisciplinary Intelligence Quotient

Situated Transdisciplinary Intelligence Quotient (SiTDIQ) refers to the cumulative score and integrated average of the items in the TD2I appraised from an individual. It represents how primed an individual may be for transdisciplinary collaboration according to their personal characteristics in interplay with their context. Alternatively, SiTDIQ also highlights areas for improvement and training.

2.6.8 Collective Transdisciplinary Intelligence Quotient

Collective Transdisciplinary Intelligence Quotient (CoTDIQ) refers to the cumulative score and integrated average of the items in the TD2I appraised from a group. It represents how primed the group may be for transdisciplinary collaboration according to their collective characteristics in interplay with their context, habits, and practices. Alternatively, CoTDIQ also highlights areas for collective training and for redesigning group culture.

2.6.9 Organizational Transdisciplinary Intelligence Quotient

Organizational Transdisciplinary Intelligence Quotient (OrgTDIQ) refers to the cumulative score and integrated average of the items in the TD2I appraised from an institution or organization (usually from the vantage point of a particular project team, knowledge group, or departmental unit). It represents how effectively supportive the organization is of transdisciplinary collaboration according to their structures, systems, and overall culture.

Alternatively, OrgTDIQ also highlights areas of opportunity for structural redesign and transformational organizational change.

2.6.10 Ecological Transdisciplinary Intelligence Quotient

Ecological Transdisciplinary Intelligence Quotient (EcoTDIQ) refers to the cumulative score and integrated average of the items in the TD2I appraised from a group or organization. It represents how aware and inclusive the group or organization is of their network/community, and therefore how consciously they engage in transdisciplinary collaboration through their considerations, structures, and practices. Alternatively, EcoTDIQ also highlights areas of opportunity for transformational organizational change, enhanced contextual awareness, and more meaningful engagement with community stakeholders.

2.7 Applications for Transdisciplinary Intelligence

This TDI framework not only allows for the measurement, study, and understanding of TDKP in historical retrospective (as shown in Chapter 3) and concurrent analysis (as described in Chapter 4), but it also serves to facilitate and foment the training (as proposed in Chapter 5) and the co-design of desirable futures (as suggested in Chapter 7). The TDI framework, therefore, affords the maximum capitalization of the impact that TDKP can successfully have.

CHAPTER 3

MANIFESTATIONS OF TRANSDISCIPLINARITY

3.1 Understandings of Industries

From an understanding of *impact* as successful knowledge exchange, industries in general (regardless of expertise) that participate in the 'knowledge economy' can therefore be analyzed and critiqued according to TDI framework, a task for which the Transdisciplinary Intelligence Inventory is particularly useful. *Industries* and *knowledge economy*, nonetheless, must not be confused despite their unavoidable interrelatedness—the latter focuses on the raw material or core product from which labor and value derive,[228] while the former entails an understanding, an essential functioning, an impact, a *longue durée*, and a vision of interrelatedness of the network and its diverse actors.[229]

In order to further illustrate this phenomenological grasp of *industries* as prime manifestations of transdisciplinary knowledge production (TDKP) at multiple levels of reality, revisiting and rethinking the histories of exemplar institutions in the creative, educational, and techno-scientific domains allows to identify and deconstruct how their respective transdisciplinary intelligence (as measured through the TD2I) contributed to their development and success in their industry and to their socio-cultural impacts—albeit a transdisciplinary intelligence not defined, identified, or construed as such by any of the historical actors or the

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[228] John A. Cotsomitis, "The Learning Economy Regime," *Journal of the Knowledge Economy*, February 12, 2021, https://doi.org/10.1007/s13132-021-00756-3.

[229] Thomas H. Aageson, "Cultural Entrepreneurs: Producing Cultural Value and Wealth," in *The Cultural Economy* (1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd, 2008), 92–107, https://doi.org/10.4135/9781446247174.n8.

authors of the sources. The methodology for this deconstructive re-thinking has been mixed in its historical methods[230] approach: partially historiographic[231] in its reinterpretation and critique of the rich (and mostly secondary) sources used; partially historiometric,[232] for its quantitative measurement (albeit with simpler math) of nomothetic qualities of past individuals and groups; partially as a collective biography[233] of the groups as organizations, and the organizations as an industry; and as a reinterpretation of their recorded behaviors as performances[234] of the transdisciplinary kind. This mixed approach aims to distill retrospectively (rather than complicate) the transdisciplinary essence(s) of these exemplars of industries engaged in TDKP in order to answer a question: *how to elucidate and measure any manifestations of transdisciplinarity in/from the past, in order to learn for the future?*[235]

3.2 Creative: Sony Pictures vs. Pixar

The comparative history between Sony Pictures Entertainment and Pixar Animation Studios may seem disparate at first, but in practice both organizations have shared not only a similar timeline marked by mergers, acquisitions, and trends in the creative industries, but also a

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[230] Bonnie S. Brennen, *Qualitative Research Methods for Media Studies* (Routledge, 2012).

[231] Michael Kackman, "History and Historiography," in *The Craft of Criticism: Critical Media Studies in Practice*, ed. Michael Kackman and Mary Celeste Kearney (Routledge, 2018).

[232] Dean Keith Simonton, "Historiometric Methods," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 21–32, https://doi.org/10.1017/9781316480748.002.

[233] Krista Cowan, "Collective Biography," in *Research Methods for History*, ed. Simon Gunn and Lucy Faire (Edinburgh, United Kingdom: Edinburgh University Press, 2011), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1363938.

[234] Simon Gunn, "Analysing Behaviour as Performance," in *Research Methods for History*, ed. Simon Gunn and Lucy Faire (Edinburgh, United Kingdom: Edinburgh University Press, 2011), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1363938.

[235] Section 3.5 elaborates on the results of such questioning. It's worth noting beforehand that while all six exemplars score relatively high in many TD2I items, the inventory was developed independently from any analysis of the exemplars, and these were chosen because of their suitability to match/illustrate the items in the inventory.

more intimate relationship with technology even in an industry that has always been driven and shaken by Engineering breakthroughs in spite of resistance by incumbent player.[236] Sony Pictures' historical narrative is based on business case studies, business innovation chronicles, and film history texts with rich primary sources and sharp analyses of the organization's history since the 1980s. Pixar's history herein has been compiled from both academic and journalistic accounts of the creation and rise to prominence of the animation studio also since the 1980s,[237] as well as a first-hand retelling (part memoir, part self-help pamphlet) by Ed Catmull,[238] one of its founders and key executives.

The history of Sony Pictures as such may have started in the late 1980s, but that was merely a convergence and literal merger of two once-eminent, Academy-award-winning film studios (Columbia Pictures and eventually the troubled Metro-Goldwyn-Meyer [MGM] too[239]) that were strategically acquired by the Japanese technology giant Sony Corporation. The merger-acquisition made for a promising **hybridity** mix of Sony Pictures: the Engineering, Design, and Entrepreneurship[240] acumen of the parent corporation, and the Art & Entrepreneurship knowhow of the acquired studios. The mix was intentional, for the Sony Corporation sought to leverage the

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[236] Scott Kirsner, *Inventing the Movies: Hollywood's Epic Battle Between Innovation and the Status Quo, from Thomas Edison to Steve Jobs* (Scott Kirsner, 2008); Eric Dienstfrey, "Under the Standard: MGM, AT&T, and the Academy's Regulation of Power," *JCMS: Journal of Cinema and Media Studies* 59, no. 3 (2020): 23–45, https://doi.org/10.1353/cj.2020.0028.

[237] A. M. Buckley, *Pixar: The Company and Its Founders* (ABDO, 2011); Karen Paik and Leslie Iwerks, *To Infinity and Beyond!: The Story of Pixar Animation Studios* (Chronicle Books, 2007); David A. Price, *The Pixar Touch* (Knopf Doubleday Publishing Group, 2008); Timothy D. Wise, "Creativity And Culture At Pixar And Disney: A Comparison," Journal Of The International Academy For Case Studies, 20 (2014); "Our Story," Pixar Animation Studios, accessed June 8, 2021, https://www.pixar.com/our-story-pixar.

[238] Ed Catmull and Amy Wallace, *Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration*, 1st edition (Random House, 2014).

[239] Tino Balio, *MGM*, Routledge Hollywood Centenary (London ; New York: Routledge/Taylor & Francis Group, 2018).

[240] The names of meta-disciplines are capitalized herein for effect, while TD2I items appear in bold font.

Hollywood studios (and their content libraries) in order to influence the entertainment industry to adopt their new technologies and formats; just years before, Sony had lost the home videotape 'format war' (Sony's Betamax vs. JVC's VHS), so Sony executives envisioned an integration of their technology business with an entertainment arm that would afford synergy and advantages for both.[241] While this strategic vision would become true in the case of Sony's Blu-ray format and some of their 3D-cinema technologies between 2008-2015, neither the Sony Corporation nor Sony Pictures has ever fully reaped the benefits of their hybridity vision because it was never executed to its fullest extent: Sony Pictures in practice has remained as independent as it has been foreign (intellectually, philosophically, culturally, and geographically) to its parent Sony Corporation, so the meta-disciplinary expertise of the two have never truly melded and enriched each other in three decades of co-existence.

Starting at the individual/**intrapersonal** level, the executives chosen by Sony Corporation to first run Sony Pictures (Peter Guber and Jon Peters) and to liaison between the two organizations (Ohga Norio and Nobuyuki Idei) were mismatched.[242] The original managing executives held no **trust** from the employees and partners of Sony Pictures, having shown lack of character, competence, and care throughout their careers and during their tenure at the organizations: they would routinely mismanage funding, act autocratically with their decision-making, interfere with projects (not to say sabotage), alienate Hollywood partners, and generally

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[241] Chatterji Dheeman, Hayes Schildwachter, and Jeffrey S Harrison, "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge," n.d., 26.

[242] Ko Unoki, "Sony's Movie Entertainment Empire," in *Mergers, Acquisitions and Global Empires: Tolerance, Diversity and the Success of M&a* (London, United Kingdom: Taylor & Francis Group, 2012), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1047040; Dheeman, Schildwachter, and Harrison, "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge."

neglect their **leadership** duties. It wasn't until the 2000s that management changes corrected that. On their part, Sony Corporation's liaisons were (and have been) so hands-off as to invite and condone exploitative behavior and under-performance by the Sony Pictures executives for longer than reasonably expected. These early missteps have had aftershocks for Sony Pictures from which the organization (and its parent corporation) has been recovering since then. For instance, the many departments and global subsidiaries of Sony Pictures (such as Screen Gems, Sony Picture Television, and streaming platform Crackle) rarely staff individuals outside from their specialized expertise or tasks, even when such already belong to and are available at both Sony Pictures and the Sony Corporation, thus wasting unknown opportunities for innovation and the synergies that inspired the merger in the first place.[243]

At the **organizational** level, the vacuum for leadership, trust, and competence left by the original top management of Sony Pictures afforded some ripe opportunities and long-lasting scars for the studio. First off, **leadership opportunities** abounded for talented mid-level managers, such as television chief Steve Bosco and film executive Amy Pascal who eventually became co-heads of the organization by the 2010s.[244] As a corollary of Sony Corporation's own manifesto-driven **culture**,[245] the **leadership style** throughout Sony Pictures has been one of facilitation, with individual employees and teams/units encouraged and supported to find their own paths to success. As an effect of that style, **mentoring** is not only formalized with structured

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[243] Richard A. Gershon, "The Sony Corporation: Market Leadership, Innovation Failure and the Challenges of Business Reinvention," in *Handbook of East Asian Entrepreneurship*, ed. Tony Fu-Lai Yu and Ho-Don Yan (London, United Kingdom: Taylor & Francis Group, 2014), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1811063.

[244] Unoki, "Sony's Movie Entertainment Empire."

[245] Dheeman, Schildwachter, and Harrison, "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge."

internships and training programs,[246] but prized as an asset and natural way of cultivating talent for the future of the organization (and its future leaders: the president of the Sony Corporation has always been groomed by a predecessor[247]). Also stemming from Sony Corporation's innovation mindset and culture, there has been a clear **learning disposition** at Sony Pictures meant towards continuous improvement, individually and collectively, be that by mentoring, market research, or simply learning from partners and customers/audiences. All these 'parental' influences have prompted a certain **goal alignment** and shared time considerations among departments within Sony Pictures and between the organization and its parent corporation—a goal to achieve steady financial success through long-term cultural impact of its technology and entertainment products. That's how and why the Walkman, the Blu-ray, the *Scream* horror movie trilogy, and the original *Spiderman* trilogy (which kickstarted the age of comic-book superhero blockbusters and Marvel box-office dominance) have all been Sony products.[248]

The darker side of the original leadership vacuum and its ripple effects, when compounded with the 'Sony culture,' translate into several clear organizational flaws. First, the **collaboration style** of Sony Pictures overall is uneven internally and externally, at times eager to work either across departments (such as when creating videogame tie-ins for movies[249] or

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[246] "Internships and Trainee Programs | Careers at Sony Pictures Entertainment," accessed June 20, 2021, https://www.sonypicturesjobs.com/internships.

[247] Unoki, "Sony's Movie Entertainment Empire."

[248] Unoki; Gershon, "The Sony Corporation: Market Leadership, Innovation Failure and the Challenges of Business Reinvention."

[249] Brooks Barnes, "Scrounging for Hits, Hollywood Goes Back to the Video Game Well," *The New York Times*, May 24, 2021, sec. Business, https://www.nytimes.com/2021/05/24/business/media/video-game-movies-sony-playstation.html.

foreign adaptations of hit TV shows[250]) or with outside partners (for instance, working with different studios with their own streaming platforms[251]), and at other times getting in trouble for collective obstinance (as was the case with the infamous 2014 North Korean hacking incident[252] and their recent profit-sharing squabble with Marvel[253]). Similarly, the **processes, policies**, **and procedures** vary diametrically within the organization: any particular activity (especially those involving collaboration) either has byzantine, overburdening systems and practices already established, or lacks any sort of proceeding thus requiring a lot of bureaucratic navigation or creative bypassing.[254] **Knowledge management** and **communication** at Sony Pictures have also been affected by these discrepancies; for instance, there usually are open concerted efforts to share the proper use of new technology and upcoming entertainment projects with both employees and partners through marketing efforts, elaborate showcases, and even seminar-like events, but the actual inception, design, and envisioned deployment of said products are largely

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[250] Jake Kanter and Jake Kanter, "Sony Pictures Television Plans U.S. TV Adaptation Of Italian Medical Drama 'Doc,'" *Deadline* (blog), October 15, 2020, https://deadline.com/2020/10/sony-pictures-television-plans-u-s-tv-adaptation-of-italian-medical-drama-doc-1234597360/.

[251] Patrick Frater and Patrick Frater, "Sony Pictures Poised to Benefit as Independent Studio in Streaming Era, Tony Vinciquerra Claims," *Variety* (blog), May 28, 2021, https://variety.com/2021/biz/asia/sony-pictures-independent-studio-streaming-era-tony-vinciquerra-1234982927/.

[252] Tatiana Siegel and Tatiana Siegel, "Five Years Later, Who Really Hacked Sony?," *The Hollywood Reporter* (blog), November 25, 2019, https://www.hollywoodreporter.com/movies/movie-features/five-years-who-hacked-sony-1257591/.

[253] Anthony D'Alessandro and Anthony D'Alessandro, "Spider-Man Back In Action As Sony Agrees To Disney Co-Fi For New Movie, Return To MCU: How Spidey's Web Got Untangled," *Deadline* (blog), September 27, 2019, https://deadline.com/2019/09/sony-walt-disneys-marvel-team-on-third-spider-man-homecoming-title-with-superhero-to-appear-in-future-marvel-pics-1202746497/.

[254] I state this out of personal experience and more recent proxy confirmation. When I worked in 2010 for Sony Pictures Television International at their Culver City studio, things as simple and obvious as employee parking or freely roaming the studio could become painstakingly complicated when done 'by the book.' For parking, if assigned an undesirably far-away spot, one could file several forms and wait 3-4 weeks for a parking-garage transfer approval from facilities management, or one could get help/access to the preferred, half-empty parking garage from the overly friendly security guard. In the case of ambulating through the lot, most employees were barred from doing so without special permission to avoid intrusions or interruptions to projects in-production; however, one could ambulate most of the studio lot if signed in as a gawking tourist or as a visiting production consultant—even regular employees…

knowledge exclusive to the particular experts and managers, many times failing to share any of it with critical stakeholders. Not even the centralization of **collaborative space** for most operations at the storied Culver City studio has translated into a more harmonious and integrative functioning of Sony Pictures. Only hopeful or stubborn **knowledge brokers** tend to alleviate these shortcomings of the entertainment studio, such as Michael Lynton own brokering (as co-head of the studio during 2004-2017) between the parent corporation and the content, the platform, and the distribution departments of Sony Pictures, all thanks to his experience across tech and creative industries (including publishing, telecommunications, and film/entertainment); his executive brokering contributed to a steady string of successful 3D-animated movies, transnational film productions, and thriving television networks in different countries. [255]

One key item that has been squandered by Sony Pictures despite their global reach and presence has been **diversity**, for the studio has yet to overcome or outgrow its parent corporation's influence on that front, still considering **variety** and **difference** among their ranks as aspects to be respected to a fault (hence the clear divisions of duties and departments), and **disparity** as an uncontested virtue (favoring and prioritizing hierarchies and lines-of-command, as is the case of Sony's presidential successors, to a degree which resembles family-owned businesses or royal thrones[256]). Sony Pictures only started to erode the symbols and structures of such hierarchies in the past 10-15 years, in an attempt to foster innovation and collaboration

[255] Naman Ramachandran and Naman Ramachandran, "Sony Pictures Television Sets First Look Deal With Nigeria's EbonyLife Media For Scripted TV Projects," *Variety* (blog), February 4, 2021, https://variety.com/2021/tv/global/sony-pictures-television-first-look-deal-nigeria-ebonylife-mo-abudu-1234899559/.

[256] Unoki, "Sony's Movie Entertainment Empire"; Dheeman, Schildwachter, and Harrison, "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge."

among its ranks; for instance, the studio eliminated the executive dining room and the lot itself was completely rethought and redesigned as a creative campus rather than a factory)—unsurprisingly, most changes have happened under the helm of the first foreign President of Sony Corporation, Howard Stringer.[257]

At the **ecological** level, Sony Pictures has inherited some of the inclusive considerations of its **stakeholders** championed by its parent corporation, although it hasn't gone as far. In its founding documents, the Sony Corporation pledged allegiance and duties towards its engineering employees (and their creative freedom), towards the rebuilding of its home country (post-WW2 Japan), towards common consumers/households, towards partner universities and research institutions, towards the advancement of technology, and towards science education and the general public.[258] In contrast, Sony Pictures has expressed and manifested concern for its employees, its contributing artists (e.g. contract filmmakers), its industry partners, and its customers; little attention (at least explicitly or evident) has been given to 'the public good' and patriotically-minded interests in the same way the Sony Corporation did, even when the federal U.S. government officials criticized and threatened to meddled with the merger in the name of national security against foreign cultural control.[259]

In the end, the more Sony Pictures has approximated a holistic performance of Transdisciplinary Intelligence in its history, the more it has overcome its early stumbles and endemic follies, as it did exemplarily during its heyday in 2005-2012. Today, however, Sony

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[257] Unoki, "Sony's Movie Entertainment Empire."

[258] Unoki.

[259] Unoki.

Pictures has receded equally in its TDI manifestations as it goes along with its parent corporation's attempts for a "One Sony" policy that aims to reduce their activities to three-pillars.[260] The approach has benefitted certain business units while affecting its overall industry/market standing, as it struggles to stand out among competing creative behemoths, such as Disney and Netflix,[261] and it chooses to divest from departments and projects that provided impact and leverage not long ago, such as its stake in MGM[262] and some its international TV networks.[263]

While being near-contemporaries and sharing a few similar key developments, the trajectory of Pixar Animation Studios has been much more upbeat, upward, and reliably steady[264] than that of Sony Pictures—as much as any of Pixar's award-winning animated movie plots. First, instead of originating from a merger or acquisition, Pixar began as a department within LucasArts/LucasFilm, the company responsible for groundbreaking visual and sound special effects in blockbusters movies (such as *Star Wars*) throughout the 1980s—out of which Pixar was spun-off in 1986 as its own start-up company focused equally on developing computing hardware/software as it was on animation.[265] The latter point would become part of

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[260] Dheeman, Schildwachter, and Harrison, "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge."

[261] Patrick Brzeski and Patrick Brzeski, "Sony Pictures Not for Sale, Says CEO Yoshida Kenichiro," *The Hollywood Reporter* (blog), May 27, 2021, https://www.hollywoodreporter.com/business/business-news/sony-pictures-not-for-sale-1234960009/.

[262] Erik Hayden and Erik Hayden, "MGM Sold to Amazon for $8.45 Billion in Blockbuster Deal," *The Hollywood Reporter* (blog), May 26, 2021, https://www.hollywoodreporter.com/business/business-news/mgm-sold-to-amazon-deal-4075596/.

[263] Manori Ravindran and Manori Ravindran, "Sony Pictures Television U.K. Channels Sold to U.S. Investment Firm Narrative Capital (EXCLUSIVE)," *Variety* (blog), May 14, 2021, https://variety.com/2021/tv/global/sony-channels-uk-sold-narrative-1234972645/.

[264] At least since 1995 and their first box-office hit, after its first ten years of fledgling as a start-up.

[265] Catmull and Wallace, *Creativity, Inc.* Loc. 97-128.

the **hybrid,** intellectual DNA of the company, since then influenced by Engineering, Design, and Art, first imprinted by its founders, original team, and key champion, and later intrinsically manifested by the company's **culture.** The original team included a trove of computer engineers and burgeoning animators, a collage exemplified by founders Alvy Ray Smith[266] (computer scientist and original VP), Ed Catmull (computer engineer, aspiring Disney-like animator, and original CEO), and John Lasseter (animator-filmmaker, original team member, and eventual Chief Creative Officer); the start-up's team would be rounded out with the Entrepreneurship and Design sensibilities brought on by funder (and 1990s CEO) Steve Jobs (of Apple, NeXT, and Silicon Valley fame/infamy).[267] The Engineering-Art-Design trifecta would become the signature core of the Pixar culture, strong enough to resist even its acquisition by Disney in the 2000s.[268]

The **organizational** level of Pixar's transdisciplinary intelligence has been built upon that trifecta as well, sublimated in a group creativity system commonly called the 'Pixar Braintrust'[269] (which plenty of social psychology and business management researchers[270] have tried to dissect and distill as a template for successful **processes, policies and procedures** at a company). At the center of the system and the culture stand a single **shared value** and **aligned goal**—to tell good stories through ever-improving computer animation. That was the mission

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[266] Who quit shortly after the spinoff because of a heated argument with Steve Jobs, and was subsequently mostly 'erased' from Pixar's official history.

[267] Catmull and Wallace, *Creativity, Inc.* Loc. 128.

[268] Wise, "Creativity And Culture At Pixar And Disney: A Comparison."

[269] Catmull and Wallace, *Creativity, Inc.* Loc. 1370-1700.

[270] Christina Gudaitis, "The Ongoing Battle of Cultures Between Pixar and Disney Animation Studio: How Business Culture Affected the Success of Both Studios," *Augsburg Honors Review* 8, no. 1 (2015): 13.

behind Pixar's first hit, *Toy Story*, the first-ever computer-animated feature film, and every movie they have made since then.[271] This near-perfect alignment of goals and values (at least of group members who remain at the company long-term) has at the same time fostered a harmonious system encompassing a prime **learning disposition,** plenty of **leadership opportunities,** open communication, fluid **knowledge management**, and more-than-adequate leadership & collaboration styles**.** All of these are best explained by describing Pixar's approach to making films. First, any and all film projects entail both deep research into the subject and learning from feedback from the 'Braintrust' and the entire staff.[272] In an instance of the former, animators of *Toy Story* famously nailed their shoes to wood planks and walked with them to learn how the walk of the movie's green toy soldiers would have to be animated; in another instance, the director of *Ratatouille* apprenticed at an elite French restaurant to be faithful to the kitchen layout and cooking experience depicted in the film.[273] As an example mutual learning, Pixar's creative teams hold 'story meetings' in which anyone can participate, providing feedback and suggesting improvements; the more experienced members of the team are charged with **mentoring** the storytelling (and other) efforts of colleagues as the latter take lead in short films of their own,[274] while all team members are encouraged to serve as **brokers** of critical knowledge for the success of the team and the stories being told. In a couple of examples of the latter, folk-tale stories *Coco* and *Brave* (based on Mexican and Scottish lore, respectively) both

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[271] Catmull and Wallace, *Creativity, Inc.* Loc. 135, 183-200.

[272] Catmull and Wallace. Loc. 851, 1440-1460.

[273] Price, *The Pixar Touch*.

[274] Catmull and Wallace, *Creativity, Inc.* Loc. 1934.

had cultural details corrected in the final versions thanks to the input from knowledgeable Pixar colleagues who weren't working directly on the projects (which also highlighted how much of an asset their collective **diversity** could be[275]). These examples also evidence Pixar's signature **communication** & **collaboration styles**: dynamic, horizontal, open, and constructive. As for **leadership style**, it has been one focused on facilitating the 'creative genius' of both individuals and the collective, while acting as stewards of the essence of the projects, the company culture, and its storytelling mission. This style has fostered a level of **trust** among the group and towards the leadership based on care and character as much as on expertise/competence.[276] The overall openness and consistent leadership style of Pixar has been no small feat of the organization, considering Steve Jobs's early influence and his notorious penchant for dictatorial, bullying-based leadership.[277] The system and the culture that has generated it work thanks to two additional factors: a collective **time consideration** which recognizes that creativity cannot be rushed (a 'fast' Pixar project takes at least five years to develop and release, as compared to the typical 2 year film production[278]), and a centralized **space** (Pixar's Emeryville campus) which has been designed for serendipitous encounters and open collaboration, full of communal spaces, leisure opportunities (for instance, sports and hobbies), and locations for focused work.[279]

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[275] Catmull and Wallace. Loc. 180-183, 1468-1481.

[276] Trust which John Lasseter notoriously abused and for which he was ousted from the company in 2017. (Rebecca Keegan, "Reanimating Pixar: How Pete Docter Steered the Studio Out of Scandal," *The Hollywood Reporter* [blog], January 6, 2021, https://www.hollywoodreporter.com/movies/movie-news/reanimating-pixar-how-pete-docter-steered-the-studio-out-of-scandal-4111715/.)

[277] Catmull and Wallace, *Creativity, Inc.* Loc. 912, 1740-1970.

[278] Wise, "Creativity And Culture At Pixar And Disney: A Comparison."

[279] "Life at Pixar," Pixar Animation Studios, accessed June 8, 2021, https://www.pixar.com/life-at-pixar; Catmull and Wallace, *Creativity, Inc.* Loc. 1264.

Blockbuster successes and awards won aside, Pixar's **ecological** level of TDI has been narrower than comparable film studios. In its case, the **stakeholders** for which Pixar has explicitly concerned itself have been its employees/team members (or more accurately, their creative output), its potential partners/clients for the computing technology, and their funders (Steve Jobs at first, Disney as parent company later on, and general shareholders in-between). Pixar has thus been unequivocally a pioneer in the creative industries with plenty of global cultural impact through its movies—albeit an impact nonetheless reserved for its niche of family-oriented animated feature films.[280]

After analyzing both histories, perhaps the best way to summarily compare Sony Pictures and Pixar begins by enumerating their hidden similarities: both studios have been intrinsically affected by technological developments, as much as all the major film studios historically have been, but much more explicitly so (more than most scholars and some insiders may acknowledge about the film/entertainment industry beyond major flashpoints, such as the introduction of synchronized sound, color film, and the advent of television[281]); both studios have had key personnel/figures who were Engineering-based hybrids (Lynton at Sony Pictures, Catmull at Pixar); and both studios have had to leverage their transdisciplinary intelligence and reinvent their value propositions according to the times. The critical difference between the two has been a contrast of scopes: whereas Sony Pictures has behaved always as entertainment conglomerate

[280] In other words, while Pixar films have become well entrenched in the global zeitgeist, they've always been far from signifying or igniting a socio-cultural revolution; for instance, *Coco* did little to influence government or public opinion about Hispanic immigrants in the U.S. at a historical point in which such debates were happening—except to offer a semi-authentic look at Mexican culture beyond race biases…

[281] Kirsner, *Inventing the Movies*.

with various stakeholders and business interests, Pixar has been fiercely specialized in 'creative computing' only. The two companies, therefore, complementarily exemplify not only how the organizational TDI derives from individual/intrapersonal and collectives interrelations of transdisciplinary intelligence, but also how ecological level of TDI can determine the adaptability and the outcomes of the organization (for which the case of Sony Pictures presents the strongest evidence), especially when the industry and the world in which an organization exists may not fully match the ecological consideration it holds to be true.

3.3 Educational: Universidad de Guadalajara vs. UT-Dallas

The comparative history between the Universidad de Guadalajara (UdG) in Mexico and the University of Texas at Dallas (UT-Dallas) is based upon equally on existing academic research,[282] historical archives,[283] primary sources consulted in my making of documentary

[282] Adrian Acosta, "Departamentalización y contexto organizacional: la experiencia de la Universidad de Guadalajara" 7, no. 1 (2005): 18; José María Kazuhiro Kobayashi et al., *La educación en la historia de México*, 1st ed. (El Colegio de México, 1992), https://doi.org/10.2307/j.ctv5137rb; Ramón Moreno Rodríguez, "Sobre Juan Real Ledezma, Universidad de Guadalajara, 'síntesis histórica,'" *Historia Mexicana* 71, no. 4 (April 1, 2022), https://doi.org/10.24201/hm.v71i4.4097; Cristina Cárdenas Castillo, "Progreso y Mentalidades En Conflicto. Un Nuevo Acercamiento a La Desaparición Del Instituto de Ciencias Del Estado de Jalisco (1883)," in *Episodios de La Universidad de Guadalajara: Perspectivas Diversas. Guadalajara* (Universidad de Guadalajara, 2009); Cristina Cárdenas Castillo, "Universidad, representaciones sociales e identidad regional en Guadalajara durante el siglo XIX," n.d., 12; María Luisa Chavoya Peña, *Episodios de La Universidad de Guadalajara: Perspectivas Diversas* (Guadalajara, MEXICO: Universidad de Guadalajara, 2009), http://ebookcentral.proquest.com/lib/utd/detail.action?docID=3193921; Carlos Manuel García González, *La descentralización de la Universidad de Guadalajara: diez años después*-- (Universidad de Guadalajara, 2004); Luis M. Rivera, *Documentos fundatorios de la Universidad de Guadalajara* (Gobierno del Estado de Jalisco, Secretaría General de Gobierno, Unidad Editorial, 1989); Angélica Peregrina, "La desaparición del Instituto de Ciencias de Jalisco (1883)," 1883, 20.

[283] Alfred T. Mitchell, "Al's Short History - UT Dallas Chronology," *Special Collections at UT-Dallas*, October 16, 2014, https://utd-ir.tdl.org/handle/10735.1/4119; "UT Dallas Chronology. | Special Collections Archives," accessed March 8, 2021, https://libarchives.utdallas.edu/repositories/5/archival_objects/34088; Alfred T. Mitchell, "UT Dallas Chronology, 1960-1989 (Abbreviated)," October 16, 2014, https://utd-ir.tdl.org/handle/10735.1/4118; "Collection: The University of Texas at Dallas Oral History Collection | Special Collections Archives," accessed March 8, 2021, https://libarchives.utdallas.edu/repositories/5/resources/368; "Narrative - Creating the Future Since 1969 - The University of Texas at Dallas," accessed March 8, 2021, https://www.utdallas.edu/create/narrative.html.

films,[284] and personal knowledge derived from family lore and first-hand accounts from people who lived through the events. The history of the UdG spans for more than a hundred years, going back to the late 1800s, while the history of UT-Dallas has barely passed the 50th-year mark—and this difference in age is intended to demonstrate similarities between the two that are 'timeless' as much as it should highlight differentiations due to their historical circumstances.

The first historical circumstance to consider seeded and preceded the formal creation of the UdG—the liberal vs. conservative sociopolitical (and at times military) conflicts of late 19th-century and early 20th-century Mexico. Prior to its establishment in the 1930s, the UdG existed on-and-off as two competing 'personalities'—on one hand, a conservative-learning university, focused on classical disciplines such as theology and liberal arts, and closely connected to the Church, old aristocracy, and conservative militants; on the other hand, a liberal-leaning secular institute, focused on up-and-coming disciplines such as law, medicine, and technical sciences, and deeply involved with the intellectual bourgeoise and the anti-colonial, Reformist militants. Depending on which political side controlled the local government of Jalisco (the home state), the conforming version of the state-sanctioned educational organization would be opened/approved, while the opposing version would be abolished/shut down, a dynamic which lasted until the 1920s.[285] During the 1930s, the schism became absolute and final: the conservatives established their own organization (the Universidad Autónoma de Guadalajara),

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[284] Alex Garcia Topete, *The Spirit of UTD: What's at the Core of Being a Comet?*, 2011, https://vimeo.com/23135124.

[285] Cárdenas Castillo, "Progreso y Mentalidades En Conflicto. Un Nuevo Acercamiento a La Desaparición Del Instituto de Ciencias Del Estado de Jalisco (1883)"; Peregrina, "La desaparición del Instituto de Ciencias de Jalisco (1883)."

while the liberal-leaning, explicitly socialist government of the state,[286] with the backing of the federal government, formally established the UdG by an act of the state legislature, which granted the 'new' organization functional autonomy from the state government (even when designated as a government entity), made it virtually tuition free,[287] gave it old facilities throughout the state capital of Guadalajara, and charged it with a mission of providing education and research that fostered progress, social justice, and the public good.[288] This latter mission has been since then its guiding principle for **aligning goals** and **sharing values** among its members and community partners.

The UdG's conflict-ridden past determined its **hybridity** composition, which relied heavily on Science, Engineering, Education, and some Humanities and Art (simply out of its departmental makeup and hires at the time). Incidentally, the conflicts and schism of the past also determined what could be considered an adverse imbalance of **diversity**: plenty of social **variety,** but very little ideological/sociopolitical **difference** or experiential/socioeconomic **disparity** range—in other words, the UdG became a focal point for middle-class and working-class students and faculty, while the elites attended private institutions elsewhere.

Between its establishment in the 1930s and its restructuring in the 1990s, the UdG had a steady and almost stereotypical **organizational** profile. Its **processes, policies, and procedures** have been as cumbersome as would be expected from a governmental entity, always dependent

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[286] Led by Governor Everardo Topete, former general and federal enforcer during the *Cristero* uprising (a Christian-extremist attempt to overthrow the secular government in 1920s Mexico to establish a theocracy, and which ended with many rebels sent to the firing squad), political powerbroker of the region, and my maternal great-grandfather (hence the shared surname).

[287] A feature of most public universities in Mexico to this day.

[288] Ulices Piña, "The Different Roads to Rebellion: Socialist Education and the Second Cristero Rebellion in Jalisco, 1934-1939," 2017, 28.

on bureaucracy. In turn, there prevailed an institutional parochialism that favored the status quo, rife with departmental silos/tribes, politicking, and intellectual stagnation. Most of these foibles were targeted in the overhaul of the university between 1989 and 1995.[289] The restructuring had implications first for the physical **spaces** occupied by the UdG, turning from an institution that leaned towards centralization (for instance, one main campus for research operations and instruction, with convenient satellites for student outreach), to a network of clusters built upon intellectual interests and design to foster interdepartmental collaboration and mirror the needs of the community (for instance, having the satellite campus with an agricultural focus closer to the agrarian outskirts of the city).[290] Yet, the restructuring also influenced the transdisciplinary intelligence of the organization in other aspects as well. Most prominently, the restructuring afforded a more dynamic and constructive **collaboration style** that has included more stakeholders beyond the boundaries of the organization. For instance, this renewed collaboration originated the establishment of the Guadalajara International Book Fair, the largest literary event in Latin America each year.[291] The re-structuring also affected the **time consideration** of the organization, carving seasonal cycles for its diverse stakeholders, within the grander, longer-term "public good" mission that can hardly be measured on a yearly basis.

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[289] Moreno Rodríguez, "Sobre Juan Real Ledezma, Universidad de Guadalajara, 'síntesis histórica.'"

[290] González, *La descentralización de la Universidad de Guadalajara*.

[291] Delin Guerra, "Guadalajara International Book Fair: The Largest Book Fair in the Spanish-Speaking World," in *American Libraries*, vol. 48 (American Libraries, American Library Association, 2017), 36–36, https://libproxy.utdallas.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=125343854&site=ehost-live; Jieyin Feng, "International Book Fairs as Intercultural Catalysts for Libraries and Publishers: Frankfurt, Guadalajara, Zimbabwe and Beyond," *Library Collections, Acquisitions, and Technical Services* 23, no. 1 (March 1, 1999): 104–6, https://doi.org/10.1016/S1464-9055(98)00108-0; Craig Bunch, "Art and Books at the Guadalajara International Book Fair," *The Art Book* 16, no. 3 (2009): 74–75, https://doi.org/10.1111/j.1467-8357.2009.01049.x.

At their core, some changes have sought to improve the **learning disposition** of the organization that had been lacking in its parochial past. Such changes have included **mentoring** programs for students and new research faculty, **brokering** systems intended to facilitate **knowledge management** among university departments and between the university and its community/partners, a stewardship and facilitating-minded **leadership style**, and overall improved means of **communication** to attend and respond to the explicit and implicit needs of Guadalajara, the state of Jalisco, and Mexico as a whole—so that the community will **trust** the UdG more as an organization that **cares** (it's already known as one of the most **competent** and reputable educational institutions in the country and beyond).[292]

In summary, all of these changes some thirty years later have transformed the UdG from a traditional, state-sponsored educational institution to an adaptive TDKP organization keenly aware of its **ecological** standing—positioned to serve not only its students and faculty, or just its state sponsors, or some nebulous "public good," but rather serve and positively impact all the **stakeholders** (e.g. community partners, private corporations, its surrounding society, the nation, the world) that exist between its organizational bounds and that desirable future of public good.

While UT-Dallas was not a direct manifestation of historical clashes and ideological crossfires like UdG has been, its history hasn't been completely free from political entanglements either even though it began as a private-sector endeavor. Envisioned as the 'MIT of the Southwest,' the organization that would become UT-Dallas started in the 1960s as the Graduate Research Center of the Southwest, a research and post-graduate education spinoff from

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[292] Acosta, "Departamentalización y contexto organizacional: la experiencia de la Universidad de Guadalajara."

Texas Instruments, a thriving electronics manufacturer based in Dallas.[293] The impetus for the research center (and still-present **goal** of the organization) was to attract Science and Engineering talent to the region, and thus support the technology endeavors of Texas Instruments. The organization was established with land, financial resources, and political influence of both Texas Instruments itself and its founders (an interrelationship that has shaped UT-Dallas since then), and was all donated/turned over to the University of Texas System in 1969 formally establish a degree-granting educational institution (after much debate and political quarrels within the state legislature regarding competition with other local universities).[294]

The original intent of the research center was complemented by the **intrapersonal/individual** influence of the founders to make the organization a prime exemplar of **hybridity**. Texas Instruments founders and UT-Dallas instigators Eugene McDermott, Cecil Greene, Erik Jonsson, and Lloyd V. Berkner (original head of the center) were not only Entrepreneurial men of Science and Engineering as the industries of their organizations would suggest—they (and their wives and families) were also deeply concerned throughout their lives with Education, Art, and Humanities, and the progress of their North Texas community. For example, McDermott and Greene gave great financial support to a variety of educational institutions (including MIT and UT Dallas), while Jonsson (who was adept at politics) used his influence and resources to improve the Dallas library system and eventually help establish an

[293] More on this in Section 3.4 ahead.

[294] Mitchell, "Al's Short History - UT Dallas Chronology."

Engineering school at UT Dallas that bears his name.[295] Eugene McDermott in particular, along with his wife Margaret,[296] became renowned art patrons and collectors who championed the value of exposure and appreciation of the arts for everyone.[297] The founders' broader curiosity about the world would imprint and manifest in the **culture** of UT Dallas as it evolved from a tiny research center to a full-fledge, tier-one research university with strong programs beyond Science and Engineering.

Berkner's influence, while not as celebrated, affected a key element that allowed UT Dallas to grow organically and adapt to its circumstances—its **leadership style** based on advanced strategic visions. Berkner was the first to realize the positional advantage that UT Dallas would have a young university, so leadership would have to focus on innovative (albeit unusual) approaches to old routines in order to create opportunities. It was such mindset, for instance, that prompted UT Dallas to be part of a wave of universities with novel 'environmental sciences' and 'geospatial sciences' departments in the 1970, a transdisciplinary move that not only attracted talented researchers and students but also government attention and funding.[298]

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[295] Caleb Pirtle, *Engineering the World: Stories from the First 75 Years of Texas Instruments* (Southern Methodist University Press, 2005). p. 222-232.

[296] "Early Influencers: Margaret McDermott Was The Dallas Changemaker," *D Magazine* (blog), accessed June 21, 2021, http://www.dmagazine.com/publications/d-ceo/2020/november/early-influencers-margaret-mcdermott-was-the-dallas-changemaker/.

[297]Mrs. McDermott, who I had the pleasure of knowing personally for the last ten years of her life and whose legacy I've proudly represented as a McDermott Scholar and McDermott Graduate Fellow, would say consistently that she learned her generosity and love for art with/from Eugene, and gave credit to him for every financial gift she ever made after his death in the early 1970s. (Margaret Milam McDermott, *Reflections* [Bright Sky Press, 2012].).

[298] Alfred T. Mitchell, "UT Dallas Chronology, 1969-1971 (Detailed)," October 16, 2014, https://utd-ir.tdl.org/handle/10735.1/4120.

Similarly, that same mindset manifested in the establishment in recent years of a joint program in art history that centers technology in a century-old discipline.[299]

These developments reveal the **organizational** transdisciplinary intelligence that has been characteristic of UT Dallas for its five decades of existence. First, an organization accustomed to hefty **processes, policies and procedures** because of its state-owned status (and quaintly controversial origin), meaning that any big change requires several layers of bureaucracy, from the local to the university-system-wide to the legislative (as was the case of establishing its engineering school, as previously mentioned). Second, an organization adept at **learning**, not because of its educational milieu, but because it has always been in a stage of growth, so it always has to learn in order to change and/or improve—going from a graduate-degree-only institution to one that included upper-level undergraduates, then going from that to a 4-year design, and most recently finding its identity as an almost-50,000-strong university with an emphasis in research that earned it Tier-One status.[300] Also as part of its learning disposition, it's been an organization concerned with the **mentoring** of young talent (students and researchers alike) and their active **knowledge management** focused on **brokering** cutting-edge knowledge in their North Texas community (particularly as related to science and technology). Third, the **collaboration style** has been mostly constructive even if labored at times due to the bureaucracy involved; thankfully, its newness has meant that hardly has leadership or group members taken a parochial approach since there's hardly any past habits/customs/practices to

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[299] "About The Edith O'Donnell Institute at UT Dallas," accessed June 21, 2021, https://arthistory.utdallas.edu/about/.

[300] "Milestone Reached: UT Dallas Qualifies for State's 'Tier One' Fund," News Center, accessed June 21, 2021, https://news.utdallas.edu/campus-community/milestone-reached-ut-dallas-qualifies-for-states-t/.

which to cling. For example, the establishment of the Arts, Technology and Emerging Communication (ATEC) program (and eventual school) was a pioneering step that universities with older and longer legacies struggle to take in spite of our technology-rich world.[301]

The university's youngness has afforded it as well fruitful TDI inclinations in some critical factors almost by happenstance. The **time considerations** of UT Dallas, as a young university, have the luxury of be purposely (and relatively) long-term, consisting of 10-year strategic plans.[302] In terms of **space**, with the generous land gift of the founders, its centralized campus has been allowed to develop and grow organically and with facilities that reflect and represent its TDI, ranging from amazing research labs to comfy living and work quarters for students and staff that foster collegiality and intellectual serendipity.[303] Moreover, UT Dallas has had the benefits of a global-grade **diversity** right on its campus, attracting since the 2000s top talent with a **variety** intellectual and ethno-cultural backgrounds, rich in **difference** of their approaches to education/research and life, and **disparate** in academic ranks and socioeconomic status thanks to the available funding and scholarships opportunities. Yet, in spite of such diversity, the collectively **shared value** of UT-Dallas has been remarkably simply: to leverage Science, Engineering, Education, Art, and Humanities (and more recently, Design and Entrepreneurship too) to find solutions to the problems of today when "creating the future."[304]

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[301] Garcia Topete, *The Spirit of UTD*.

[302] Mitchell, "UT Dallas Chronology, 1960-1989 (Abbreviated)."

[303] Pirtle, *Engineering the World*. p. 231-232.

[304] David Daniel, "Creating the Future: Annual Report 2011" (The University of Texas at Dallas, 2011), utdallas.edu/president/annualreport/2011.

The **ecological** TDI level of UT-Dallas perhaps seems as the least noteworthy, for it is common among higher education institutions. For instance, **trust** by members and outsiders of UT-Dallas has been grounded on its prestige/**competence** as much as its legally-binding charges of **caring** after the public good and requirements of good **character** which government entities carry along. This has been expressed both in its strategic partnerships with the City of Richardson and other community partners,[305] as well as its charter claiming "an imperative need…in the best interest of all the people of the State of Texas."[306] Derived from these, the relevant **stakeholders** for the university have been broadly inclusive for quite a while, ranging from its faculty, student, and championing supporters, to public and private/corporate partners (technically, how it all started), non-profits, the all-encompassing field of scientific and academic research, the Dallas community, and the global good.[307] If there has been any significant change regarding stakeholders, it has been that UT-Dallas has made such relationships increasingly networked and interrelated; for example, by establishing joint ventures that aim to promote business development and social-impact innovation in the area.[308]

At the end, the UdG and UT-Dallas reveal a couple of transdisciplinary intelligence truths. First, educational organizations are not spared from the complex TDKP demands of other industries, many times matching more the stereotype of isolated/insulated 'Ivory towers' rather

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[305] Dallas Innovates, "Richardson's Innovation Quarter — Aka The IQ — Is Making Big Moves as a Living Lab and Nerve Center » Dallas Innovates," *Dallas Innovates* (blog), June 1, 2021, https://dallasinnovates.com/richardsons-innovation-quarter-aka-the-iq-is-making-big-strides-as-a-living-laboratory-and-nerve-center/.

[306] "Texas House Bill No. 303: The University of Texas at Dallas," Pub. L. No. 303, 3 (1969).

[307] "University Marks 50th Anniversary of Signature Moment in Its History," News Center, accessed June 21, 2021, https://news.utdallas.edu/campus-community/50th-anniversary-bill-signing/.

[308] Innovates, "Richardson's Innovation Quarter — Aka The IQ — Is Making Big Moves as a Living Lab and Nerve Center » Dallas Innovates."

than their ideals of public-interest engines and changemakers. Second, any mission statement and goals idealized for greater socio-cultural impact of any educational institution are meaningless for the organization (and its stakeholders) without the learning disposition to figure out dynamically *how* to accomplish them collaboratively beyond institutionalisms and other detrimental assumptions—no matter the caliber of intellectual arsenal or the depth of resources at the disposition of the institution.

3.4 Technological: Bell Labs vs. Texas Instruments

The comparative history of Bell Labs and Texas Instruments is based on the thorough and definitive historical works of Jon Gertner for the former, [309] and Caleb Pirtle's for the latter,[310] both of which are rich with primary sources and historical contextualization. It's worth acknowledging, however, that Gertner does a better job at critiquing key figures and the Bell Labs organization as a whole than Pirtle, for the latter's work was conceived and published as a celebration of Texas Instruments for the occasion of their 50th anniversary. Laudatory inclinations notwithstanding, both works account for all the items in the Transdisciplinary Intelligence Inventory (TD2I)[311] in ways that illuminate the successes and failures of both technology pioneers.

Starting with the individual/**intrapersonal** level, the key figures at the conception and the pinnacles of each organization epitomized both a collection of **hybrids** and a **hybrid**

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[309] Jon Gertner, *The Idea Factory: Bell Labs and the Great Age of American Innovation* (Penguin, 2013).

[310] Pirtle, *Engineering the World*.

[311] TD2I items and their relative terms are denoted herein with bold typeface.

collective.[312] In the case of Bell Labs, the likes of Frank Jewett (physicist-engineer and first president of the lab), Mervin Kelly (original director), Harold Arnold (first head of basic & applied research), Jim Fisk (the leadership heir to Kelly), William Shockley (key scientist behind the lab's transistor breakthrough), and Claude Shannon (the 'father of information theory') all represented the meta-disciplinary expertise of the industrial lab that functioned as 'an institute of creative technology'[313] and that entailed merging Science and Engineering with an Entrepreneurship bend (given by their parent company, the monopoly American Telephone and Telegraph [AT&T]). At Bell Labs, scientists and engineers alike at the lab were paid 'for their imaginative abilities…where the very point of new ideas was to make them into new things.'[314] Yet, the interests and avocations of the members manifested their hybridity beyond the confines of Science and Engineering; for instance, Shannon was notorious for his interest in jazz,[315] juggling, and unicycles,[316] while Shockley routinely advised projects of the Department of Defense well outside his declared area of expertise in solid-state physics. While many of the members of Bell Labs were experts of their fields, they were hardly single-minded specialists.

Those in positions of leadership, such as Kelly, Arnold, and Fisk, gained respect and **trust** mostly because of their expertise rather than their care or their character (although Kelly and Fisk were exceptions to this rule). **Leadership**, formal or informal at Bell Labs, was a matter

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[312] Even though both groups lacked the desirable levels of heterogeneity that have been previously discussed, they were inevitable products of their times in which white heterogenous men were the only possible choice, missing out on the advantages of having women and Other(s) in their organizations.

[313] Gertner, *The Idea Factory*. Loc. 160.

[314] Gertner. Loc. 160.

[315] Gertner. Loc. 2102.

[316] Gertner. Loc. 2598.

of collegial recognition or parent-company designation, not of **character**, trust, or openly encouraged **leadership opportunities**. Simply put, leadership depended exclusively on official authority or prominent expertise, even when an individual showed lackluster leader qualities. In fact, Gertner points out that controversial figures, particularly "star" researchers like Shockley (who tried to take sole credit for the transistor[317]), caused reservations and friction in team projects due to the distrust they triggered in an otherwise collaborative environment.

In spite of frictions and low levels of trust, Bell Labs was known for its dynamic **collaboration style** that had no imposed regulations, its problem-driven **learning disposition**, and widely-open **communication**. The latter manifested as internal publications (for example, The Bell Laboratories Record[318]), a technical journal, public conferences and outsider visits,[319] and other socio-intellectual gatherings procured by both leadership and rank-and-file members.[320] **Knowledge management** consisted of meticulous codification and circulation, whether that of experiments (in the form of rigorous journals[321]) or thoughts about science and the future (in the form of memos and academic-style papers), which were all arranged into proper **processes, policies, and procedures**.[322] The dynamic spirit of collaboration was also manifested physically in the design of the labs, first in their New York City building, and then in

[317] Gertner. Loc. 1675-1794.

[318] Gertner. Loc. 1102.

[319] Gertner. Loc 779.

[320] Gertner. Loc. 763

[321] Gertner. Loc. 1009.

[322] Gertner. Loc. 2241.

their upgraded Murray Hill campus,[323] a **space** designed to make it impossible to walk the labs 'without encountering a number of acquaintances, problems, diversions, and ideas' amidst the very long corridors and offices assigned in a fashion that prevented team members and departmental colleagues from neighboring each other, thus expecting collaboration and breakthroughs by serendipity.[324] The organizational design fostered collaboration too by creating interdisciplinary groups that combined 'theoreticians and experimentalists' to pursue electronic technologies.[325] The success of these strategies can be confirmed in the person of Harry Nyquist, an unassuming electrical engineer whose main role in the lab was as informal **knowledge broker** and **mentoring** instigator of fellow members: those co-workers who routinely had breakfast or lunch with him comprised the list of most patent-holders among the distinguished lab's ranks, all whom recognized Nyquist's contribution as the person 'who got them thinking.'[326]

In further details of Bell Labs' **organizational** level of development, intellectual variety was fostered as an asset; however, recruitment of talent was based solely on expertise and experience, thus leaving out other considerations that could have enhanced the impact and **dimensions of diversity** for the organization. At times, the **differences** and **disparities** among lab members outweighed and disrupted the benefits of intellectual **variety**, as they did in the case of Shockley and his transistor's co-inventors Bardeen and Brattain, in which the former's abuses of his higher rank and self-centered attitudes towards research credit provoked conflict.

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[323] Gertner. Loc. 1339.

[324] Gertner. Loc. 1350

[325] Gertner. Loc. 1387.

[326] Gertner. Loc. 2380.

Leadership style at Bell Labs, beyond any particular individual, was one of facilitation[327] that allowed the new knowledge and collaboration to be freely pursued—even when leadership expressed commitment mostly to the profitability and market dominance goals of AT&T[328] rather than the advancement of Science and Engineering, a belief that most members of the lab held as the chief **shared value** that made them cohere as a team and was the basis for the organizational **culture**.[329] Luckily, the close relationship with AT&T also influence Bell Labs' **consideration of time**: long-term, searching to solve immediate technical problems in their telecommunications markets[330] while open to activities that eventually led to technological breakthroughs elsewhere, such as radio-telescopes for astronomy.[331]

In **ecological** terms, Bell Labs' **stakeholders** were quite clear and limited in numbers and scope. First and foremost, the main stakeholder was its parent AT&T, whose **goal alignment** was the measure for all successes and potential failures of the lab's endeavors; after all, AT&T paid all the bills and kept the stream of money flowing to the lab. The second stakeholder was the federal U.S. government, which posed an anti-trust threat for AT&T if it (and the lab) failed to live up to their promise that their monopolistic approach to telecommunications led to improvements in it. While Bell Labs was regarded as a paragon of corporate scientific research and cradle of cultural impact through their technologies, the knowledge spillover responsible for such goodwill and pristine reputation were an 'incidental dividend of their work' at the service of

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[327] Gertner. Loc. 1794.

[328] Gertner. Loc. 526.

[329] Gertner. Loc. 1068.

[330] Gertner. Loc. 2710.

[331] Gertner. Loc. 1868

AT&T.[332] Such insistence eventually led not only to AT&T's troubles with the federal government that eroded its **resilience**, but also to the lab missing out on the next biggest breakthrough after the transistor, one that was hatched at their lab and showed off to the world as scientific breakthroughs. but abandoned due to a lack of vision—the semiconductor microchip, which was inspired by a visit to Bell Labs of a young researcher named Jack Kilby,[333] who would then ignite the digital revolution of the world with the groundbreaking invention as a member of Texas Instruments.

The capacity for Texas Instruments to originate and exploit that invention of the semiconductor microchip must be understood as the culmination and result of their organizational and ecological transdisciplinary intelligence. From the establishment of Texas Instruments, the **individual/intrapersonal** TDI of its founders set the tone for the decades to come, the successes it would accomplish, and the various near-catastrophes it dodged as a corporation. All of the protagonist Texas Instruments founders (Eugene McDermott, Cecil Greene, Erik Jonsson, Pat Haggerty) manifested **hybridity**, pursuing not only the Science, Engineering, and Entrepreneurship endemic to the company,[334] but also showing deep interest and meaningful participation (in conjunction with their exemplary wives and eventual families) in Arts, Humanities, and Education throughout their entire lives.[335] For instance, Jonsson, the most entrepreneurial of the founders, became mayor of Dallas and promoted an ambitious

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[332] Gertner. Loc. 794.

[333] Gertner. Loc. 4363-4560.

[334] Pirtle, *Engineering the World*. p. 2-15.

[335] Pirtle. p. 222-229.

expansion of its library system; on their part, McDermott & Greene were avid supporters of schools and colleges across the US and abroad, while Eugene (along with his wife Margaret) not only financially supported art institutions and museums but also built an impressive collection of art for their own enjoyment. The most iconic example of the founders' hybridity, of course, manifested in their establishment of the University of Texas at Dallas (covered in detail in Section 3.3). The founders hybridity also influenced their and Texas Instruments' **learning orientation**, aimed at continuous improvement, following curiosity, and learning constantly from one's surroundings; such philosophy can be summarized by McDermott's personal quote 'learning begins by looking at the world,'[336] and is exemplified in Texas Instruments' programs promoting science and math education.[337] Similarly, the whole **leadership style** of and **leadership opportunities** within Texas Instruments have echoed those of the founders: leaders focused on facilitating the work and expertise (not to say genius) of others,[338] while also willing to delegate and/or rotate leader responsibilities according to context, such as when the Jonsson and McDermott exchanged management and board positions of the company among themselves (and others) according to their own personal strengths for the roles and for facing challenging circumstances amidst war crises or business opportunities.[339]

The biggest imprint of the founders upon the organization, ultimately, can be found in the explicit and uniform **culture** of Texas Instruments—one concerned with **trust**, community

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[336] Margaret McDermott, *'Reflections'* (Bright Sky Press, 2012), https://www.pentagram.com/work/reflections.

[337] Pirtle, *Engineering the World*. p. 217-219, 238-240.

[338] Pirtle. p. 189-203.

[339] Pirtle. p. 22-30.

(inside and outside the organization), and what could be called a 'certain harmony.' For instance, Texas Instruments fosters trust with actions more than with words: TI leaders have fostered trust among its employees with pioneering profit-sharing programs when the company went public,[340] and they have fostered trust by caring for and tending to their community's needs and various stakeholders through service programs and funding of non-profit organizations.[341] The 'certain harmony' that has concerned Texas Instruments, on the other hand, refers to intentionally **aligning their goals** and **sharing values** with their employees, partners, and all kinds of **stakeholders** (at times even competitors, such as when Texas Instruments has pushed for investments and reforms that would benefit all tech companies in North Texas).[342] Sometimes, the focus on aligning goals and sharing values has backfired for Texas Instruments on the business side, such as their competition with Japanese manufacturers in 1980s,[343] or some missed opportunities in mergers and expansions (including one with Xerox).[344] Moreover, part of that 'certain harmony' has entailed supporting and leveraging diversity in all of its dimensions as an asset; intellectual variety has certainly lead to breakthroughs and successes, but it has been all the other types of **variety, difference**, and **disparity** that have allowed Texas Instruments to be keenly aware of and responsive to its communities, stakeholders, market shifts, and socio-cultural influences. For example, the Texas Instruments had women as part of its middle

[340] Pirtle. p. 190-192.

[341] Pirtle. p. 233-237.

[342] Pirtle. p. 246-255.

[343] Pirtle. p. 111-113.

[344] Pirtle. p. 116-122.

management team since 1948, and the organization has led diversity initiatives concerned with gender, ethnic minorities, and people with disabilities since the 1990s.[345]

Texas Instruments, as the corporation that it is, does have its burdens to balance at the organizational level in addition to all of its TDI virtues. For instance, the **processes, policies, and procedures** have had a level of complication normal to companies of the size of Texas Instruments, for most activities need to be formalized, accounted for, and reported for one reason or another, ranging from management rules and HR regulations to proper accounting practices and auditable paperwork. These processes, policies, and procedures cause friction in several areas of interest for TDI: the **collaboration style** can become stuck between the rigidity of formality imposed by paperwork, and the fruitless inoperability of casual cooperation that avoids any bureaucratic interventions; **communication** becomes too regulated and stiff, never reaching the more desirable openness and constructiveness of free dialogue; and **knowledge management** becomes so routinely systematic that no new insights can be found without something or someone disrupting said systems, such as **brokers** facilitating knowledge exchanges informally or **mentoring** that has to go beyond the established programs in order to be transformational.[346] Additionally, both the collaborative **space** and the **time considerations** of Texas Instruments suffer under its organizational constraints—the former remains fragments by departments and geographically distributed even when its tries to concentrate in collaborative headquarter

[345] Pirtle. p. 208-210.

[346] Pirtle. p. 211-219.

facilities across the globe, while the latter gets dictated by limited-term strategic plans and quarterly financial reports.

The **ecological** TDI level of Texas Instruments may be the most illustrative among all the exemplars herein, for it has manifested in ways and magnitudes uncharacteristic of private, for-profit corporations. Particularly, as previously mentioned, Texas Instruments has manifested a remarkable capacity and willingness to include as many **stakeholders** as possible in its external actions and decision-making, even would-be competitors with which Texas Instruments has allied in the past for the sake of research.[347] This capability has been most apparent in the company's lobbying efforts and change initiatives, such as when it leveraged its community connections and its investment powers to persuade Texas legislators to enact the establishment of the UT-Dallas school of engineering in the 1980s-1990s (a change that would benefit Texas Instruments and their local tech competitors alike with the supply of brilliant engineering graduates),[348] or when the Texas Instruments Foundation has spearheaded educational initiatives throughout Dallas for underserved communities.[349]

In the end, the impact value of TDI differed between Bell Labs and Texas Instruments on ecological terms. Both organizations had very similar TDI compositions and inclinations[350] at their individual/intrapersonal and interrelated/organizational levels, yet they had divergent evolutions in spite of their similarities and comparable technological breakthroughs: whereas

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[347] Pirtle. p. 246-248.

[348] Mitchell, "UT Dallas Chronology, 1960-1989 (Abbreviated)."

[349] Pirtle, *Engineering the World*. p. 227-229.

[350] As scored by the TD2I instrument and explored further in Section 3.5 herein.

Bell Labs declined after 50 years and receded from th0e limelight starting in the mid-1980s (after AT&T's monopoly was intentionally broken up and Bell Labs itself became a commoditized venture that has belonged to several corporations since then[351]), Texas Instruments has continued to adapt resiliently, thrive, and remain among the global tech elite well past the 50-year mark. The difference can be explained by their respective ecological TDI—Bell Labs' was limited and indifferent to anything beyond AT&T's monopoly; Texas Instruments' has been relentlessly mindful and considerate of their environment and circumstances (business and otherwise), making sure that its decisions and actions not only give the organization a competitive advantage but also that those be the right thing to do for as many stakeholders as possible. As one of its prominent CEOs, Jerry Junkins, stated in the 1990s edition of the official *Ethics in the Business of TI* booklet: "If it comes down to a choice between a desired profit and doing it right…we'll do it right."[352] In the end, Bell Labs, in its monopolistic bubble, failed to notice that it wasn't the lone titan of industrial research anymore, while Texas Instruments continues to reinvent its role in industry and in society. This contrast between the exemplars proves that the impact and outcomes beyond one's own expertise/industry stand out as the most accurate measurement for success of transdisciplinary knowledge production, regardless of the size, longevity, or ecosystem of the group/organization involved.

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[351] "The Reincarnation of Bell Labs," Fortune, accessed June 21, 2021, https://fortune.com/2015/02/02/bell-labs-real-estate-revival/.

[352] Pirtle, *Engineering the World*. p. 214-216.

3.5 Transdisciplinary Intelligence in Historical Perspective(s)

Beyond these reconsidered histories of exemplary organizations from a transdisciplinary lens guided by the items of the Transdisciplinary Intelligence Inventory (TD2I), the subsequent scoring of the inventory for each of these cases accomplishes two goals. First, it validates the instrument by illustrating how it helps in identifying and enumerating key, multi-level factors of transdisciplinary intelligence. Second, the scores highlight and uncover further insights regarding both the interrelationships among the different items and levels, and their implications for success and failure of TDKP efforts. The method I used here was simple: I filled out a TD2I answer sheet for each organization based on facts and statements from their respective sources, and computed the scores of each of the 20 inventory items accordingly, as well as the SiTDIQ, OrgTDIQ, and EcoTDIQ. I had to do two adjustments given the historical-account use of the inventory: I omitted Resilience, Character, Language, and Leadership opportunities from the scoring since there were insufficient references in the sources to answer the items (only 2 out of the 6 exemplars had clear allusions to any single one of these); and I used the profiles/comments about the founders/key personnel exclusively to account for the individual/intrapersonal section of the inventory (as I did in the narrative). The scores are presented in Table 3.

The first insight relates to the positive connection of founders/key personnel hybridity and the Organizational Transdisciplinary Intelligence Quotient later on. Hybrid leaders seem to instill a TDI culture (explicit or implicit) that outlasts their tenure; in contrast, organizations with a considerable level of TDI potential stumble more and for longer (when compared to lesser-potential ones) when led by leaders lacking hybridity (as has been the case of Sony Picture's sub-

optimal eras). This capacity for founder influence concurs with existing management research regarding the entrepreneurial ramifications for companies/firms of their founders' profiles.[353]

The second insight pertains to throughput between organizational capacity for TDI and its ecological-level impact—a collective's/organization's high TDKP prowess can have a muted outcomes without the ecological transdisciplinary intelligence to match it and translate it into impact for their circumstances. Additionally, the reverse is also true, for an ambitious ecological take of TDI remains a mirage without the collective/organizational prowess to instigate it. In the case of Pixar, no matter how competent in TDI it is organizationally, its limited scope of stakeholders constrains the (potential) impact of its productions. In the case of universities, their grand missions for progress and social good stand as mere lip (or ink) service until they manifest TDI at the organizational level.

Finally, Processes, Policies & Procedures (PPP) may be the easiest factor to redesign (an attractive feature when trying to tilt an organization towards TDI); yet it may also be the least relevant or least troublesome to counter-compensate through strength in other TD2I items, since combinations of Trust, Communication, and Knowledge Management (not to mention Resilience) can easily assuage the bad effects of bureaucracy overloads. In contrast, Learning Disposition may be the cornerstone or fulcrum upon which the rest of transdisciplinary intelligence hinges in balance, since an appropriate learning disposition yields positive impacts

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[353] Daniel W. Elfenbein, Barton H. Hamilton, and Todd R. Zenger, "The Small Firm Effect and the Entrepreneurial Spawning of Scientists and Engineers," *Management Science* 56, no. 4 (2010): 659–81; Tiona Zuzul and Mary Tripsas, "Start-up Inertia versus Flexibility: The Role of Founder Identity in a Nascent Industry," *Administrative Science Quarterly*, April 17, 2019, 000183921984348, https://doi.org/10.1177/0001839219843486; Tyler Wry, Michael Lounsbury, and Mary Ann Glynn, "Legitimating Nascent Collective Identities: Coordinating Cultural Entrepreneurship," *Organization Science* 22, no. 2 (April 2011): 449–63, https://doi.org/10.1287/orsc.1100.0613.

and self-corrections for matters of Resilience, Mentoring, Knowledge Management, Leadership Style, Collaboration Style, Communication, and Stakeholder relationships. While all exemplars, regardless of success, scored consistently poorly in PPP throughout their histories, (mentions of) improvements in Learning Disposition seemed to have cascade positive effects for the rest of the inventory items—both anecdotally in their narratives and quantitively in their scores (at times prompting erasures and corrections in the answer sheets themselves). Ultimately, learning stands at the core of transdisciplinary intelligence.

Table 4: Transdisciplinary Intelligence Inventory Scores of Historical Exemplars

TD2I Item	Sony	Pixar	UdG	UTD	Bell	TxIn
Resilience	NA	NA	NA	NA	NA	NA
Learning Disposition	1.64	4.09	1.80	3.83	1.80	3.83
Leadership Opportunities	NA	NA	NA	NA	NA	NA
Mentoring	2.00	5.00	1.00	1.00	5.00	3.00
Knowledge Brokers	3.00	5.00	4.00	4.00	4.00	4.00
Dimensions of Diversity	2.42	4.76	2.42	2.52	3.80	4.05
Goal Alignment	1.60	4.44	1.67	4.44	3.00	2.67
Stakeholders	1.00	1.96	4.62	4.62	2.57	4.62
Space considerations	2.40	2.40	5.00	5.00	2.40	2.86
Knowledge management	2.40	3.75	3.43	3.00	3.43	3.43
Trust & Respect	1.45	3.89	2.21	2.40	2.27	3.89
Shared Language	NA	NA	NA	NA	NA	NA
Character Strengths	NA	NA	NA	NA	NA	NA
Collaboration Styles	3.27	4.62	2.40	3.27	4.62	3.27
Processes, policies & procedures	2.40	3.43	2.40	2.40	2.40	2.40
Time considerations	2.40	3.00	3.00	3.00	3.75	2.40
Culture	3.00	5.00	3.00	3.00	4.00	4.00
Shared Values	1.33	3.75	1.67	4.44	2.86	3.43
Leadership Styles	3.00	3.75	3.00	3.00	3.00	5.00
Communication	1.55	4.71	3.43	4.44	3.43	3.69
SiTDIQ	1.44	4.50	2.00	3.83	2.54	4.19
OrgTDIQ	1.77	4.24	2.11	2.78	2.95	3.44
EcoTDIQ	1.97	2.70	3.89	3.89	2.72	3.44

CHAPTER 4

UNFOLDING TRANSDISCIPLINARITY: PROJECT HERMES

4.1 Origin

The inspiration for Project HERMES emerged well before I even applied to the doctoral program which this dissertation fulfills. Originally, the research project meant not only to do a comparative study of the film studios and the tech industry as two well-studied and acknowledged transdisciplinary ecosystems (which evolved into Chapter 3), but it also meant in a way to extend the work of my master's capstone project about transdisciplinary exemplars.[354] The latter became unquestionably part of the scope of my doctoral pursuits because the more I delved into transdisciplinarity, knowledge production, and innovation case studies, the more similarities started to become apparent in different industries and professions, ultimately rarifying in the meta-disciplinary cultures and features of transdisciplinary knowledge production described in Chapter 2. Since all of this knowledge became apparent for me, doctoral studies would be the avenue to confirm and validate them as a novel expertise—expressed, captured, and scaffolded in the chapters of this dissertation.

The name of the project corresponds to an acronym: Highly Effective Research Merging Epistemic Systems. The acronym-based name, however, derives from both my experience as a radio journalist for National Public Radio in Washington D.C. in 2010 and my undergraduate years pursuing a political science minor. Thanks to both, I learned and confirmed that the clever

[354] Alex Garcia Topete et al., "SEAD Exemplars: Evidence of the Value of Transdisciplinary Projects" (SEAD Committee, December 2017), https://seadexemplars.org/wp-content/uploads/2018/01/SEADExemplarsReport-December-2017.pdf.

names and acronyms of congressional bills correlated (not to say predicted) the levels of public support and the chances of becoming law of said bills. For instance, bill titles that mention 'family,' 'child/ren,' or 'security,' or that have a recognizable one/two-word acronym (e.g., PATRIOT Act) are historically almost certain to become law; titles that are highly specific, descriptive, or 'wonky' (as in full of jargon) either get passed in what could be considered anonymity or just don't make it to a vote. I also learned that the same applies to federally-funded or state-sanctioned projects, which meant that the course of action was clear for my proposed doctoral research—to craft an academically-worded project title that would satisfy reviewers, but that, at the same time, could be retrofitted to an acronym that would convey succinctly the proper significance of the project to funders and other 'outsiders' who may need to support it in the future. Hermes, the Greek god of commerce, travel, thieves, and tricksters, thus became the title (and maybe even mascot) of a research project meant to study the transdisciplinary exchange of ideas, practices, and knowledge.

Aside from clever titling, IRB approval and certification (Appendix C) of the project were procured from its inception in accordance to university policies and standards of conduct of responsible human-subject research. The processes and results of the human-subject side of Project HERMES comprise the focus of this particular chapter.

4.2 Methodology

Given the complexity of transdisciplinary phenomena, a mixed-methods provided the most adaptable and comprehensive approach to grasp both the details and the bigger implications of transdisciplinarity and knowledge production within different industries and contexts. I used a multi-modal, multi-phase, mixed-methods research design that over the course of approximately

16 months. The design encompassed five phases of qualitative, quantitative, and practice-based data collection, with the second, third, and fourth phases overlapping and happening concurrently for a period of time.

The first phase (which originated Chapter 1 and Chapter 2) involved reviewing the existing literature covering transdisciplinarity and knowledge production from the perspective diverse-yet-complementary theories in the fields of cultural studies, philosophy, history, political economy, social psychology, cognitive science, sociology, and management science (among others) to understand why and how to perform transdisciplinarity as "the labor of diverse inquiries" and as a "practical system."[355] This phase produced the synthetized model of transdisciplinary intelligence that could be measurable, adaptable, and relevant across not only multiple domains of knowledge and sectors of industry and society, but also applicable retrospectively to historical exemplars.

The second phase (which originated Chapter 3) entailed the historiographic and archival research of primary and secondary sources regarding past and present settings of knowledge-producing industries and their respective discourses pertaining transdisciplinarity. This analysis of four exemplar organizations (N=4 selected by critical sampling) shed light on how much these organizations function as "*crossings"*[356] for and as validation cases for the TD2I in different fields of knowledge production and application thanks to their constitution, physical location, or

[355] Foucault, "History of Systems of Thought"; Foucault, *The Order of Things*; Foucault, "The Discourse on Language."

[356] Bruno Latour, *An Inquiry Into Modes of Existence* (Harvard University Press, 2013).

historical focus of interest. Simply put, these exemplars show how the symbiosis of knowledge and work manifests at the systems level.

The third phase entailed survey work investigating transdisciplinary teams in a variety of knowledge-producing industries and environments. The findings of three surveys (Appendix B) compare the TDI metrics of traditional disciplinary research versus transdisciplinary research in academic and industry settings. The first survey encompasses 40 questions that combine multi-choice and open-ended formats; it's designed to generate data that will be analyzed for actor-network mapping.[357] The second survey offers 42 Likert-scale questions in which sets of 7 questions are meant to measure the aptitude and biases of the respondent towards each of the seven disciplinary ways of knowing (the TDA & TDAQ previously described in Section 2.6) by adding points for agreement and subtracting points for disagreement with the statements. The third survey has 10 multiple-choice questions meant to score the level of knowhow and bias of the respondent regarding the terminology of the disciplinary ways of knowing (expressed as the TDK & TDKQ from Section 2.6). The pilot of this phase entailed a sample of convenience focusing on the personnel of the research centers and labs at the University of Texas at Dallas; eventually, the sampling expanded through "snowball sampling" to groups in other universities, media organizations, and tech companies, among others (N=30, approximately). Section 4.3 details the execution and results of this research phase.

The fourth phase delved deeper into the individual, subjective manifestation of transdisciplinary intelligence through the use of phenomenology according to the methodological

[357] Due to time and resource constraints, I had to discard this first third for the project herein; so it became part of the afterlife of this project.

framework proposed by Van Manen.[358] For this effect, I conducted intersubjective phenomenological interviews (Appendix D) with a diverse sub-group of co-investigators-participants (N=7), who were selected by maximum variation sampling from the pool of participants in phase three. The purpose of this phase has been to uncover the essence and structure of the transdisciplinary intelligence experience of individuals, within both themselves and their organizations. Section 4.4 expounds upon the theoretical framework, execution details, and interpretation of results of this phase.

The fifth and final phase involved a speculative element embedded within a practice-as-research design regarding a training program for cultivating transdisciplinary intelligence individually and collectively (which originated Chapter 5). As part of the future validation and measurement of the apprenticeship and simulation components of the training program, the survey instruments of phase three will be repurposed to measure the "before" and "after" performances learners.

Considering the mixed-methods design of this project, several issues and challenges had to be anticipated during its course of action. The first issue was self-reporting in surveys and interviews, such as inaccurate memories, contradictory answers, cognitive detachment, and social-desirability responses.[359] While that was an unavoidable limitation for the surveys in this project, the design of the questions already expects contradictory answers and detachment, so

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[358] Max Van Manen, "Practicing Phenomenological Writing," *Phenomenology+ Pedagogy* 2, no. 1 (1944): 36–69; Max Van Manen, "' Doing' Phenomenological Research and Writing: An Introduction," 1984; Max Van Manen, "Phenomenology of Practice," *Phenomenology & Practice* 1, no. 1 (October 28, 2007), https://doi.org/10.29173/pandpr19803.

[359] Lois R Harris and Gavin T L Brown, "Mixing Interview and Questionnaire Methods: Practical Problems in Aligning Data" 15, no. 1 (2010): 20.

they have been worded accordingly. In addition, scaffolding the other research methods purposefully counterbalanced the issue overall. The interviews, on their part, were meant to be phenomenological in nature and semi-structured in execution, which aims to mitigate the power differential between interviewer and interviewee (a flaw often critiqued by feminist researchers[360]), and not only acknowledge but also build upon the subjectivity of both the interviewer and interviewee to consider them as peers in the collaborative generation and collection of the data. Another problem was recruiting a significant population of participants from a broad-enough range of academic departments, industries, and organizational types. Using a resource learned from previous research efforts, most participants in this project tended to be incentivized by the prospect of having a report regarding their individual and team TDI scores—particularly for participants in industry or simply outside the boundaries of UT-Dallas. Another issue was the geographic dispersion of participants, which means both doing research beyond a single territory and managing the challenges of cultural variances among different regions. Finally, there was also the issue of potential, unintentional tokenism of women and/or ethnic minorities when sampling, which was intentionally avoided in favor of true inclusivity and diversity according to feminist and anti-colonial research standards, such acknowledging their positionality and prioritizing their recruitment as participants (especially in phase 4).

[360] Denise Leckenby and Sharlene Nagy Hesse-Biber, "Feminist Approaches to Mixed-Methods Research," in *Feminist Research Practice: A Primer*, ed. Sharlene Nagy Hesse-Biber and Patricia Lina Leavy, 2007, 249–91.

4.3 Quantitative Methods

The survey instruments of the quantitative phase of Project HERMES were adapted for transdisciplinary subject matters from Hofstede's seminal cross-cultural analysis work in the transnational business management domain;[361] they were adapted first in terms of how to craft the questions and design the survey with language and a progression that preserve fidelity and honesty from the respondents (and therefore the accuracy of the instrument), and second in terms of the known principles and criticisms established by Hofstede's framework.[362] For example, the Likert-scale questions were worded with neutral language that obfuscated which meta-discipline they measure in order to avoid self-reporting biases.

Beyond the design, the collection of respondent's data was the next challenge to overcome. For two years, during which the project focused on a UT-Dallas-exclusive respondent pool, the response rate did not match the expected returns; however, once the project was IRB-authorized to extend beyond the confines of the university for the last six months of the project, the collection of data reached its validation goals. By the time collection closed in February of 2021, there were 55 full responses from a population of approximately 500 potential respondents, which means that the results have a ±10% margin of error for an instrument with an 85% confidence level. Out of the 55 respondents, 19 were 'independent/unaffiliated

[361] Hofstede, "The Cultural Relativity of Organizational Practices and Theories."

[362] Vas Taras and Piers Steel, "Beyond Hofstede: Challenging the Ten Commandments of Cross-Cultural Research," in *Beyond Hofstede: Culture Frameworks for Global Marketing and Management*, ed. Cheryl Nakata (London: Palgrave Macmillan UK, 2009), 40–60, https://doi.org/10.1057/9780230240834_3.

practitioners' or belonged to groups with no other respondents, while the remaining 36 belonged to 8 distinct research groups/teams located in Texas, Arizona, and Massachusetts.

4.3.1 Results

The TDA, TDAQ, TDK, TDKQ, and TDB scores of the respondents, along with the collective averages for the groups, are displayed in the next table.

Table 5: Survey Results

Subject	Eng Apt	Sci Apt	Des Apt	Art Apt	Hum Apt	Ent Apt	Edu Apt	Eng Know	Sci Know	Des Know	Art Know	Hum Know	Ent Know	Edu Know	TDAQ	TDKQ	TDB
1	5	9	-1	-3	0.5	-1	2	3	6	1	1	7	2	2	1.36	1.64	27
2	0	1	1.5	3.5	4.5	0.5	4	1	3	3	4	6	3	2	1.36	2.96	19
3	4	6	9	5	8.5	-0.5	7.5	8	2	12	8	10	9	13	2.35	3.62	73
4	4	2.5	4	3.5	7.5	6	7.5	3	3	7	4	3	1	0	4.32	2.10	90
5	0.5	2.5	2.5	3.5	5.5	4	4.5	6	8	10	11	17	5	11	1.87	3.35	45
6	-2	1	1	3	8.5	1	4	8	11	8	4	11	6	7	1.67	4.18	65
7	2.5	6	6	1.5	6	5	7	3	3	4	2	4	3	3	3.67	6.42	64
8	2.5	6	4	1.5	5	2.5	4.5	3	7	3	2	8	4	5	3.04	2.55	77
9	4	5.5	2.5	6	10	5.5	7.5	10	7	10	8	14	6	6	4.95	3.88	87
10	2	6	0.5	5.5	12	2.5	4.5	4	9	2	2	9	5	3	1.97	2.02	78
11	5	6.5	5	4	9	5	8	13	10	16	16	19	10	13	5.65	5.14	85
12	3.5	3.5	2.5	1.5	4	1	2.5	5	7	5	4	10	6	6	2.13	4.56	19
13	2	6	1	0.5	6	3.5	4	7	8	9	5	10	3	4	1.60	2.98	43
14	2	3	3	6	6.5	-2	7	13	8	13	10	13	7	10	3.29	5.08	58
15	2.5	7	1.5	1.5	4	2	5	8	9	6	8	8	6	6	2.48	6.61	20
16	3.5	7	9	7	11	6	8.5	2	2	3	4	6	2	2	6.62	2.63	95
17	3	4	6.5	4	6	4	5.5	8	10	11	12	16	6	12	4.41	4.61	78
18	2.5	0	2.5	2	7.5	2.5	4.5	13	8	12	9	14	8	10	2.92	5.08	43
19	-4	-4	0.5	-1	8.5	-3.5	3.5	8	8	8	5	11	6	6	1.67	4.92	49
T1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.73	4.35	81.95
20	5.5	5.5	4.5	4.5	10	6	4.5	14	12	16	17	19	7	15	5.40	5.07	84
21	4	3.5	4	3.5	8	3.5	5.5	3	2	3	5	5	4	3	4.21	3.80	80
T2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.97	1.67	50.00
22	6	6	3	1.5	5	0.5	3.5	7	12	7	8	15	6	7	1.83	3.34	50
23	-2	4.5	-2.5	1	4	2	2.5	0	0	0	0	0	0	0	2.14	0.00	50
T3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.69	1.87	74.84
24	1	-3.5	4.5	2.5	9.5	0	6	9	8	12	13	17	6	7	2.75	3.23	59
25	2	1	5	5.5	7.5	1.5	5.5	1	1	4	4	5	1	1	2.44	1.49	85
26	4	1.5	4	6.5	6	3	4.5	0	0	1	2	2	2	1	3.43	1.56	89
27	3	0.5	2.5	3.5	4	0	5.5	2	0	2	0	0	1	1	1.74	1.17	75
28	4.5	-2	6	5.5	9	0	8	9	9	11	10	14	8	6	4.59	5.33	74

T4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.79	3.51	54.91
29	4.5	4	6	6.5	8.5	5.5	8	9	6	10	7	9	5	5	5.75	4.15	88
30	-0.5	2	4	5	4.5	2	3	3	2	3	3	6	4	4	1.75	3.80	24
31	0.5	-0.5	4.5	6.5	9	2.5	6	5	6	7	6	11	8	5	1.39	4.42	22
32	2.5	5	3.5	5	4	3	5	4	3	6	5	4	0	0	3.75	1.71	89
33	6	2	4	7.5	8.5	7	7.5	9	11	8	6	10	2	7	4.85	3.44	88
34	0.5	5	2	2	5.5	1.5	3	3	7	2	1	5	3	2	1.60	2.12	52
35	3	5	7	9	12	6	3.5	12	8	15	12	11	8	7	5.29	4.41	87
36	2	2	2	1.5	6	3.5	4	5	2	4	2	5	2	3	2.44	2.78	62
37	10	4.5	3	3	10	6.5	8	3	3	4	3	4	2	4	5.12	5.37	84
38	-2	1	2	2.5	5	1.5	7	13	6	14	11	10	7	7	2.05	3.72	25
39	5.5	5	6.5	2.5	5	4.5	5	3	2	2	5	5	1	4	4.49	2.41	89
40	5.5	4.5	5	2	7	4	6	12	10	11	9	14	8	11	4.21	7.29	64
41	3.5	5.5	3.5	3.5	7.5	4	7.5	8	9	8	8	9	4	4	4.50	3.98	82
42	10	8.5	9	6	11	6	7.5	10	9	11	8	10	8	4	7.90	5.25	92
43	0.5	0.5	4.5	5	5	1.5	5	11	10	11	12	14	9	9	1.28	8.31	100
44	1	4	3.5	9.5	9	4.5	7	4	4	5	5	10	3	3	3.31	3.13	83
T5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.06	3.03	73.82
45	1.5	-1	3.5	4	8	2.5	3.5	2	5	5	6	6	2	3	2.32	2.67	63
46	7	7	8.5	8	12	5.5	10	7	8	7	7	11	5	12	7.83	4.24	93
47	2	1.5	3	5	7	-1	9	2	8	3	7	11	6	9	2.37	2.64	71
T6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.28	4.80	77.37
48	4.5	3	5	3.5	9	3.5	4.5	8	11	8	8	11	8	6	4.22	6.18	69
49	5	6	7.5	4.5	10	7	8.5	4	6	5	4	8	5	4	6.47	4.85	89
50	3	1	6	5	8.5	4.5	8	8	12	9	12	15	6	8	3.23	3.89	77
T7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.62	2.45	35.48
51	-0.5	2	4	5	4.5	2	3	3	2	3	3	6	4	4	1.75	3.80	24
52	-1	-0.5	7	5	11	1	5	1	0	3	6	3	2	2	1.51	1.80	70
T8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.71	2.89	59.73
53	3	5	6	4.5	5	4.5	6	3	4	4	7	7	5	4	4.63	3.84	83
54	1	3	5	6	10	2.5	5	10	3	12	8	11	7	6	2.92	3.33	75
55	3	1	2	2	5.5	-1.5	1.5	2	3	1	4	7	2	2	1.82	2.10	40

The four most outstanding findings from the scores (and which are reinforced visually by the radar charts in Figures 1 & 2) pertain to counterintuitive realities suggested by the data.

First, the only two meta-disciplinary aptitudes with a strong correlation (>.7 coefficient) to individual's TDAQ were Engineering Aptitude and Entrepreneurship Aptitude, while all others had weak-to-mediocre correlation coefficients (Table 4). This may be due to a 'benign agnosticism' or 'inadvertent collegiality' shared by both meta-disciplinary cultures: neither one tends to claim supremacy of their way of thinking in comparison to others, even if the cases of their staunchest practitioners. Phrased differently, they may be the two meta-disciplinary cultures that best organically explore and integrate elements from other disciplines without having to

battle disciplinary prejudices or animosities (e.g., science vs. art). Design, known for its empathetic orientation and collaborative toolset, [363] surprisingly fell short of the strong-coefficient cut-off; while it may be a glitch of this particular dataset (which should be tested in another study), it may also indicate that such orientation in an individual prevents rather than facilitates integration of foreign elements *because that empathy appropriates any meta-disciplinary exploration within Design's paradigm*—there's no expansion of worldview(s) if it's all part of the standard, *designerly* process.

Second, there seems to be weak-to-no correlation between an individual's level of content knowledge in a discipline and their level of aptitude for that discipline. In fact, anecdotally, practitioners who scored in the negative for an aptitude had higher-than-average scores in the knowledge of the same meta-discipline, which would suggest that individuals may know a discipline's content really well because they oppose it in their inclinations/aptitudes. In contrast, all seven meta-disciplinary knowledge scores seem to be strongly correlated, with only Entrepreneurial Knowledge showing a strong correlation to TDKQ—perhaps for the same 'benign agnosticism' speculated before.

[363] G Mauricio Mejía et al., "An Emerging Role for Design Methods in Transdisciplinary Practice," in *Proceedings of the 24th International Symposium on Electronic Art (ISEA 2018), Durban*, 2018, 67–71.

Table 6: Correlation Coefficients

	Eng Apt	Sci Apt	Des Apt	Art Apt	Hum Apt	Ent Apt	Edu Apt	Eng Know	Sci Know	Des Know	Art Know	Hum Know	Ent Know	Edu Know	TDAQ	TDKQ	TDB	CoTDAQ	CoTDKQ	CoTDB
Eng Apt	1																			
Sci Apt	0.544389	1																		
Des Apt	0.446485	0.16738	1																	
Art Apt	0.167876	-0.00327	0.576369	1																
Hum Apt	0.252702	-0.02275	0.519788	0.597996	1															
Ent Apt	0.532232	0.472617	0.449391	0.416272	0.417122	1														
Edu Apt	0.430948	0.149186	0.575229	0.502394	0.516761	0.441167	1													
Eng Know	0.148523	0.029795	0.158445	0.118708	0.304185	0.120802	0.23939	1												
Sci Know	0.1983	0.090774	-0.00428	-0.03286	0.21535	0.091195	0.14208	0.698651	1											
Des Know	0.118316	-0.04396	0.291077	0.224262	0.380538	0.165689	0.312637	0.932354	0.597678	1										
Art Know	0.141584	-0.0791	0.348057	0.249948	0.331375	0.150908	0.30628	0.796019	0.620969	0.873137	1									
Hum Know	0.110247	-0.04213	0.156214	0.107582	0.293702	0.030728	0.202095	0.786924	0.810556	0.789227	0.846201	1								
Ent Know	0.071939	-0.02295	0.280032	0.155023	0.32806	-0.05991	0.220823	0.781341	0.645027	0.757682	0.717769	0.786162	1							
Edu Know	0.164755	0.049911	0.268766	0.12023	0.246588	0.047493	0.277459	0.7475	0.648402	0.746222	0.781801	0.842305	0.76104	1						
TDAQ	0.707483	0.457809	0.647427	0.452914	0.553492	0.732833	0.653232	0.27901	0.174293	0.299707	0.291362	0.159972	0.145614	0.207627	1					
TDKQ	0.224793	0.03958	0.296325	0.04536	0.199412	0.187527	0.268118	0.643712	0.560502	0.562714	0.531173	0.543586	0.717394	0.57541	0.281204	1				
TDB	0.469857	0.217085	0.550009	0.519046	0.537282	0.537929	0.564066	0.088208	0.035276	0.159388	0.180955	0.022798	-0.03795	0.058995	0.666476	0.025666	1			
CoTDAQ	0.316769	0.161709	0.223244	0.042033	0.312441	0.395054	0.26472	0.262911	0.371604	0.254107	0.347528	0.326992	0.275424	0.362606	0.397207	0.342942	0.314827	1		
CoTDKQ	0.234848	0.342777	0.285688	0.111912	0.287236	0.593545	0.241839	0.345565	0.385522	0.270192	0.277208	0.259785	0.298984	0.31567	0.374995	0.499217	0.188158	0.752312	1	
CoTDB	0.267642	-0.15215	0.153401	0.050373	0.242386	0.024563	0.297565	0.047635	0.214251	0.117807	0.233331	0.239002	0.140413	0.243661	0.272621	0.062949	0.336148	0.757027	0.190178	1

Third, broadness in aptitudes is rare (which was to be expected), with ‘average’ individuals usually having at most three inclinations in their profile. Yet, scoring below zero in aptitude for at least one discipline tended to be more common than broadness or a disparately sharp/high score for a single one, suggesting that aversion, opposition, or bias against a certain disciplinary culture or way of thinking can be more widespread and/or influential than previously acknowledged.

Fourth, the cumulative TDK of teams tends to extend into more disciplines than its TDA counterpart. Furthermore, team members’ TDAQ virtually align with each other in almost all analyzed teams, suggesting that groups self-select for similarly-inclined individuals even when aiming for a transdisciplinary makeup, thus reinforcing ‘blind spots’ in their composition in ways that could lead to groupthink in disciplinary matters. This latter point is most apparent in the chart representations of Team 3 in relation to Science and Entrepreneurship as shown in Figure 1, and of Team 7 and Team 8 in relation to Engineering as shown in Figure 2.

These quantitative findings illuminate a few of the complex dynamics among the factors of individual and collective transdisciplinary intelligence in knowledge production.

Figure 1: Visual Representations of TDAQ-TDKQ, Teams 1-4

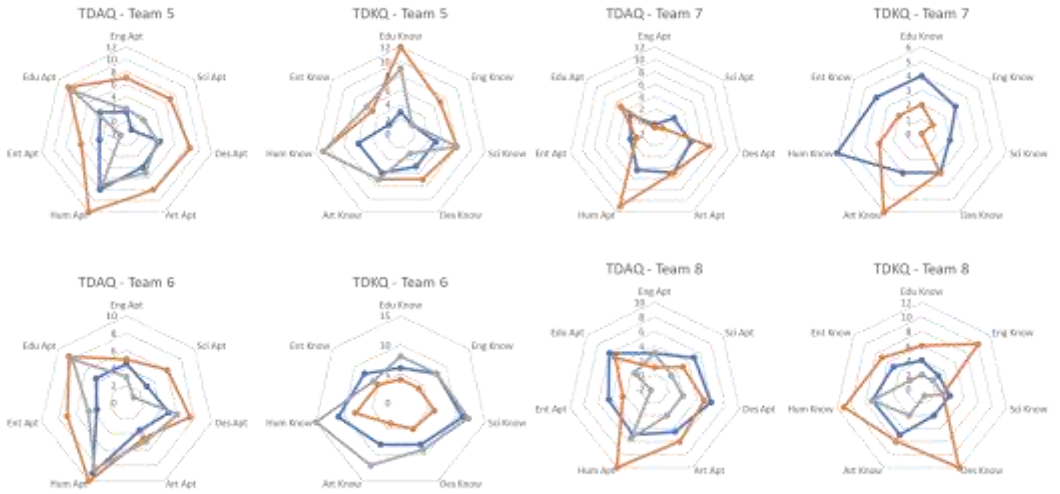

Figure 2: Visual Representations of TDAQ-TDKQ, Teams 5-8

4.4 Phenomenological Methods

Since we ought to understand transdisciplinary knowledge production with a phenomenological grasp, phase two of Project HERMES focused on phenomenological methods as the most appropriate and attuned way to delve into the subjective aspects of the phenomenon. However, before discussing the experience and results from this phenomenological inquiry, the

following section exhibits the theoretical framework and some intellectual justifications for this approach.

4.4.1 Postphenomenology, Technoscience & Phenomenological Theory

How to understand the *relationship* (Latin *re-ligare*: gather again) between *science* (meant both as the study of the natural world and as its etymological sense of *knowledge* in Latin *Scientia)* and *technology* (Greek *tekhnē*: craft; art; system) in our ever-increasingly complex world? Phenomenologist and philosopher of science and technology Don Ihde has been trying to answer such a question throughout his work since the 1970s,[364] and proposing, with utmost clarity, a particular way to deconstruct and grasp that complexity in his University of Peking lectures regarding postphenomenology and technoscience.[365] In the lectures, Ihde accomplishes three main objectives: to trace the philosophical lineage and history of postphenomenology, bestowing particular importance to the phenomenological work of Edmund Husserl[366] and the pragmatist work of John Dewey;[367] to illustrate the relevance and application of postphenomenology to science and technology regardless of the era; and to contrast Western and Eastern cases of science and technology throughout history to showcase cultural nuances that can be overcome by and through postphenomenology. The Peking lectures, however, focus heavily

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[364] Don Ihde, *Technics and Praxis*, Boston Studies in the Philosophy of Science 24 (Dordrecht: Reidel, 1979); Don Ihde and Richard M. Zaner, eds., *Interdisciplinary Phenomenology*, Selected Studies in Phenomenology and Existential Philosophy 6 (The Hague: M. Nijhoff, 1977); Don Ihde, *Experimental Phenomenology: An Introduction* (SUNY Press, 1986); Don Ihde, "Postphenomenology—Again," *Aarhus, Department of Information & Media Studies*, 2003; Don Ihde, *Postphenomenology: Essays in the Postmodern Context* (Northwestern University Press, 1995); Don Ihde, *Experimental Phenomenology, Second Edition: Multistabilities* (SUNY Press, 2012).

[365] Ihde, *Postphenomenology and Technoscience*.

[366] Husserl, *The Crisis of European Sciences and Transcendental Phenomenology*.

[367] Dewey, *How We Think*; John Dewey, *Art as Experience* (Penguin, 2005). Dewey, *How We Think*; Dewey, *Art as Experience*.

on the disciplinary, even 'traditional,' notions of *science and technology* (astronomy, engineering, biology, anthropology, computers, machines, etc.), when in reality postphenomenology could not only 'open up' our understanding of such fields of knowledge, but it can also afford us a better grasp of other human phenomena worth investigating, those that challenge the meaning and boundaries of *'science and technology.'* Art, the humanities, entrepreneurship, education, and contemporary forms of hybrid knowledge production and transdisciplinary human endeavors all deserve postphenomenological consideration in order to deepen our appreciation and comprehension of such phenomena, which is precisely the intent of the work herein.

Yet, an analysis of the history, methods, and case studies offered by Ihde regarding postphenomenology must precede its exercise in uncharted contexts, for learning and training must precede mastery. To that end, Ihde's own map for exploration in the Peking lectures offers the model to follow herein, starting with the influences and forces informing postphenomenology.

PHILOSOPHICAL HERITAGE IN PARALLELS

At the beginning of the Peking lectures, Ihde identifies not only the scholars and thinkers who directly influenced his own take on postphenomenology, but he also contextualizes his approach both within the history of philosophy and 'science and technology studies,' as well as the broader tradition of Western thought. In terms of historical context, Ihde positions postphenomenology as a direct descendant of a well-defined succession of intellectual currents: the historical and anti-positivist turn of science in the 1950s-1960s heralded by Thomas Kuhn

and his concern with scientific revolutions and paradigm shifts;[368] the social turn of science in the 1970s-1980s epitomized by Bruno Latour[369] through his work on actor-network theory and the notion that science is both socially constructed and irredeemably technologically mediated; and the post-structuralist, post-Marxist, post-modern (post-everything, really), and feminists turns of the 1980s-1990s championed by the likes of Donna Haraway, all of whom insisted in highlighting the implicit biases and hidden flaws of scientific practices, issues such as hegemonic tendencies, sexism, and colonialism.[370] In Ihde's view, this history has had the effect of pulling (or shoving) the originally positivist-leaning philosophy of science towards interpretation and the conclusion that "knowledge is *produced* out of practices"[371] rather than discovered purely from '*nature*.'

Once history has been established, Ihde proceeds to relate and interlink the aims and practices of Husserl's phenomenology (as influenced in its origins by David Hume and Immanuel Kant, and later enhanced by the work of Martin Heidegger,[372] Maurice Merleau-Ponty,[373] and José Ortega y Gasset[374]) and Dewey's pragmatism (as influenced also by Kant, as well as by the psychology work of William James and the pragmatism of Charles Sanders-

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[368] Thomas S. Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press, 1996).

[369] Bruno Latour, *Science in Action: How to Follow Scientists and Engineers Through Society* (Harvard University Press, 1987); Bruno Latour and Steve Woolgar, *Laboratory Life: The Construction of Scientific Facts* (Princeton University Press, 2013). Latour, *Science in Action*; Latour and Woolgar, *Laboratory Life*.

[370] Haraway, *Simians, Cyborgs, and Women*; Haraway, "Situated Knowledges."

[371] Ihde, *Postphenomenology and Technoscience*., pages 7-8.

[372] Martin Heidegger, *Discourse on Thinking* (Harper Collins, 1969); Martin Heidegger, "The Question Concerning Technology," 1977, 23.

[373] Maurice Merleau-Ponty, *Phenomenology of Perception* (Motilal Banarsidass Publishe, 1996).

[374] Gasset, *Meditación de la técnica y otros ensayos sobre ciencia y filosofía*; Jose Ortega y Gasset, *Phenomenology and Art*, trans. Philip W. Silver (W. W. Norton & Company, 1975).

Peirce[375]), finding plenty of commonalities and complementarities among the two approaches, such as their focus on experience and consciousness, the exploration of psychology as a promising field of study, and the body-environment modeling of the world.[376] Later, Ihde also tags phenomenology and pragmatism (along with Marxism) as belonging to the *praxis* tradition of philosophy that would interrogate the interrelation of technologies and the world from mid-20th century to modern day.[377]

While insightful in its briefness, this cursory summary provided by Ihde does not suffice for transdisciplinary intentions and understandings. Rather, Husserl's phenomenology and Dewey's pragmatism must to be reviewed more thoroughly for the purpose of grasping and applying postphenomenology beyond the boundaries of the 'science and technology' examples in the Peking lectures.

PHENOMENOLOGICAL REORIENTATION

In the *Crises,* Husserl sets out an ambitious, three-pronged agenda: to deconstruct and upend the Cartesian-Kantian tradition of object-subject dualism and of separation between the natural sciences and philosophy; to push for the reorientation of the sciences (natural and otherwise) away from 'objectivism' and towards a 'grounding' of knowledge in the experienced world; and to position phenomenology as the prime method to reorient the sciences.

Husserl accomplishes the first by critiquing and questioning the object-subject dualism established by Descartes, and later consolidated by Kant in what Husserl calls "his own sort of

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[375] Charles Sanders Peirce, *Pragmatism as a Principle and Method of Right Thinking: The 1903 Harvard Lectures on Pragmatism*, ed. Patricia Ann Turrisi (Albany: SUNY Press, 1997).

[376]Ihde, *Postphenomenology and Technoscience*., pages 9-11.Ihde., pages 9-11.

[377] Ihde, *Postphenomenology and Technoscience*., page 21.

mythical talk"[378] that becomes inaccessible and devoid of any intuitive approach. Husserl does, however, borrow Kantian vocabulary and the concept of "inner sense" to set up the arguments for the reorientation "for all philosophers, for all scientists" to acknowledge everything "taken for granted" or "pregiven"; and the use of phenomenology as an "intentional analysis" in the process of knowledge discovery about the world.[379] The "crises" mentioned in the title of the lectures-turned-book, according to Husserl, consist of the claim to "objective truth", to objectivism, of the natural/positivist sciences in an attempt to place scientific knowledge in another realm, almost as superior or alien to the world itself, instead of recognizing "that all science is a human accomplishment, an accomplishment of human beings who find themselves in the world, in the world of general experience."[380] In other words, Husserl insists that all knowledge about world objects has to be subjective, that scientific knowledge cannot be considered "self-evident" and "truth in themselves", for it is grasped and experienced by a community of subjective beings within a world, not by an omniscient, neutral, 'objective' third entity. Husserl also insists on the relevance of recognizing the "lifeworld" as a "realm of original self-evidence"[381] in which the "real objective world" and the subjective "experienced world" are one and the same—only then can the sciences reorient towards its depths through phenomenological praxis.

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[378] Ibid. 3 above, section 30.

[379] Ibid. 3 above, section 30.

[380] Ibid. 3 above, section 31.

[381] Ibid. 3 above, section 32.

Such a reorientation requires "an *epoche*, a withholding of natural, naive validities and in general of validities already in effect"[382]—a first step in the phenomenological inquiry, and in the case of the sciences, one requiring transcendental proportions in which the *epoche* stands as a "habitual attitude" that reconsiders all of the lifeworld as a phenomenon (or collection of phenomena) to be investigated in order to notice "invariant structures" and "cross out" all pre-given biases, assumptions, certainties, and lazy understandings about our experience(s) of the world.[383] This *transcendental epoche* or *transcendental reduction* hence becomes, for Husserl, at once the solution to the crises and the foundation for phenomenological praxis, allowing for a renewed viewing and understanding of the *essences* of the phenomena of the lifeworld through the rigor of the phenomenological method of inquiry: acknowledging the embodied materiality of the lifeworld; questioning all the *pre-givenness* of the objects and interrelations in it, all while suspending every bias and certainty one may hold about *knowing* the world; exploring the *intersubjectivity* (that is, the collective and collaborative quality of consciousness and perception) and the variants of phenomena; and finally grasping the essence of the phenomena through and beyond our experience.[384] This detailed, intuitive, and well-defined sequence would become the grounding for Ihde's postphenomenology and its method of inquiry.

Husserl concludes the *Crises* recognizing a few of the challenges and paradoxes left unresolved by the phenomenological approach, in particular the challenge of language[385] (which

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[382] Ibid. 3 above, section 35.

[383] Ibid. 3 above, sections 41-52.

[384] This may be a crude over-simplification which uses too few of Husserl's terms, but as Ihde points out and Husserl himself criticizes of Kant, the language of the original can sin of opaque and convoluted due to the traditions it aims to overturn.

[385] Ibid. 3 above, section 55.

may be confusing, misconstrued, or ineffably 'mythical'), and the challenge of not reducing the *transcendental epoche* into a kind of psychologism (while asserting that "transcendental-phenomenological reorientation" can be "significant for psychology itself"[386]) that renders all the world as mere inner/mental interpretation—a pitfall to be avoided if phenomenology is to be taken seriously as its own type of legitimate science.

Such paradoxes and challenges for a practicing phenomenologist, however, the pragmatist bypasses with ease due to their dissimilarities, as Ihde suggests, while sharing plenty of the goals, interests, and outcomes at the core of their praxis.

PRAGMATIC APPROACHES

Contrary to Husserl's style and tradition, philosopher-educator-psychologist John Dewey provides remarkably straightforward conceptualizations and explanations for pragmatism in his treatises *How We Think*[387] and *Art as Experience*[388], explicitly aiming not only at sciences but also at play, art, and learning as dimensions of human experience worthy of in-depth *experimentation* (from the Greek *ex-peras:* outside limits). Similar to Husserl, Dewey grounds his theories on reconsiderations of the notions of *thinking* (distinct from *imagining*[389]) as "conscious operations of selection and arrangement,"[390] and of *experience* as "the result, the sign, and the reward of that interaction of organism and environment which, when it is carried to

[386] Ibid. 3 above, section 59.

[387] Dewey, *How We Think*. Dewey.

[388] Dewey, *Art as Experience*.

[389] Ibid. 24 above, page 3.

[390] Ibid. 24 above, page 158.

the full, is a transformation of interaction into participation and communication."[391] Also similar to Husserl, the pragmatist not only makes repeated calls for a mode of *reflective thinking* that comprises "active, persistent, and careful consideration of any belief or supposed form of knowledge in light of the grounds that support it"[392] (which could read almost as a layman's translation of Husserl's *epoche*), but he also critiques the origins of science and technology as practical developments grounded on everyday problems, rather than as intellectual endeavors of humankind.[393]

Dewey, due to his expertise in psychology and learning, deals time and again with instances of *consciousness, perception,* and *embodiment*, particularly as related to meaning, believing, understanding, thinking, and experience. To best explain those concepts, nonetheless, Dewey turns to art, not science or technology, as the "best proof of the existence of a realized and therefore realizable, union of material and ideal"[394] because an artwork "has esthetic standing only as the work becomes an experience for a human being"[395] through "doing and undergoing"—meaning it's wholly grounded on our material embodiment, perception, and consciousness of and about the art. Hence, Dewey uses psychology to disentangle (or cut) philosophical Gordian knots about empiricism, subjectivity, and knowledge, instead of having to provide warnings and acknowledgements of paradoxes and challenges about them—and in doing

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[391] Ibid. 25 above, page 22.

[392] Ibid. 24 above, page 6.

[393] Ibid. 24 above, page 167

[394] Ibid 25 above, page 27.

[395] Ibid. 25 above, page 4.

so, pragmatism becomes a practical companion, complement, and counterbalance to the more rigorous but intricate phenomenology of Husserl.

POSTPHENOMENOLOGY: AN INTEGRATION

Merging and synthetizing aspects of both phenomenology and pragmatism, Ihde proposes *postphenomenology* as a hybrid that picks the best of both approaches: first, by taking the language and conceptualization of pragmatism, particularly around 'experience' and 'consciousness', to get rid of the obfuscation and anti-scientific biases of which phenomenology is accused; second, by adopting the rigorous methods of phenomenological inquiry, such as the variational theory that includes "considerations of the materiality of technologies, the bodily techniques of use, and the cultural contexts of the practice,"[396]which then methodically highlight the importance of multistability (potential for multiple and diverse outcomes), alternations (experimental variations of a phenomenon, either imagined or attempted in the world), embodied perceptions, and "a dynamic understanding of the lifeworld."[397] The goal of this synthetic hybridization, of postphenomenology itself, amounts for Ihde to "a way to probe and analyze the role of technologies in social, personal, and cultural life…studies of *technologies* in the plural"[398]—which he claims to be the missing part in Husserl's viewpoint, that of technology.[399]

Postphenomenology, thanks to its pragmatist influences according to Ihde, then can re-consider technology without the nostalgia or the pessimism attributed to it by the *philosophy of*

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[396] Ihde, *Postphenomenology and Technoscience*., pages 18-19.

[397] Ihde., page 23.

[398] Ihde., page 23.

[399] Ihde., page 30.

science and technology works of Martin Heidegger, Theodor Adorno, Herbert Marcuse, Max Weber, and Hannah Arendt, ranging from imminent utopianism to accusations of Armageddon, disenchantment of Nature, and the decline of civilization. Instead, postphenomenology ought to focus on how "technologies have *always been part of our lifeworlds*"[400], yet they have been often overlooked in three crucial dimensions: their ubiquitous and instrumental incorporation into human experiences since prehistoric times,[401] their enabling through embodiment of knowledge production for all sciences,[402] and the symbiotic relationship of technologies with science—a comprehensive notion that Ihde underscores with and through the term *technoscience,*[403] arguably the main concern and interest of postphenomenology.

Technoscience, in its most distilled form, means to Ihde "the hybrid output of science and technology, now bound inextricably into a compound unity;"[404] or put in different terms, that there can be no technology without some sort of knowledge to build and use it, just as there can be no modern science without technologies and instruments to enable, *embody,* or *mediate* scientific observation and measuring. For instance, there could be no more scientific breakthroughs in quantum physics without the hadron supercollider to run relevant experiments using neutrinos and quantum particles, and at the same time, the hadron supercollider would be a mere fantasy of science fiction rather than a marvel of technoscience without the engineering prowess and the quantum mechanics knowledge necessary to design and to build it. In order to

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[400] Ihde., page 38.

[401] Ihde., pages 34-37.

[402] Ihde., pages 45-46.

[403] Ihde., pages 38-41.

[404] Ihde., page 41.

understand the overall importance of technoscience to human experience, nonetheless, Ihde capitalizes on and sublimates the traditions of phenomenology, pragmatism, and philosophy of science and technology in the form of *phenomenology of technics*, thus regarded as the foundation for empirical studies of human-technoscience relationships[405] (what could be taken as a type of "levels of reality" in Nicolescuan transdisciplinarity[406]). Those relationships sum up to the following:

- Embodiment relations, in which the use of a technology or instrument is so intrinsic for the human experience that the technology becomes somewhat imperceptible unless it malfunctions; for instance, eyeglasses are a technology that can be seamless and integral to a person's literal view and experience of the world, unless they're missing, in which case the role of the eyeglasses in correcting the sight of the person becomes obvious.
- Hermeneutic relations, in which the technology mediates a person's interpretation of the world either by representation or translation; writing serves as the prime example of the former since the written word aims to represent realities of the world to be reinterpreted by people, while thermometers would be an example of the latter, since they translate and quantify the phenomenon of heat and cold for humans to read.
- Alterity relations, in which a technological artifact gets treated as a person-like entity worthy of attention, consideration, and even empathy (if designed well enough); artificial intelligence and anthropomorphized robots are obvious cases of this relation.

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[405] Ihde., pages 42-44.

[406] Nicolescu, "Transdisciplinarity - Past, Present and Future"; Nicolescu, "Methodology of Transdisciplinarity"; Paul Cilliers and Basarab Nicolescu, "Complexity and Transdisciplinarity – Discontinuity, Levels of Reality and the Hidden Third," *Futures* 44, no. 8 (October 2012): 711–18, https://doi.org/10.1016/j.futures.2012.04.001.

- Background relations, in which a technology becomes a given and unnoticed part of the environment despite their very material reality; unless, of course, the technology malfunctions, thus revealing a gap, a deficiency, or a 'disconnect' between humans and the lifeworld; the ethereal and metaphorically temperamental 'Internet' best exemplifies this type of relation.

Throughout the Peking lectures, particularly when dealing with technoscience, the phenomenology of technics, and historical examples, Ihde gives hints and alludes to the versatility of postphenomenology beyond the classical, Western understanding of 'science'—and from those hints and allusions, a broader, more transdisciplinary, and future-facing version of technoscience and postphenomenology emerges, with the capacity to enrich our understanding and experiences of a multiplicity of knowledges and human endeavors as subsequent sections will explore herein.

CONTEMPORARY TECHNOSCIENCE

The idea of expanding postphenomenology and technoscience by exploring their implications for other phenomena comes from Ihde himself in the Peking lectures, when he calls for the rethinking of the philosophies of science and technology, the multicultural histories behind scientific practices, and taking "a much more robust account of instruments and technologies as they shape both our lifeworld and our sciences,"[407] the latter assertion implying a richness of the lifeworld yet to be explored postphenomenologically, but for which the methods and foci of inquiry stand at our disposal.

[407] Ihde, *Postphenomenology and Technoscience*., page 61.

Aside from Ihde's explicit outlining of technoscience's contemporary implications, his aforementioned hints and allusions belong to one of two themes relevant for further exploration: culture and knowledge, respectively. First, from the beginning passages of the lectures, the mentions of *culture* appear subtly but steadily, always linking it to history and the lifeworld, then to technologies and knowledge. For instance, Ihde first connects "historical cultures and environments" to "different structured lifeworlds" from "different epochs and locations;"[408] a notion that he relates later to Husserl's "historical-cultural-praxical world" by invoking the "multidimensionality of technologies as *material cultures within a lifeworld*"[409], meaning that particular technologies affect the perception and apprehension of a particular reality. Later, Ihde mentions historical practices of geometry as examples of a practice that "reconstitutes cultural perception" within "a differently constructed lifeworld,"[410] thus opening the possibility of considering culture as a dimension of technoscience and vice versa. The latter point gains prominence when Ihde insists on reading "the history of science as a multicultural phenomenon" in which innovations and knowledge advancement have happened during "periods of strong multicultural interaction"[411] rather than as an inevitable 'progressive' *technological trajectory*. This line of thought not only leads to the realization that "technologies tend to be multistable"[412] given their cultural dimension, producing different outcomes in different cultural contexts, but

[408] Ihde., page 19.

[409] Ihde., page 22.

[410] Ihde., page 32.

[411] Ihde., pages 46-47.

[412] Ihde., page 44.

also to the conclusion that technoscience and the knowledge it enables ought to have "*cultural variants"*, such as the visualist bias of most scientific instruments and equipment.[413]

The issue of *cultural variants* is the point of intersection with the theme of knowledge, which itself can be summarized by Peirce's axiom quoted by Ihde: "Knowledge is more properly interpreted as habits of acting than as representations of reality, and thus not so much in need of special foundations as being located in historical and social processes."[414] The intersection of culture and knowledge also appears with the issue of *"demarcation boundaries"* complicating the differentiation between valid science and mere cultural practices[415]—both of which can only produce new knowledge that is technologically mediated.[416]

What follows this reconsideration of culture and knowledge regarding technoscience is not only the revelation of a "new relation" of "human-technology-knowledge" which Ihde terms "embodied hermeneutics,"[417] but also the disclosure of a broadly applicable model of inquiry which systematically involves human perception, a measuring, a calculative or interpretative practice, and the incorporation of technology[418]—a sequence meant to guide postphenomenological (embodied) hermeneutics regardless of the context or the phenomenon to study from an expanded, contemporary technoscience lens.

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[413] Ihde., page 75.

[414] Ihde., pages 29-30.

[415] Ihde., page 50.

[416] Ihde., page 55.

[417] Ihde., page 56.

[418] Ihde., page 50.

Ihde provides three exemplars of such use of this hermeneutical model meant for contemporary technoscience, all of which happen to be quite transdisciplinary in nature when analyzed in their particularities. First is the case of a prehistoric Venus figurine[419] (the incorporated technological artifact), whose textured head (the measurement) had not been identified as a 'weave' or textile reference for years until a female archeologist with a fashion design background (the human perception) interpreted the grooved design of the statuette as such (the interpretative praxis). While Ihde treats the fact about the female archeologist's success as a parenthetical anecdote, it ought to be considered as evidence of both the power of transdisciplinarity[420] and the value of a technoscientific lens. In the second exemplar, Ihde ventures into the arts and humanities with an embodied hermeneutic of song recordings using his own perceptions of musical history[421], arguing that the 3–4-minute recording capacity (the measurement) of early phonographs (the incorporated technology) established that length as the default for the art form of the musical song since the late 1800s, independent from any artistic considerations (the interpretative praxis). In the third exemplar of interest, which also involves transdisciplinarity, Ihde gives a detailed account of the acoustic performance-experiments of physicist-artist Felix Hess, who uses sound technologies to turn infrasound recordings into songs and sound art audible by people (human perception).[422] Hess's interpretative praxis of infrasound

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[419] Ihde., page 73.

[420] Helga Nowotny, "The Potential of Transdisciplinarity," *H. Dunin-Woyseth, H. and M. Nielsen, Discussing Transdisciplinarity: Making Professions and the New Mode of Knowledge Production, the Nordic Reader, Oslo School of Architecture, Oslo, Norway*, 2004, 10–19.

[421] Ihde, *Postphenomenology and Technoscience*., page 74.

[422] Ihde., pages 76-78.

(the measurement) has led not only to aesthetic experiences and artistic knowledge/artifacts, but also to scientific discoveries about weather—quite the hybrid success in knowledge production through contemporary technoscience.

Ultimately, embodied hermeneutics, postphenomenology, and contemporary technoscience may allow for deeper and surprising understandings of how technologies, culture, and knowledge compound together as *science*, as well as their implications for the totality of human experience(s), from the inner self to the home, to the agora, and to the universe at large.

Technoscientific Imaginations

Whereas the pathway to understand postphenomenology and technoscience means looking to the past and analyzing the present in minute detail, just as Husserl, Dewey, and Ihde did throughout their respective works, the applications, implications, and significations of postphenomenology are meant to project forward, to unfold into the future. By opening up, enlightening, and enticing our deeper understanding of the relations between humankind, technology, knowledge, and the world/reality, we can begin to imagine better ways to design technology, to engage its mediation, to embrace this timeless human condition, and to exist (Greek *ex-stasis:* to stand out) in our tech-rich environment, acknowledging all of its paradoxes and complexities as if 'walking on a tight rope' between past and future.[423] Perhaps, in the end, the best answer to the question posed at the beginning cannot be known, but must be imagined—imagined through iterations and variations of technoscience as the ideal tool to mediate, to think,

[423] Friedrich Nietzsche, *Thus Spoke Zarathustra* (Penguin UK, 1974).

to appreciate, and to experience the wonders and the nuances of all lifeworlds given to us, within and beyond.

4.4.2 Phenomenological Investigations

Following a mix of guidelines proposed by Van Manen,[424] Giorgi,[425] and a few others[426] (including illustrated examples[427]), the phenomenological investigations within Project HERMES unfolded as explained herein.

First, the questions that served as the basis of the intersubjective phenomenological interviews (Appendix D) were designed as open-ended and according to the standards of responsible conduct of human-subject research, per IRB approval requirements.

After the approval and 'seed design,' in preparation to do the interviews, my first step was to do a 'self-interview;' first as an oral, self-recorded recollection, which I then expanded through reflective writing (Appendix E). The purpose and result of this effort became the *epoche*

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[424] Manen, "Phenomenology of Practice"; Van Manen, "' Doing' Phenomenological Research and Writing: An Introduction"; Max van Manen, "Linking Ways of Knowing with Ways of Being Practical," *Curriculum Inquiry* 6, no. 3 (1977): 205, https://doi.org/10.2307/1179579; Van Manen, "Practicing Phenomenological Writing."

[425] Amedeo Giorgi, "The Question of Validity in Qualitative Research," *Journal of Phenomenological Psychology* 33, no. 1 (2002): 1–18, https://doi.org/10.1163/156916202320900392; Alberto De Castro, "Introduction To Giorgi's Existential Phenomenological Research Method," no. 11 (2003): 13.

[426] Martin Adams, "Practising Phenomenology: Some Reflections and Considerations," *Journal-Society For Existential Analysis* 12, no. 1 (2001): 65–84; Adams, "The Primacy of Interrelating"; Thomas A. Conklin, "Method or Madness: Phenomenology as Knowledge Creator," *Journal of Management Inquiry* 16, no. 3 (September 2007): 275–87, https://doi.org/10.1177/1056492607306023; Scott D Churchill and Frederick J Wertz, "An Introduction To Phenomenological Research In Psychology: Historical, Conceptual, And Methodological Foundations," n.d., 30; Roberta De Monticelli, "Phenomenology Today: A Good Travel Mate for Analytic Philosophy?," *Phenomenology and Mind, No 1 (2011)*, November 27, 2016, https://doi.org/10.13128/phe_mi-19640; Thomas Groenewald, "A Phenomenological Research Design Illustrated," *International Journal of Qualitative Methods* 3, no. 1 (March 2004): 42–55, https://doi.org/10.1177/160940690400300104.

[427] Frank Dufour, "La composition musicale comme expérience," n.d., 8; Pierre Vermersch, "Bases de l'auto-explicitation (1)," 2007, 31.

that deconstructed, revealed, and allowed me to suspend my own knowledge biases prior to the execution and interpretation of the interviews.

Once prepared for the interview phase and during the collection of survey responses, I selected co-investigators[428] from the pool of respondents. Those selected either stated explicitly their expertise or experience in transdisciplinary terms, or they volunteered for the interview (which was a question within the survey). From 10 selected co-investigators, I was able to interview a total of 7 within the timeframe allowed by the project and with the limitations imposed by the ongoing COVID19 pandemic.

I conducted the interviews virtually, using video-conference software and recording them as video files. The interviews averaged 50 minutes of conversation, and ended when the co-investigator and I agreed that all the base questions had been answered thoroughly in relation to their experience and expertise. I at times interjected with contributions from my own experiential perspective and research findings to foster a dialogical intersubjectivity with the co-investigator, in order to avoid a one-way or monological narrative that may leave key aspects of their experiences unrepresented or unexplored.

The analysis and interpretation phase started with the transcription of the sound recordings of the interviews. I used the artificial intelligence tool Otter.AI to do the 'bulk' round of transcription; I then reviewed and revised the transcriptions for accuracy and readability, while in parallel coding them for *meaning* units and annotating them as *individual phenomenological descriptions* with emergent phenomenological structures. The full articulation

[428] Rather than 'subjects,' because interviewees are full-fledged, equal collaborators in phenomenological practices.

of the findings comprises Section 4.5. Due to time constraints and scheduling conflicts, confirmation of the annotated and coded transcriptions by the co-investigators could not be obtained, which otherwise would be an additional measure of validation of the findings.

Uncovering the phenomenological structures through this investigation directly influenced the development of the Transdisciplinary Intelligence Inventory, for the findings served as foundation for querying the experiences of individuals and organizations involved in transdisciplinary knowledge production. In other words, the TD2I was designed, in part, to question and surface the commonly subjective aspects of transdisciplinary collaboration as revealed via phenomenological methods.

All along since the inception of Project HERMES, I've kept a research journal, of which one of its sections is devoted to my thoughts and perceptions of my experience performing this research. The journal entries cover quasi-immediate thoughts as events and insights happened, as well as more in-depth reflections *a posteriori.* The journal in this dimension has had the effect of allowing me to put the unfolding and my own performance as researcher into perspective—a must for proper phenomenological investigations.

4.4.3 Results, Interpretation & Reflection

The profiles of the selected co-investigators[429] are summarized in Table 3. Balance of genders and variety of ethnic and geographic backgrounds were procured as part of the selection process in order to mitigate hegemonic biases. Yet, I acknowledge that Eastern & Asian

[429] Pseudonyms have been used to protect their anonymity and maintain ethical standards.

perspectives, as well as that of the younger (under 20) and older (50+) spectrum, were underrepresented in this particular sampling, instead leaning towards Western and Global South perspectives in the 35-40s range due to availability and their own interest in participating.

Table 7: Co-Investigator Profiles

Co-Investigator	Expertise (Meta-Disciplinary)	Demographics	Regions
Jacob	Science & Art	Male, 40s	Americas, Europe
Yanni	Art & Humanities	Male, 30s	Americas, Africa
Eva	Entrepreneurship & Art	Female, 30s	Americas
Saul	Education, Humanities, Engineering	Male, 30s	Americas, Europe
Sandy	Education, Arts, Entrepreneurship	Female, 40s	Americas
Ines	Art, Science, Humanities & Education	Female, 40s	South Asia, Americas
Zeus	Engineering, Humanities & Art	Male, 20s	Americas, Central Asia, Europe

I explain herein, in detail, the commonalities in structure, units of meaning, and elements of experience distilled from the co-investigators' individual phenomenological descriptions.

Curiosity-Imagination-Speculation-Anticipation

The journey towards transdisciplinary knowledge production starts with a *curious imaginative speculation of the future;* whether individually or collectively, the practitioner wonders about the possible, yet-unthought-of outcomes tomorrow of going today into a transdisciplinary quest. Usually, such speculation has an improvement bias ('how could this be better?'), for even transgressive approaches try to point out weaknesses and fallacies in the hopes of correcting them. Co-investigator Eva described her on drive of *curious imaginative speculation* as:

I am always very interested in the sort of joint energy that allow us do something and to become bigger than just me.

In the case of transdisciplinary collaborations, this *curious imaginative speculation* also involves a *curious anticipation* in regards to the potential collaborator(s)—wondering about the possibilities unlocked by joining intellectual forces and resources ('what could we accomplish together that I couldn't on my own?') and unrealized accomplishments.

Time & Time Again

Starting with the speculation and throughout TDKP, the sense of time becomes one of *longue durée,* always projecting to the future and towards *what-is-yet-to-come*[430]—the sought-after breakthrough, the upcoming deadline, the promised funding, the next opportunity to collaborate. At the same time, this sense of time means perceiving time as *diffused*, *cyclical*, and *networked*. *Diffused* because engaging in TDKP feels more like an emergent habit or virtue than a flashpoint event even if there's a representative single event that triggered it (such as a hackathon or conference). An individual practitioner may have a clear memory of when they were called or recognized themselves as immersed in TDKP, but they always point to a previous inclination or interest (the *curious imaginative speculation*) as the source of their immersion; something similar happens with collaborations, for the actual working together is preceded by cross-interest and even mutual admiration by the practitioners (the *curious anticipation*), all

[430] The Spanish word "porvenir" would be a more fitting and concise concept here, but alas, language confines possibilities...

which blurs their time definitions.[431] For instance, Eva mentioned of her own collaboration timing:

> *[A collaboration] ends whenever the job ends or whenever the project ends. Sometimes it doesn't end at all. There are people that I'm still collaborating with from projects a long time ago. It's not every day, but once every so often…*

Cyclical because, just as the beginning is blurred, any 'ending' is just a threshold to the next *what-is-yet-to-come*: the next phase, the next project opportunity, the next collaboration. In other words, no practitioner feels 'done' or that they have 'finished' TDKP; whether a project wraps up successfully and produces desired outcomes or it fails, that simply becomes motivation to continue to the next attempted iteration. *Networked,* because the time considerations are never linear and objective but rather multi-subjective and non-linearly interconnected, not only with the other elements of the structure, but also with Others—collaborators, stakeholders, the environment, etc.[432] No single definition or individual consideration of time or a timeframe prevails evenly throughout TDKP.

[431] Hemingway's oft-repeated quote from *The Sun Also Rises* about going bankrupt comes to mind: "Gradually, then suddenly."

[432] For further exploration, see: Charles Bambach, "The Time Of The Self And The Time Of The Other," *History and Theory* 50, no. 2 (May 2011): 254–69, https://doi.org/10.1111/j.1468-2303.2011.00582.x.

Communicative Interactions

Communication, unsurprisingly, plays a fundamental role in the unfolding of TDKP, from the collaboration of practitioners to the diffusion of its insights. However, since the languages can vary so drastically from discipline to discipline and public to public, *communicative interactions* carry the most influence in TDKP matters—what is done (or not done), how it is done, and the perceptions and reactions from Others, all express more meaning and have more networked implications for other elements of the structure than any verbal (or even nonverbal) dialogues and exchanges. For example, allowing for a junior researcher to take the lead of the project during a short period is a *communicative interaction* conveying more trust than any pep talk between the project leader and the junior researcher. Similarly, the act of discussing shared goals and values has more importance than the content or the agreements from the discussion. Co-investigator Zeus made a comparison in the context of chess:

Having people with your strength, your expertise level, I think is really important. Because if you play against, for example, lower rated players all the time, and you beat them 100 games out of 100 games, you're not going to learn much. Or if you play someone and they keep making mistakes all the time, you're most likely not going to learn much. A computer may help a lot…but I always compare that to playing tennis against the wall. They can return every single ball so you don't have the human element…

Without acknowledging and prioritizing this power of communicative interactions, TDKP suffers as miscommunication occurs, friction rises, and collaboration devolves; successful TDKP practitioners are keenly aware of this reality, thus procuring and prioritizing plenty of positive communicative interactions early in any TDKP project.

Faithful Corroboration

While trust stands out as a prerequisite for any successful collaborative endeavor, in TDKP specifically it always starts as a good-faith assumption included within the *curious speculation*—there's an implicit or explicit promise between (and a hope from) would-be collaborators that they can trust each other. But for that assumption and promise to mature, it demands *faithful corroboration*[433] at every stage and with every action and interaction that happens; everything a TDKP practitioner does (or leaves undone or fails to do), will either reinforce or undermine the trust bond between them and Others. Co-investigator Jacob shared an anecdote of such *faithful corroboration*:

> *I learned this with another collaborator many years ago who was born in the 80s: We were the generational transition for the internet. We are not internet native but we learned when we were in our teens or 20s, to do things online so we learned to do some things by email. So, we tend to think: 'OK I write an email and that will be enough.' But my collaborator suggested we forget to talk to the people trying to fix the things that you need. You can write*

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[433] *Faithful* as in 'sincere, honest, reliable, or true;' and *corroboration* from Latin *co-roborare:* 'to make strong together.'

an email just to formalize some things… but talk to people. It's advice that I have been following since then. Talk to people to have a good collaboration…

Every communicative interaction, therefore, carries meaning as *faithful corroboration* of any/all of the three factors of trust:[434] demonstrations of competence/expertise, confirmation of care, or expressions of good character.

Performative Multi-stability

TDKP in practice, even if not in documentation and formalities, manifests *horizontally* in terms of performative structure—collaborators (and shareholders even) have equal and egalitarian standings in their collective. Only when dealing with externalities such as funding, bureaucratic processes, and publishing, do structural disparities of rank, reputation, or job titles have any relevance for TDKP. This *performative horizontality* stands out as one facet or form of the *performative multi-stability* that characterizes TDKP—the organizational structure, functioning, and internal roles of a collective can (and usually dodo) morph into a multiplicity of forms that best adapt to current circumstances or challenges. These changes, however, are neither definitive nor evolutionary, for adaptation isn't the goal of the process; rather, adaptation is a bridge to overcome current, challenging circumstances and arrive to the desired circumstances or outcomes, after which the changes can be reverted or changed to something else. Jacob has been adept to such *multi-stability* in his collaborations:

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[434] Sweeney, Matthews, and Lester, "Trust."

[My collaborator] of this project is someone that's very different from me. We have in common that we both like music, but that's it. He's completely different, you know, politics, visions, different visions of world politics. I'm very methodical…I need to have a good idea of the things, of the music, and this guy would arrive to rehearsals and say 'I don't have the music yet.' That was something that was very, very complicated for me in the beginning. But in the end, I began to understand his process of creation.

Multi-stability in TDKP becomes most obvious in the case of leadership, which tends to be democratized and dispensed across collectives (anyone can be empowered to lead depending on context) during most projects, while it can be concentrated in an individual when circumstances demand it (e.g. somebody has to be listed as principal investigator for funding purposes) or applied nimbly by a designated steering sub-group as a compromise point—yet changing from one to another style of leadership doesn't negate a change back or forth in the future. Organizations, collectives, or individuals who try to practice TDKP while promoting adherence to hierarchies or enforcing strict rules ultimately fail at TDKP by attrition or collaborator/practitioner disengagement.

Subjective Multi-dimensionality

In TDKP, consciously seeking and preferring in the composition of TDKP collaborations a diversity as broad and inclusive as possible in all of its levels (variety, difference, disparity) leads to a *subjective multi-dimensionality* that not only mirrors that of the Nicolescuan theory of transdisciplinarity and corresponds to its *performative multi-stability*, but one that also

effectually affords multiple perspectives, multiple thinking, and most importantly a *paradoxical complementarity* of performative roles in TDKP. *Paradoxical complementarity* refers to every practitioner and/or member of a collective becoming, at once, the complementary opposite of (as well as) the role they perform or embody within the group; for instance, project leaders also must perform at the same time as team members, project stakeholders, and 'followers' if they are to belong and fit in the *subjective multi-dimensionality* and *performative multi-stability* of TDKP.

Sandy expressed her perception of *subjective multi-dimensionality* as:

I have multiple work identities. And it's really hard to introduce myself, as you know, I'm an artist, I'm a researcher, I'm an educator or this or that, because I sound like so many things. But when I'm in my favorite space, that's a combination of all those identities at the same time…

Aside from leadership, the *paradoxical complementarity* of *mentor-apprentice* and *outside-insider* (*brokering*) have particular importance in TDKP. The former means that everyone has knowledge to share and knowledge gaps to fill, thus broadening minds and horizons with their communicative interactions, and this has implications for trust, *performative multi-stability*, and the learning that inherently happens in TDKP. The latter (*brokering*) means that everyone has both enriching, outside perspectives and deeply specialized insights to exchange, all depending on the issue, the context, and the angle under consideration; and this also has implications for *performative multi-stability*, learning, and the outcomes of TDKP. Co-investigator Saul reflected upon his own experiences of *subjective multi-dimensionality:*

> *I think in a real variety of modalities. I've often been in circumstances where I had to take on roles that maybe don't seem connected. In independent studios where I worked, I needed to be the writer, the website, the creator, and the game designer, and the developer… But it was more about understanding other people's perspectives and more about understanding their roles, rather than taking those roles on yourself. It was more about adapting your own discipline to the other disciplines, so that everything will cohere.*

Persistent Knowledge Exchange

While learning stands out as an inherent purpose or habit of mind of TDKP practitioners, for they seek to learn from and about collaborators, communities, projects, opportunities, and more. Yet, learning is but one example of the *persistent knowledge exchange* that characterizes TDKP—the flow of knowledge doesn't stop, and it happens among all the agents and elements of the knowledge ecosystem. Practitioners and collaborators exchange knowledge between them, intentionally learning from each other, but they also exchange knowledge with and within collectives, institutions, their publics, and their environment—and each of these both take and receive knowledge in that exchange, one that revitalizes some knowledge and fossilizes others. For instance, the environment may receive the impact of the technology used (and adapt accordingly), or a public may react against a piece of knowledge originated by researchers that renders a common belief obsolete. Co-investigator Yanni characterized his experience with *persistent knowledge exchange:*

There is a whole section in my studies that focus on the life sciences and all of that. On that specific matter [my collaborator] kind of broaden my understanding and my view of life, and he directed me to some areas of studies that I wouldn't have been aware about. When it came to discuss these theories, not in terms of science but in terms of aesthetics, we didn't share the same language… in the end, it was successful, because of the materials that I was exposed to…

The process of exchange may not occur uninterruptedly or seamlessly, but it does so persistently; if the exchange halts, TDKP fails or already has.

Multi-modal Outcomes

The goals and results of TDKP are never univocal or singular, or confined to a particular format or medium. Even if collaborators agree that their definition of a successful outcome is to publish in an academic journal, that one output usually fulfills multiple goals and carries a variety of impacts; it could satisfy an inner drive for one collaborator and a promotion requirement for the other. Ines provided a clear example of such *multi-modal outcome* for one collaboration with a biologist colleague:

I've written a song about our collaborations, and he will tell me: 'you know, I feel that I feel that my paper has something to do with the song.' I will take imagery from his research, and allegorize our use of metaphor. I use a lot of metaphors and allegories in my writing.

Multi-modal outcomes, whether in essence or outputs, function then as both indicators of success and outlines for TDKP work by defining how the knowledge produced will engender artifacts, performances, impacts, purposes, and desirable futures.

4.5 Discernment & Conclusions

The quantitative findings and phenomenological insights afforded by Project HERMES lead to some particular conclusions regarding successful TDKP practitioners and TDKP's worth in industry settings. First and foremost, these findings and insights provided the foundation for the Transdisciplinary Intelligence Inventory detailed in Section 2.6.6 and Appendix A, which itself serves as a cornerstone of this dissertation and the TDI framework.

For TDKP practitioners as individuals, one can discern that cultivating Engineering and Entrepreneurial Aptitudes may very well be the key to unlocking transdisciplinary potential and amphibian behaviors of any expert, for the data suggests that these aptitudes help in overcoming disciplinary entrenchments and endemic biases when a practitioner ventures beyond two or more areas of expertise.

Bridging the particularly individual and the collectively relevant, *curiosity* stands out as the prime antecedent for collaborations (preceding even trust) and for transdisciplinary endeavors in general. Successes and failures, breakthroughs and insights, trust and effective communication, they all come after curiosity sets things in motion, almost like gravity's inevitable force, for an individual's worldly intrigue or for a boundary-crossing collaboration.

In terms of collectives involved in TDKP, mindfully heterogenous team/group composition supersedes innovative organizational designs, smart processes/policies/procedures, and expert leadership, for the dynamic performance of all these will depend on the breadth of

transdisciplinary aptitudes, knowledge, skills, and behaviors represented and *performed* by the individuals comprising the group—and said group composition must be mindfully conceived and executed in order to resolve the blind spots and groupthink that afflict even the most expert of TDKP teams.

Finally, in relation to knowledge, the most successful TDKP practitioners and collectives thrive when they center the morphological dynamism of knowledge, instead of trying to apprehend perfectly or appease its projective potential—as if trying to grab a fistful of river water or freeze its flow when one ought to navigate that river instead with sails and oars. In other words, successful TDKP entails prioritizing the exchange, translation, repurposing, remixing, and circulation of knowledge, not its definitive codification and classification.

CHAPTER 5

APPRENTICING TRANSDISCIPLINARITY

5.1 Framing Education

Beyond the attention-accumulating and intellectual capital understandings of education as a system and as a network of institutions, a transdisciplinary grasp of it warrants a more 'agnostic' and goodwilled notion of *education*[435] as a phenomenon, one that manifests as the systematized and intentional facilitation of learning at all levels of society (from the individual to global communities).

In Deweyian terms, education framed by transdisciplinary notions entails not only content to be transferred, codified, systematized, and apprehended by learners, but also a shift in attitudes, mental models, and cognitive abilities.[436] Simply put, education in the transdisciplinary realms must both impart relevant knowledge in the form of information and skills, and transform a learner's ways of thinking and behaving towards a more holistic and harmonious grasp of the world—in other words, a more transdisciplinary mindset that allows individuals and communities to thrive in a complex, transdisciplinary world.

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[435] Latin *educere:* "bring out, lead forth; bring up, train" (Online Etymology Dictionary).

[436] Dewey, *Democracy and Education*; Dewey, *How We Think.* Dewey, *Democracy and Education*; Dewey, *How We Think.*

5.1.1 Ecosystem: Institutions & Mission

From a future-building standpoint, knowledge-producing organizations of all kinds belong to the quadruple-helix (and plus) model of innovation,[437] all because of the inherent diffusion and application of knowledge. The model, nonetheless, entails concerns and goals that reach beyond the traditional take on education's role as simply teaching either the citizens or the workforce of tomorrow. Rather, the helix model seeks to understand the true impact of knowledge for all the levels/actors in the system, ranging from educational institutions, to governments (and their agencies), to industry and private sector participants, to entire societies/communities, to the natural environment.

Because of the helix model's more integrative and holistic approach, the TDI framework complements and corresponds to components of the model, for they both understand knowledge production and dissemination as multilayered and *polyphonic*[438] in its aims of and effects for improving the present and crafting desirable futures—all through the use and appreciation of knowledge rich with interconnectedness, foresight, insights, transformative potential, symbolic meaning, practicality, dialogical exploration, and collective cognition. But to accomplish such heroic goals championed by the helix model (or the TDI framework), all the individuals who comprise the institutions, organizations, and whole knowledge-based ecosystems ought to

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[437] Cinzia Colapinto and Colin Porlezza, "Innovation in Creative Industries: From the Quadruple Helix Model to the Systems Theory," *Journal of the Knowledge Economy* 3, no. 4 (December 1, 2012): 343–53, https://doi.org/10.1007/s13132-011-0051-x; Loet Leydesdorff, "The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy?," *Journal of the Knowledge Economy* 3, no. 1 (March 1, 2012): 25–35, https://doi.org/10.1007/s13132-011-0049-4; David Sarpong et al., "Organizing Practices of University, Industry and Government That Facilitate (or Impede) the Transition to a Hybrid Triple Helix Model of Innovation," *Technological Forecasting and Social Change* 123 (October 2017): 142–52, https://doi.org/10.1016/j.techfore.2015.11.032.

[438] Wildman, "From the Monophonic University to Polyphonic Multiversities"; Wildman.

understand their networks as interdependent, interactive, and reciprocally enhancing because and through the knowledge they produce and share, whether casually, intentionally, or by *spillover* through knowledgeable people changing jobs and/or locations.[439] Additionally, only when education within this helix model means including everyone (from experts to lay public to seemingly uninvested actors) in the exchange and dissemination of knowledge, as well as making everyone aware and knowledgeable of the challenges and good practices necessary for that exchange to happen, will the network interactions cumulatively afford the helix model to achieve the desirable futures to which it aspires.

5.1.2 Transdisciplinary Education

Education that serves desirable futures therefore ought to become a transdisciplinary education—not one that simply relies on institutionalizing transdisciplinarity[440] or that encodes transdisciplinary features in general curricula,[441] but rather one that accomplishes both while also conveying transdisciplinarity itself as subject matter, set of skills, and beneficial behaviors for learners (or audiences, end users, or consumers) in the long-term. The latter may strike as counter-intuitive in a field (education) marred by test scores and standardized achievement metrics. The transdisciplinary education needed for desirable futures therefore requires equally that transdisciplinarity be institutionally recognized, supported, and instructionally widespread,

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[439] Rajshree Agarwal, Martin Ganco, and Rosemarie H. Ziedonis, "Reputations for Toughness in Patent Enforcement: Implications for Knowledge Spillovers via Inventor Mobility," *Strategic Management Journal* 30, no. 13 (2009): 1349–74; Jan Whittington et al., "Push, Pull, and Spill" 30 (2019): 69.

[440] Nicolescu, "The Transdisciplinary Evolution of Learning."

[441] Sarah Gehlert, "Turning Disciplinary Knowledge Into Solutions," *Journal of Adolescent Health* 52, no. 5 (May 2013): S98–102, https://doi.org/10.1016/j.jadohealth.2013.02.015.

and that Transdisciplinary Intelligence be offered as a learning program. Considering all the features of transdisciplinary knowledge production, a TDI learning program would differ from traditional education in the following aspects:

- A focus on collaborative skills and mindsets, as well as metacognitive skills, rather than content mastery alone.
- Relying on embodiment and experience for learning facilitated by and personalized through technological tools, thus transgressing upon classroom-type techniques that depend on teacher instruction.
- Continuous learning and practice for personal and systemic transformation, transcending program milestones and individual achievements.
- Translation of content into relevant and curiosity-sparking experiences that enhance learning.

5.2 Learning Theory

Transdisciplinary Intelligence, when considered as a type of expertise in itself, requires a particular set of best practices to cultivate learners' mastery of the knowledge and improve their performance. Because the learning program proposed herein not only emphasizes the learning value of experiences but also envisions technological/multimedia tools as the means to facilitate the learning instead of in-person instruction, the theoretical framework to design this program goes beyond the general cognitive principles of learning (such as chunking, primacy, and

recency)[442] and its key drivers (e.g. curiosity and relevance for motivation[443]) to also include principles from more specialized theories as described in the following subsections.

5.2.1 Interactive Multimodal Learning

Since TDI learning would depend primarily on tech-based tools, such as massive open online courses (MOOCs) and gamified simulations (as described in Section 5.3), the design of such tools takes into account the following principles of interactive multimodal learning: guided activities for cognitive processing, reflection for meaning making, explanatory feedback, self-pacing, and relevant pre-training. [444] These principles ensure that the formats selected for TDI learning enhance rather than merely facilitate the comprehension of the content.

5.2.2 Authentic Learning

Because TDI would be a kind of 'usable knowledge' that learners can grasp the best in situated learning environments, the design of the program ought to: provide authentic, real-life contexts, activities, experts (for modelling performance), and multiple perspectives; promote reflection, articulation of tacit knowledge, and collaborative construction of the knowledge (i.e.,

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[442] Judy Calder, "Teaching Tools & Techniques," *Journal of Teaching in Marriage and Family* 6 (2006).

[443] Boyd E. Rossing and Huey B. Long, "Contributions of Curiosity and Relevance To Adult Learning Motivation," *Adult Education* 32, no. 1 (September 1, 1981): 25–36, https://doi.org/10.1177/074171368103200102; G. Pluck and H. L. Johnson, "Stimulating Curiosity to Enhance Learning," *GESJ: Education Sciences and Psychology* 2 (19) (December 31, 2011), http://gesj.internet-academy.org.ge/en/title_en.php?b_sec=edu.

[444] Roxana Moreno and Richard Mayer, "Interactive Multimodal Learning Environments," *Educ Psychol Rev*, 2007, 19.

make learners help under learners); and furnish critical coaching, scaffolding, and assessment within the tasks.[445]

5.2.3 Experiential Learning

Related to the aspects and goals of the aforementioned situated learning, experiential learning theory derives from the work of Dewey, Kolb, Freire, and others, and focuses on "learning by doing" in its simplest form; more specifically, it means to "immerse adult learners in an experience and then encourage reflection…to develop new skills, new attitudes, and new ways of thinking."[446] Because it is one of the preferred frameworks for adult education, experiential learning stands out in relevance for the design of a TDI training program. Whether field-based or 'classroom-based' (which more accurately means 'not in a real-world setting' such as role-playing activities and simulations), experiential learning principles to consider include: providing present or reconstructing past concrete experiences, performing reflective observation, integrating ideas and concepts from observations, and applying those ideas to solving problems and making decisions.[447] The goal of experiential learning, therefore, consists not only of "[helping] students relate theory to practice and analyze real life situations in light of course

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[445] Jan Herrington and Ron Oliver, "An Instructional Design Framework for Authentic Learning Environments," *Educational Technology Research and Development* 48, no. 3 (2000): 23–48.

[446] Linda H Lewis and Carol J Williams, "Experiential Learning: Past and Present," *New Directions for Adult and Continuing Education* 1994, no. 62 (1994): 5–16.

[447] Lewis and Williams.

materials,"[448] but also "[encouraging] individuals to become continuous learners, to extract meaning from their experiences, and to pass the learning along in collaborative contexts."[449]

5.2.4 Deliberate Practice

As a widely-recognized source of expertise, deliberate practice manifests as a kind of experiential learning, for it entails purposeful, repeated engagement in practice/rehearsal tasks with immediate feedback under the supervision of an expert or trainer[450]—precisely a combination of elements or characteristics of experiential learning. In other words, expertise requires a performative practice that's "enacted and embodied, rather than possessed or applied…[integrating] knowledge and skills into particular ways of being in the world."[451] Through deliberate practice, the learner improves their performance of expertise, transforming from novice to competent to proficient, eventually becoming the expert who can reach a level of flow at peak performance.[452] Expertise in TDI terms, however, demands deliberate practice not of one's chosen field of knowledge or profession, but of collaboration in transdisciplinary knowledge production, along with enough experience in foreign areas of expertise to grasp a common understanding.[453]

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[448] Durga Lekshmi Lekshmi, "4 A Plan for Instruction: An Innovative Instructional Plan for Multi-Discipline," *Purakala with ISSN 0971-2143 Is an UGC CARE Journal* 31, no. 46 (2020): 209–24.

[449] Lewis and Williams, "Experiential Learning: Past and Present."

[450] Dew et al., "Toward Deliberate Practice in the Development of Entrepreneurial Expertise."

[451] Dall'Alba, "Reframing Expertise and Its Development."

[452] Eugene Mario DeRobertis, *The Phenomenology of Learning and Becoming* (Palgrave Macmillan, 2017).

[453] Priaulx and Weinel, "Connective Knowledge."

5.2.5 Apprenticeship

Apprenticeships, in which a novice-student learns under the direct supervision of a mentoring expert, have been the de facto learning model for centuries[454] (and currently, a favorite of the European Union[455]) of not only crafts, trade jobs, and vocational occupations (including teaching and medicine),[456] but also a prefer method for *professional learning*[457] in areas such as scientific/academic research and filmmaking. The film industry in particular relies on apprenticeships for educating and assimilating new generations of members into the community of practice, from the guilds and specialized associations (e.g. editors, cinematographers, directors) that institutionalize apprenticeships as programs and membership requirements, to the more informal expectations that all filmmakers start as multi-functional 'PAs' (production or personal assistants) working under executives or established filmmakers in order to 'learn the ropes' and the 'tools of the trade.' Even film schools tout the access and range they provide to practical, in-the-field opportunities as main features of their undergraduate and graduate programs, over any course content or film scholar serving as professor.

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[454] Michael Gessler, "Concepts of Apprenticeship: Strengths, Weaknesses and Pitfalls," in *Handbook of Vocational Education and Training*, ed. Simon McGrath et al. (Cham: Springer International Publishing, 2019), 1–34, https://doi.org/10.1007/978-3-319-49789-1_94-1.

[455] Pekka Kämäräinen, "Research as Mediator between Vocational Learning, Work Process Knowledge and Conceptual Innovation–on the Role of Research in the Modernisation of Vocational Education and Training (VET)," n.d.; Melissa Johnson and Katie Spiker, "Broadening the Apprenticeship Pipeline," 2018, 12.

[456] Selena Chan, "From Job to Calling: Vocational Identity and the Role of Apprenticeship," *Vocations and Learning*, April 13, 2019, https://doi.org/10.1007/s12186-019-09220-5.

[457] Evan M. Glazer and Michael J. Hannafin, "The Collaborative Apprenticeship Model: Situated Professional Development within School Settings," *Teaching and Teacher Education* 22, no. 2 (February 2006): 179–93, https://doi.org/10.1016/j.tate.2005.09.004.

Learning through apprenticeships accomplishes three main goals: it facilitates the transfer of both explicit (content knowledge and skills) and tacit knowledge inherent to a job through cognitive apprenticeship processes (e.g. exposure, observation, mentoring);[458] it allows for both 'skilling up' existing workers[459] and streamlining students' passage from school to industry settings, thus tightening the bonds between knowledge and labor[460] (which can even have an impact in the financial reality of the students) and between academia and industry;[461] and it reframes learning from the epistemological (knowing) to the ontological (being),[462] meaning that those who are apprenticed into the film industry, for instance, learn not only about filmmaking but ultimately how to be professionals in that particular industry.[463]

Simply put, apprenticeships have proven to provide a way to learn the full extent of what performing a particular expertise requires, one in which the guidance and interaction with the *mentoring expert*[464] become the liminal space in which to re-frame experiences and exchange

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[458] Hayden Fennell et al., "Computational Apprenticeship: Cognitive Apprenticeship for the Digital Era," preprint (SocArXiv, September 28, 2019), https://doi.org/10.31235/osf.io/jy328; Lynette Stockhausen and Craig Zimitat, "New Learning: Re-Apprenticing the Learner," *Educational Media International* 39, no. 3–4 (January 2002): 331–38, https://doi.org/10.1080/0952398022000036164.

[459] Ervin Dimeny and others, "Skilling Up: The Scope of Modern Apprenticeship.," *Urban Institute*, 2019.

[460] Mandy Crawford-Lee and Sam Moorwood, "Degree Apprenticeships: Delivering Quality and Social Mobility?," *Higher Education, Skills and Work-Based Learning* 9, no. 2 (May 13, 2019): 134–40, https://doi.org/10.1108/HESWBL-05-2019-123; Hanna Moon, "Unleashing Apprenticeship: From Onboarding to Professional Development," *European Journal of Training and Development* 42, no. 1–2 (February 19, 2018): 110–24, https://doi.org/10.1108/EJTD-06-2017-0056; Siobhan Magner and Naomi Jackson, "Apprenticeships: Bringing College to the Workplace," n.d., 6; Thomas Deißinger et al., *Contemporary Apprenticeship Reforms and Reconfigurations* (LIT Verlag Münster, 2019); David Goodman, "The Apprenticeship Experience at University:" 26, no. 2 (2019): 14; Tamar Jacoby and Robert I Lerman, "Industry-Driven Apprenticeship," n.d., 84.

[461] Crawley et al., *Universities as Engines of Economic Development*.

[462] Gloria Dall'Alba, "Learning Professional Ways of Being: Ambiguities of Becoming," *Educational Philosophy and Theory* 41, no. 1 (January 2009): 34–45, https://doi.org/10.1111/j.1469-5812.2008.00475.x.

[463] Michael G. Pratt, Kevin W. Rockmann, and Jeffrey B. Kaufmann, "Constructing Professional Identity: The Role of Work and Identity Learning Cycles in the Customization of Identity among Medical Residents," *The Academy of Management Journal* 49, no. 2 (2006): 235–62.

[464] What would traditional be called "the master," but which has undesirable racial and colonialist implications).

new knowledge through imitation, observation, advise, and deliberate practice—elements needed for gaining true competency in TDI.

5.2.6 Team Training Models

TDI naturally includes collaborative skills which demand their own particular learning models—being an expert in a knowledge domain does not equal being an expert at collaborating, just like "a team of experts is not the same as an expert team."[465] Collaborative expertise more commonly refers to 'effective team performance' or 'expert teamwork,' which is characterized by "contributing to and facilitating teamwork processes…[such as] team adaptation, shared cognition, team leadership, team composition, and the ability to overcome challenges."[466] Shared cognition has been identified as the hardest to accomplish and the cornerstone of these interdependent processes, manifesting as *shared mental models* (a shared understanding of systems and patterns) and *team meta-cognition* (awareness of how the team thinks collectively); however, both of these latter two can be developed and improved upon through *cross-training*, a type of learning which "introduces team members to the roles and responsibilities of their teammates…contributing to team communication, coordination, and…[anticipation and assistance] of other members."[467] Cross-training has three general modalities according to their methodological depth: clarification (discussing or presenting the characteristics of the roles),

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[465] Shirley C. Sonesh et al., "What Makes an Expert Team? A Decade of Research," in *The Cambridge Handbook of Expertise and Expert Performance*, ed. K. Anders Ericsson et al., 2nd ed. (Cambridge University Press, 2018), 21–32, https://doi.org/10.1017/9781316480748.002.

[466] Sonesh et al.

[467] Michelle A. Marks et al., "The Impact of Cross-Training on Team Effectiveness.," *Journal of Applied Psychology* 87, no. 1 (2002): 3–13, https://doi.org/10.1037/0021-9010.87.1.3.

modeling (such as 'shadowing' or watching recordings), and rotation (literally performing each of the different jobs for a limited time with basic training).[468] Because any role includes hard-to-discuss tacit knowledge within its duties and tasks, modeling and rotation cross-training work better in improving the performance of expert teams, for their highly technical nature adds levels of complexity that can be grasped only through careful observation or direct experience. In fact, in-depth cross training has been recommended for interdisciplinary research and team science so that "individual members no longer focus only on their own task [and instead] connect that task to a more integrated overall understanding of the task and their teammates' roles in accomplishing it."[469] Furthermore, broader and more detailed team training such as crew resource management (CRM), in which an expert team rehearses their performance in different challenging scenarios before they face them in real settings, prepares expert teams for peak performance not only standard circumstances but also in abnormal situations by reducing the chance of errors and promoting continuous learning.

Ultimately, team training and cross-training provide a foundation for TDI learning that promises to enhance collaboration among experts and stakeholders, while improving the odds of success by mitigating pitfalls and improving shared understandings.

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[468] Marks et al. Marks et al.

[469] Stephen M. Fiore, "Interdisciplinarity as Teamwork: How the Science of Teams Can Inform Team Science," *Small Group Research* 39, no. 3 (June 2008): 251–77, https://doi.org/10.1177/1046496408317797.

5.3 TDI Training Program: Apprenticeship & Simulation

With the aforementioned learning models and transdisciplinary educational goals in mind, the Transdisciplinary Intelligence Training (TDIT) method (?) comprises two programs that combine and represent the most meaningful characteristics of experiential learning, deliberate practice, and team training in order to develop learners' expertise in TDI—a multimodal apprenticeship and a simulation game. The TDI apprenticeship intends to facilitate the acquisition, through virtual experiences, of knowledge, skills, and a small dose of desirable behaviors for TDI, all which can then be practiced purposefully and iteratively in the TDI simulation until the trial-and-error at play lead the learner from novice to expert—all without having to fail at a real-life transdisciplinary knowledge production project first to learn how to perform the next one better.

5.3.1 TDI Apprenticeship

The apprenticeship program in TDI, as described in more detail in Appendix F, has been designed as a guided exploration of the thirteen ways of knowing, thinking, and being that comprise a holistic TDI approach. The apprenticeship program manifests as a 14-module MOOC that uses text, video, sound, interactions with 'classmates' and a course facilitator, and experience-based assignments. Throughout the modules, learners analyze case studies, reveal their existing knowledge and biases through authentic assessments, are exposed to the perspectives of fellow learners and historical exemplars, reflect on past experiences and imagine future ones, find meaningful interconnections and applications for what they learn, and overall sample those TDI ways of being and thinking while exploring the contours and content of the

apprenticeship. Ideally, by the end of the course, the learner will be better positioned to identify the different ways of being and thinking in others, and to identify and adapt between the ways on their own actions and decision-making.

5.3.2 TDI Simulation

Simulation games have exceled at facilitating the acquisition of complex knowledge and skills thanks to varied deliberate practice and embodied learning,[470] particularly for high-risk/high-stakes settings in which mistakes during real-life practice could have disastrous or fatal consequences, such as surgical procedures, military operations, and flying aircraft.[471] By allowing experimentation of different situations/scenarios, such as simulating flights in harsh weather, while also allowing for repeated attempts and "safe failures," simulation games provide qualified practice and experiences that otherwise would be hard to rehearse for in real life. Additionally, in the cases of team-based simulations, the repeat participation of the team members contributes to accelerated team building, cross-training, and overall performance improvement, for the simulations can substitute months or years of experienced collaboration, to a degree that permits team members to anticipate and support each other's actions in a variety of situations.[472]

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[470] Eduardo Salas and Janis A. Cannon-Bowers, "The Science of Training: A Decade of Progress," *Annual Review of Psychology* 52, no. 1 (February 2001): 471–99, https://doi.org/10.1146/annurev.psych.52.1.471.

[471] Caroline E. Zsambok and Gary A. Klein, eds., *Naturalistic Decision Making*, Expertise, Research and Applications (Naturalistic Decision Making Conference, Mahwah, N.J: L. Erlbaum Associates, 1997).

[472] Eduardo Salas, Gerald F. Goodwin, and C. Shawn Burke, *Team Effectiveness In Complex Organizations: Cross-Disciplinary Perspectives and Approaches* (New York, United States: Taylor and Francis, 2008), pp. 535-536. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=381324.

Beyond the well-established training benefits, simulation games also allow for a *procedural rhetoric*[473] take on the phenomenon they emulate—that is, the simulation mechanics and overall design stand themselves as statements regarding the challenges and complexities of the phenomenon. For instance, a combat simulator makes a procedural rhetoric point about the difficulty and ethics of war when the simulation terminates a mission scenario ('fails') when a user shoots a civilian target.

Upon these foundations of deliberate practice, experiential learning, and procedural rhetoric, a TDI Simulation (TDISim), as designed and described in Appendix G, would round out the TDI Training by building upon the learning successes of the TDI apprenticeship, by providing a low-stakes iterative environment in which emerging TDI experts can deliberately practice and improve their performance, by allowing for collaborative experience (with either real or virtual teammates) prior to real-world deployments, and by using procedural rhetoric to expose and explain the nuances, complexities, and systemic challenges of transdisciplinary knowledge production. The latter aims to enlighten not only TDI experts-in-training, but also key stakeholders, such as funders and institutional leaders, whom the TDI simulation would cross-train in how their choices, demands, and expectations can precipitate the failure or launch the success of a TDKP project in their sphere of influence. The TDI simulation would accomplish all of this through its interface and gameplay, which would together make explicit all the activities (as game options) which a TDI practitioner must perform and all the considerations (listed in the TD2I) they ought to balance and negotiate in order to succeed in TDKP projects—which

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[473] Ian Bogost, "Procedural Rhetoric," *Persuasive Games: The Expressive Power of Videogames*, 2007, 1–64.

inevitably fail if there's not an integral awareness of 'how the game is played' by TDI practitioners and key stakeholders alike. For instance, with its game mechanic of keeping score of the Institutional Trust for the user's virtual project, the TDI simulation would show a TDI expert-in-training that the score can go up by having regular meetings with the institutional supervisor and by keeping up with bureaucratic procedures; but the simulation mechanic would also show that by choosing those activities over others, items like the knowledge production itself may decrease and other scores may lag to the detriment of the mission. Similarly, that same mechanic would show to a funder or institutional leader that too many meetings or bureaucratic requirements (which they set) may have good intentions but can potentially crater a TDKP project by squandering (or hoarding) two of the most valuable resources: time and attention.

Ultimately, the TDI simulation would afford TDI experts-in-training to hone all of their skills, strategically and deliberately, without the fear of failure warranted in a real-world situation.

5.4 Future Interventions & Implications

While the TDI simulation remains as merely a design on paper due to lack of development time and resources, the TDI Apprenticeship program is currently available as a self-guided/self-paced MOOC. However, the onset of the COVID19 pandemic interfered with the possibility of executing experimental interventions for the validation of the TDI apprenticeship. I fully intend to develop a working version of the TDI simulation after finishing the doctoral program, in order to test and measure the effectiveness of the TDI Training Program as a whole according to the constructs and instruments detailed in Sections 2.6 and 4.3, and of the apprenticeship and the simulation too (separately). Such interventions will be out in real-world

settings rather than controlled lab experiments, thus deploying the tools and metrics within teams and organizations seeking to understand and improve their TDKP capabilities—and the findings from such interventions will undoubtedly prompt iterative improvements and fine-tuning of the instruments, the apprenticeship and simulation, and perhaps even the TDI framework itself.

CHAPTER 6

TRANSDISCIPLINARY BOUNDS

6.1 Limitations

The research project described herein has aimed for comprehensiveness rather than for exhaustiveness, as an instantiation of the transdisciplinary ideals behind it—breadth and connection, not inscrutable and isolating specialization. This decision had different effects for the scope (and thus limitations) of each chapter explored, as well as distinct implications for the future: my own, of others, and of research and knowledge itself.

Chapter 1 explores and connects the understandings and histories of knowledge, labor, and expertise across diverse domains and discourses not to provide ultimate definitions of that interrelated triad, but to unveil the threads that weave the fabric of the research and ideas in the other chapters and their positioning within the network of existing, *legacy* theories and practices. Future research could and should delve deeper into the ramifications for each domain and discourse of such networked, multidimensional, transdisciplinary understandings of knowledge, labor, and expertise as those imbue through disparate discourses, such as knowledge management, science of team science, information sciences, and political economy, just to name a few. My own research, thanks to this doctoral project, will always base considerations of industry ecosystems and other analyses of collective and organizational performance(s) upon the cornerstone of those transdisciplinary understandings.

Chapter 2 provides an expansive yet admittedly ever-incomplete survey of the existing (whether widely evident, sneakily hidden, or rapidly emergent) work focused on transdisciplinary

knowledge production, with the intention to distill it all according to commonalities and patterns instead of single-mindedly deconstructing contradictions, paradoxes, and shortcomings of that diverse work. Future research tagged as transdisciplinarity and transdisciplinary studies should investigate how well the *transdisciplinary intelligence* framework, with its metrics and inventory, applies to (and perhaps fails in) a variety of specific conditions[474] of projects, people, organizations, and contexts—all which may aid to enhance the framework by reaffirming its successes and studying its areas of improvement as revealed by particular challenges and conditions.

Chapter 3 attempts not so much to rewrite the histories therein, as much as re-read them with a TDI lens. The mixed historical-methods approach, as mentioned before, was hence limited in its interpretation of primary sources (which would be preferred in a more traditional approach), focusing instead mostly on existing, excellent, and well-documented secondary sources, for such narratives lent themselves better for a TDI rereading. Future research may look closer at the primary sources to confirm or disprove the transdisciplinarity claims suggested by rereading the secondary sources.

Chapter 4 capstones my doctoral fellowship experience as manifested by Project HERMES. Even though it unfolded as an evolving 4-year project, its execution and conclusion were critically affected by the onset of the COVID-19 pandemic, meaning that the ethnographic thoroughness (e.g., site visits to knowledge production groups) and phenomenological rigor (including in-person sessions with co-investigators to embody truly the inter-subjectiveness)

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[474] I admit that I believe that the tools of TDI apply (and succeed) universally, but that's just the type of zeal that ought to drive a doctoral project.

could not be accomplished as originally intended, at least during the timeframe afforded. Future efforts may replicate the project, in whole or in part, as originally planned, as well as delve deeper into aspects related to that embodied presence that had to be precluded given current global affairs.

Chapter 5 offers a blueprint[475] for the future of transdisciplinary knowledge production, one based upon learning and intentional experiences that appropriate the dark human instincts of biases and ruthless competition, and retools these for the sake of self-knowledge and growth. While the architected apprenticeship program and simulation game are left clinically untested or simply propositional (respectively), such limitations also signal towards their future: design and implementation in the field of the real world, reiterating to improve upon their design and content, just like the training itself ought to develop.

Limitations, nonetheless, should not qualify as deterrents to do something worthwhile albeit imperfect and incomplete, but as indicators of where to go and what to do next in order to strive towards that improved future.

6.2 Critiques & Its Discontents

Aside from critiques based on limitations and methodological concerns addressed in the previous section, there also exist objections that are philosophical and teleological in nature with regards to the research herein, its meaning, and its intentions.

[475] And some would say Trojan-horse manifesto.

Transgressive-minded scholars may object both to the "instrumentalization" goal of the research overall and to my penchant to distill and synthetize rather than *deconstruct & problematize* the concepts and issues raised; such objections may even seek to question the academic validity of the project in general and of my doctoral experience in particular. Those objections and doubts, however, would be misplaced, for I never rooted my intentions in academic contestations but in worldly performance and demonstrations that bring the theory (albeit represented in more accessible, or at least less daunting, terms) in contact with the realities of public spheres and private lives. Knowledge detached from reality, kept in the hallowed halls of Ivory Towers, simply stagnates instead of sublimating into popular wisdom and societal change.

The same scholar may also object to my considerations of identity and culture in relation to something as profane as industry and professions, as if doing so somehow demerits or debases such life-defining constructs when referring to gender, sexuality, race, ethnicity, socio-economic status, or disability. I posit precisely the opposite: that my consideration of identity herein can serve as a gateway towards empathy, understanding, and normalization of marginalized identities, for the hegemonic majority struggles to imagine (let alone grasp) the nuances and viewpoints of the marginalized Other(s), but almost everyone and anyone can identify the implications of belonging (or not belonging) in relation to their jobs. When trying to enlighten someone, that cannot be done by shouting (or even cleverly arguing) them out of the darkness; the way to have them leave the shadows is to meet them where they are and share a (familiar) torch that they can use to light their way out of the cave of ignorance and disbelief.

More normative-minded scholars may judge my research as deviant because I 'didn't focus enough,' whether on their own comfortable domain, or a favorite author-scholar/thought tradition, or preferred methodology/style. These scholars may delegitimize the work herein according to ideologies, implicit or explicit, of what constitutes 'true, worthy & appropriate' research. Such determination would be accurate in one regard only—the research herein is in fact deviant by design, for it had to deviate from the standards of research paradigms that have proven deficient in grasping integrally the multiplicities and complexities of phenomena beyond their discrete areas of interest, expertise, or concern. Paradigms, after all, do shift over time, particularly when the boundary of the known world overflows the limits of the paradigm; but paradigm shifts never occur without challenging or breaking the norm(s).

Regardless of the source or motives behind critiques, they ought to remain as restricted examinations or qualified judgments of a deliberately *abnormal*[476] approach to research, rather than absolute condemnations of such work, for that only repeats the mistakes and prejudices of the past,[477] which have systemically hindered the contributions to science and participation in innovation ecosystems of those who tend to make the radical breakthroughs—women and minorities.[478] If mere critiques can invalidate or marginalize new knowledge (and/or their agents/producers) that challenge the status quo, who then will critique the critics? Who will watch the watchmen?

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[476] As in atypical and non-conforming to the norms.

[477] As delineated in Section 1.xxx.

[478] Adrián A. Díaz-Faes et al., "Do Women in Science Form More Diverse Research Networks than Men? An Analysis of Spanish Biomedical Scientists," ed. Cassidy R. Sugimoto, *PLOS ONE* 15, no. 8 (August 27, 2020): e0238229, https://doi.org/10.1371/journal.pone.0238229; Bas Hofstra et al., "The Diversity–Innovation Paradox in Science," *Proceedings of the National Academy of Sciences* 117, no. 17 (April 28, 2020): 9284–91, https://doi.org/10.1073/pnas.1915378117.

6.3 *Eppur Si Muove…*

Ultimately, the more general and well-meaning critique may be raised that my research neither advocates zealously for radical, structural transformations (much needed to adjust troubling inequities in our society), nor does it propose an unequivocal solution to a single pressing problem from the many plaguing our fraught, overpopulated, polluted, almost-doomed world—and both shortages have derived from conscious decisions and design. My research never intended to generate an ideological '*roadmap'* towards global salvation or a utopic society; rather, I aimed to craft and provide a reliable metaphorical '*compass'* (and perhaps bundle a '*machete'* too, to hack through the wilderness and the irrelevant) with which the problem-solvers and citizen of tomorrow can learn to find the paths towards such promising futures in spite of the messy, entangled presents. Most of the time, the wellbeing and life of a sick patient doesn't depend on developing groundbreaking new therapies or novel surgical procedures, but simply on establishing healthy habits/conditions and ensuring that the medical team keeps their mistakes as close to zero as possible—precisely what the TDI framework means to accomplish for those who take knowledge production and collaboration seriously in their efforts to solve collectively the problems of our societies and our world today, tomorrow, and beyond.

Regardless of knowledge limitations, regardless of paradigmatic critiques, and regardless of unattainable ideals, time keeps running and the world keeps moving—whether we move forwardly along, or fall and get left behind.

CHAPTER 7

TRANSDISCIPLINARY FUTURES

7.1 Future Implications

7.1.1 Transdisciplinary Research

This dissertation advances knowledge by bridging the gaps between and synthesizing the findings from the science of team science, organizational & management science, and transdisciplinary studies. By adapting tools and methods designed to measure ethno-cultural diversity in groups,[479] and then applying them to knowledge production settings (which manifest all the traits of culture in their respective disciplinary ways of knowing), not only can future collaborative research efforts be improved through better design, but also current research collaborations and teams could be optimized through training, reorganization, or other types of interventions.

Similarly, this project offers a new framework and tools to evaluate the performance, creativity, and innovation of groups according to a dimension of '*disciplinary heterogeneity'* previously overlooked by management sciences, science & technology studies, and science of team science research (but habitually examined by psychological, organizational, and communication sciences when dealing with teamwork performance, expertise, and creativity[480]).

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[479] Hofstede, "The Cultural Relativity of Organizational Practices and Theories"; Ang and Dyne, *Handbook of Cultural Intelligence*; Janet A. Harkness, Fons J. R. van de Vijver, and Peter Ph Mohler, *Cross-Cultural Survey Methods* (J. Wiley, 2003); Gudykunst, Mody, and Asante, *Handbook of International and Intercultural Communication*.

[480] Fiore, "Interdisciplinarity as Teamwork."

Lastly, the findings of this doctoral project expand the notion of transdisciplinarity at the individual, collective, and metacognitive levels, thus building upon current understandings based solely upon practices, institutional boundaries and barriers, or a problem-solving discourse.

7.1.2 Industries and Jobs of Tomorrow

Employers have indicated the need for the rising generation of employees to be able to think beyond their areas of expertise in creative as well as in analytical modes,[481] in order to be prepared for 'the jobs of the future.' More importantly, such thinking modes are critical for undoing the shallowness of work (instigated by the specialization of knowledge and the Industrial Revolution) by turning unskilled and skilled labor forces into skill-full and knowledge-able citizens who discern the systematic issues afflicting their worlds and who actively participate in and contribute to redesigning their futures. However, few publicly available tools and educational programs actively integrate these ways of thinking, especially for job training. The findings herein directly lead to the design of transdisciplinary apprenticeship modules and simulations meant to train participants in skills that have proven resilient to tech disruptions affecting industries and employment. By prompting hybridity of knowledge and skills, such apprenticeship modules and simulations provide a viable alternative approach to the business-centric *'T-shaped'* job training,[482] one that anticipates the implications of remote work, artificial

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[481] Jill Casner-Lotto and Linda Barrington, *Are They Really Ready to Work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century US Workforce.* (ERIC, 2006).

[482] Barile et al., "Structure and Dynamics of a 'T-Shaped' Knowledge"; Hansen, "Introducing T-Shaped Managers"; Karjalainen, Koria, and Salimäki, "Educating T-Shaped Design, Business and Engineering Professionals"; Neeley and Steffensen, "The T-Shaped Engineer as an Ideal in Technology Entrepreneurship: Its Origins, History, and Significance for Engineering Education"; Neeley and Steffensen; Oskam, "T-Shaped Engineers for Interdisciplinary Innovation: An Attractive Perspective for Young People as Well as a Must for Innovative Organisations."

intelligence, automation, and biotech, just to name a few imminent disruptions to the labor market.

Also in terms of innovation, its practice and diffusion benefit from the findings and products of this dissertation work, for it is meant to promote the development of transdisciplinary/'*T-shaped*' skills and sensibilities that prompt entrepreneurship, innovative disruptions,[483] along with solutions to the wicked problems of the world and social-impact breakthroughs. Not only would university research groups be better equipped and prepared to design their teams and collaborative endeavors with the tools herein, but private R&D teams and companies would also be provided with an additional means to asses and refine their competitive constitution, performance, and insight potential, similar to the popular "moneyball" approach developed and popularized by sports teams.[484] This can be done then by a wide array of key knowledge-producing industries, including the creative industries, defense & intelligence, and the non-profit sector. The education sector could also benefit by having an additional framework (Transdisciplinary Intelligence) upon which to build (and measure) educational interventions in the STEM/STEAM field. After all, several decades of research have supported the proposition

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[483] E.P. Lazear, "Entrepreneurship," *Journal of Labor Economics* 23, no. 4 (2005).

[484] Michael Lewis, *Moneyball: The Art of Winning an Unfair Game* (W. W. Norton & Company, 2004); J Scott Armstrong and others, "Predicting Job Performance: The Moneyball Factor," *Foresight: The International Journal of Applied Forecasting* 25 (2012): 31–34; Richard Wolfe, Patrick M. Wright, and Dennis L. Smart, "Radical HRM Innovation and Competitive Advantage: TheMoneyball Story," *Human Resource Management* 45, no. 1 (2006): 111–45, https://doi.org/10.1002/hrm.20100; Armstrong and others, "Predicting Job Performance: The Moneyball Factor"; Lan Wang and Rick Cotton, "Beyond *Moneyball* to Social Capital inside and out: The Value of Differentiated Workforce Experience Ties to Performance: Beyond Moneyball to Social Capital inside and Out," *Human Resource Management* 57, no. 3 (May 2018): 761–80, https://doi.org/10.1002/hrm.21856.

that an interdisciplinary, collaborative, doing-based model of STEM curriculum promotes student learning objectives, even more so when integrating arts and design.[485]

7.1.3 Our World… If We Can Keep It

Ultimately, I aspire through this dissertation to offer an adaptable framework of transdisciplinary knowledge work that contributes to solving the wicked problems of our world more consciously, doing so by bridging the differences (derived from specialization) in epistemologies and worldviews that have become major barriers to successful collaboration in matters of producing and legitimizing both new and indigenous knowledge.[486] Specifically, I seek to facilitate a better design and management of any and all collaborative efforts meant to improve our world, as these transcend areas of expertise and the public and private sectors of society through a transdisciplinarity that becomes the established paradigm for our understanding of what and how research happens as knowledge work—a paradigm that is democratized, communal, inclusive & integrative, ethical, and sustainable in principle, in execution, and by design. And the world needs this paradigm shift to happen soon, because the wicked problems continue to threaten us while the attempts at solving them keep being insufficient, flawed, and prejudicial to people and the environment in ways that transdisciplinary principles could have prevented.

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[485] Patrick Caton et al., "Amping-Up Pedagogy through Interdisciplinary Instruction," *Journal of Interdisciplinary Studies* 6, no. 1 (n.d.): 2017.

[486] Baptista et al., "SHAPE-ID: Shaping Interdisciplinary Practices in Europe Deliverable 2.3: Final Report on Understandings of Interdisciplinary and Transdisciplinary Research and Factors of Success and Failure Project Information"; Frodeman, Klein, and Pacheco, *The Oxford Handbook of Interdisciplinarity*; Klein, "Evaluation of Interdisciplinary and Transdisciplinary Research."

APPENDIX A

TRANSDISCIPLINARY INTELLIGENCE INVENTORY

INDIVIDUAL: INTRAPERSONAL

My Individual **Transdisciplinary Intelligence Balance** is:						
No score ◯ -1	Score of 0 ◯ 0	Score of 1 ◯ 1	Score of 2 ◯ 2	Score of 3-4 ◯ 3	Score of 5 ◯ 4	Score of 6-7 ◯ 5
My **resilience/grit** can be described as:						
Failure isn't an option ◯ -1	◯ 0	I don't endure adversity ◯ 1	◯ 2	I recover from adversity ◯ 3	◯ 4	I grow from challenges ◯ 5
My disposition toward **learning** is:						
I know what I need already ◯ -1	◯ 0	I don't have enough time ◯ 1	◯ 2	I'd like to learn new things ◯ 3	◯ 4	I'm always learning ◯ 5

My **character strengths**, ranked from strongest (1) to weakest (24), are:

____ Appreciation of Beauty	____ Bravery	____ Creativity	____ Curiosity
____ Fairness	____ Forgiveness	____ Gratitude	____ Honesty
____ Hope	____ Humility	____ Humor	____ Judgment
____ Kindness	____ Leadership	____ Love	____ Love of Learning
____ Perseverance	____ Perspective	____ Prudence	____ Self-Regulation
____ Social Intelligence	____ Spirituality	____ Teamwork	____ Zest

INDIVIDUAL: SITUATED

My leader(s) and peers **respect** me:						
Only when it's convenient ◯ -1	◯ 0	Out of professionalism ◯ 1	◯ 2	For my expertise ◯ 3	◯ 4	As a trusted colleague ◯ 5
My **communication** experience with/from others is:						
Closed and difficult ◯ -1	◯ 0	Slow and incomplete ◯ 1	◯ 2	Regulated and formal ◯ 3	◯ 4	Open and constructive ◯ 5
Collaboration with others is:						
Not advised ◯ -1	◯ 0	Rigid and formal ◯ 1	◯ 2	Casual and distributed ◯ 3	◯ 4	Dynamic and cooperative ◯ 5
I find **policies, processes, and procedures**:						
Difficult and distracting ◯ -1	◯ 0	Complicated ◯ 1	◯ 2	Necessary ◯ 3	◯ 4	Simple and helpful ◯ 5
My level of **trust** for my leader(s) and peers can be described as:						
I actively distrust them ◯ -1	◯ 0	◯ 1	◯ 2	◯ 3	◯ 4	Full and reciprocal ◯ 5
My **opportunities to lead** can be described as:						
I've been punished for it ◯ -1	◯ 0	Leading isn't part of my job ◯ 1	◯ 2	I sometimes get to lead ◯ 3	◯ 4	I have a leadership role ◯ 5
My **mentors** can be described as:						
Mentoring is not an option ◯ -1	◯ 0	I would like mentoring ◯ 1	◯ 2	I have a formal mentor ◯ 3	◯ 4	I have formal and informal mentors ◯ 5

I **belong to my group** because they:						
I don't belong or fit ◯ -1	◯ 0	Advance my goals ◯ 1	◯ 2	Share my worldview ◯ 3	◯ 4	Share my goals and values ◯ 5

COLLECTIVE: INTERRATIONAL

The **culture** of the group can be described as:						
Divided into subgroups ◯ -1	◯ 0	Confrontational ◯ 1	◯ 2	Still in development ◯ 3	◯ 4	Harmonious ◯ 5
Communication within the group is:						
Closed and difficult ◯ -1	◯ 0	Slow and incomplete ◯ 1	◯ 2	Regulated and formal ◯ 3	◯ 4	Open and constructive ◯ 5
Collaboration with others is:						
Not advised ◯ -1	◯ 0	Rigid and formal ◯ 1	◯ 2	Casual and distributed ◯ 3	◯ 4	Dynamic and cooperative ◯ 5
The group's **policies, processes, and procedures** can be described as:						
Difficult and distracting ◯ -1	◯ 0	Complicated ◯ 1	◯ 2	Necessary ◯ 3	◯ 4	Simple and helpful ◯ 5
Recruitment of group members can be described as:						
Poor and random ◯ -1	◯ 0	Based on convenience ◯ 1	◯ 2	Based on expertise ◯ 3	◯ 4	Based on cultural fit ◯ 5
The **leadership orientation** of the group can be described as:						
Authoritative leader ◯ -1	◯ 0	There are no clear leaders ◯ 1	◯ 2	There's a leader who facilitates ◯	◯ 4	Anybody may be a leader ◯ 5

				3		
The **mentorship orientation** of the group can be described as:						
Mentoring is not an option ◯ -1	◯ 0	Mentoring is encouraged ◯ 1	◯ 2	Mentoring is formal ◯ 3	◯ 4	There are formal and informal mentors ◯ 5
The **collaborative space** of the group is:						
Mostly remote and dispersed ◯ -1	◯ 0	Virtual but concentrated ◯ 1	◯ 2	In-person and concentrated ◯ 3	◯ 4	Hybrid in-person and virtual ◯ 5
The **goals of the group** are:						
Conflicting ◯ -1	◯ 0	Complementary ◯ 1	◯ 2	Shared and agreed ◯ 3	◯ 4	Shared and understood ◯ 5
The group shares a common **language** for about:						
Below 70% ◯ -1	◯ 0	80% ◯ 1	◯ 2	90% ◯ 3	◯ 4	95+% ◯ 5
The group considers **time** in:						
Deadlines ◯ -1	◯ 0	Cycles and short terms ◯ 1	◯ 2	Cycles and long terms ◯ 3	◯ 4	Long terms and phases ◯ 5
Knowledge flows within and out of the group thanks to:						
Needs and requirements ◯ -1	◯ 0	Meetings and writing it down ◯ 1	◯ 2	Key members with connections ◯ 3	◯ 4	Systems & roles ◯ 5
The collective disposition toward **learning** is:						
Already know what's needed ◯ -1	◯ 0	Not enough time ◯ 1	◯ 2	Learn new useful things ◯ 3	◯ 4	Always learn more ◯ 5

The group **works together** because of:						
Convenience ◯ -1	◯ 0	Institution or funding ◯ 1	◯ 2	Shared worldview ◯ 3	◯ 4	Shared goals and values ◯ 5
The **diversity** of the group is:						
An issue to manage ◯ -1	◯ 0	A matter of circumstance ◯ 1	◯ 2	A project requirement ◯ 3	◯ 4	A collective asset ◯ 5
The group members are **different** from each other:						
In goals and values ◯ -1	◯ 0	In most opinions ◯ 1	◯ 2	In methods and approaches ◯ 3	◯ 4	In complementary ways ◯ 5
The group members **vary**:						
In roles ◯ -1	◯ 0	In expertise ◯ 1	◯ 2	In cultural background ◯ 3	◯ 4	In worldviews & backgrounds ◯ 5
The **disparities** among group members are:						
Irrelevant to the project ◯ -1	◯ 0	A matter of rank and experience ◯ 1	◯ 2	A structural circumstance ◯ 3	◯ 4	An issue to manage ◯ 5
The group leader(s) **communication style** is:						
Closed and difficult ◯ -1	◯ 0	Slow and incomplete ◯ 1	◯ 2	Regulated and formal ◯ 3	◯ 4	Open and constructive ◯ 5
The group leader(s) are **committed** to:						
Getting the job done ◯ -1	◯ 0	The institution ◯ 1	◯ 2	The project ◯ 3	◯ 4	The collective culture ◯ 5
The group leader(s) **care** about:						

Getting the job done ◯ -1	◯ 0	The institution ◯ 1	◯ 2	The project ◯ 3	◯ 4	The group and its goals ◯ 5
The **competence** of the group leader(s) can be described as:						
Unreliable ◯ -1	◯ 0	Sufficient for position ◯ 1	◯ 2	Expert(s) of their field(s) ◯ 3	◯ 4	Expert leader(s) ◯ 5
The **character** of the group leader(s) can be described as:						
Unreliable ◯ -1	◯ 0	◯ 1	Adequate for position ◯ 2	◯ 3	◯ 4	Outstanding ◯ 5
The **leadership style** of the group leader(s) can be described as:						
Autocratic ◯ -1	◯ 0	Steward(s) of the project ◯ 1	◯ 2	Steward(s) of the group ◯ 3	◯ 4	Adapts to circumstances ◯ 5

COLLECTIVE: INSTITUTIONAL

The **culture** of the institution can be described as:						
Divided into subgroups ◯ -1	◯ 0	Confrontational ◯ 1	◯ 2	Still in development ◯ 3	◯ 4	Harmonious ◯ 5
Collaboration within the institution is:						
Not advised ◯ -1	◯ 0	Rigid and formal ◯ 1	◯ 2	Casual and distributed ◯ 3	◯ 4	Dynamic and cooperative ◯ 5
The institution's **policies, processes, and procedures** can be described as:						
Difficult and discouraging ◯ -1	◯ 0	Complicated ◯ 1	◯ 2	Necessary ◯ 3	◯ 4	Simple and helpful ◯ 5
Collaboration outside the institution is:						

Not advised ◯ -1	◯ 0	Rigid and formal ◯ 1	◯ 2	Casual and distributed ◯ 3	◯ 4	Dynamic and cooperative ◯ 5
The group considers **time** in:						
Deadlines ◯ -1	◯ 0	Cycles and short terms ◯ 1	◯ 2	Cycles and long terms ◯ 3	◯ 4	Long terms and phases ◯ 5
The **collaborative space(s)** of the institution can be described as:						
Non-existent ◯ -1	◯ 0	Mostly remote and dispersed ◯ 1	◯ 2	Casual & fortuitous ◯ 3	◯ 4	Designed & encouraged ◯ 5
Compared to the collective's, the **goals of the institution**:						
Conflict ◯ -1	◯ 0	Differ ◯ 1	◯ 2	Complement ◯ 3	◯ 4	Align ◯ 5
The institution **supports** the collective project because of:						
Convenience ◯ -1	◯ 0	Funding ◯ 1	◯ 2	Shared goals and values ◯ 3	◯ 4	Stakeholder influence(s) ◯ 5
The institutional leadership's **communication style** is:						
Closed and difficult ◯ -1	◯ 0	Slow and incomplete ◯ 1	◯ 2	Regulated and formal ◯ 3	◯ 4	Open and constructive ◯ 5
The institutional leadership is **committed** to:						
Status quo ◯ -1	◯ 0	The institution ◯ 1	◯ 2	The project ◯ 3	◯ 4	Collective success ◯ 5
The institutional leadership **cares** about:						
Funding opportunities ◯ -1	◯ 0	The institution's reputation ◯ 1	◯ 2	The project ◯ 3	◯ 4	Collective success ◯ 5

The **competence** of the institutional leadership can be described as:						
Unreliable ◯ -1	◯ 0	Good administrators ◯ 1	◯ 2	Expert(s) of their field(s) ◯ 3	◯ 4	Visionary leader(s) ◯ 5
The **character** of the institutional leadership can be described as:						
Unreliable ◯ -1	◯ 0	◯ 1	Adequate for position ◯ 2	◯ 3	◯ 4	Outstanding ◯ 5
The **leadership style** of the institutional leadership can be described as:						
Autocratic ◯ -1	◯ 0	Bureaucratic ◯ 1	◯ 2	Unobtrusive ◯ 3	◯ 4	Facilitating ◯ 5

COLLECTIVE: ECOLOGICAL

Collective **stakeholders** include:

____ Funders	____ Local Government	____ Government Agencies	____ Non-profits
____ Corporations	____ Local Businesses	____ Minority Groups	____ Community organizers
____ Neighbors	____ Local Residents	____ State Government	____ Federal Government
____ Global Organizations	____ Global Communities	____ Environment	____ Other(s)

The stakeholders' **respect** for the group or project is based on:

Convenience ◯ -1	◯ 0	Proximity ◯ 1	◯ 2	Expertise ◯ 3	◯ 4	Past experience ◯ 5

The **relationship** of the group to stakeholders can be described as:

Confrontational ◯ -1	◯ 0	In development ◯ 1	◯ 2	Consultative ◯ 3	◯ 4	Part of the group ◯ 5

Policies, processes, and procedures involving stakeholders can be described as:

Difficult and discouraging ◯ -1	◯ 0	Complicated ◯ 1	◯ 2	Necessary ◯ 3	◯ 4	Cooperative and helpful ◯ 5

Collaboration with stakeholders is:

Forced and difficult ◯ -1	◯ 0	Rigid and formal ◯ 1	◯ 2	Casual but constant ◯ 3	◯ 4	Dynamic and cooperative ◯ 5

Stakeholders consider **time** in:

Deadlines ◯ -1	◯ 0	Cycles and short terms ◯ 1	◯ 2	Cycles and long terms ◯ 3	◯ 4	Long terms and phases ◯ 5

Collaborative space(s) with stakeholders can be described as:

Non-existent ◯ -1	◯ 0	Formal & sparse ◯ 1	◯ 2	Casual & common ◯ 3	◯ 4	Intentional & encouraged ◯ 5

Compared to the collective's or the project's, the **goals** of stakeholders:						
Conflict ◯ -1	◯ 0	Differ ◯ 1	◯ 2	Complement ◯ 3	◯ 4	Align ◯ 5
Knowledge flows to and from stakeholders thanks to:						
Needs and requirements ◯ -1	◯ 0	Meetings and writing it down ◯ 1	◯ 2	Key members with connections ◯ 3	◯ 4	Public communications ◯ 5
The collective disposition toward **learning from stakeholders** is:						
When appropriate ◯ -1	◯ 0	At the start of a project ◯ 1	◯ 2	Learn relevant things ◯ 3	◯ 4	Always learn more ◯ 5
Stakeholders **work** with the group because of:						
A mandate ◯ -1	◯ 0	Necessity ◯ 1	◯ 2	Shared worldview ◯ 3	◯ 4	Shared goals and values ◯ 5
The **culture** of the stakeholder community can be described as:						
Divided into subgroups ◯ -1	◯ 0	Confrontational ◯ 1	◯ 2	Still in development ◯ 3	◯ 4	Harmonious ◯ 5
Communication with stakeholders is:						
Closed and difficult ◯ -1	◯ 0	Slow and incomplete ◯ 1	◯ 2	Regulated and formal ◯ 3	◯ 4	Open and constructive ◯ 5

APPENDIX B

TRANSDISCIPLINARY QUESTIONNAIRE

RESEARCHER

1. Name:
2. Work Group:
    a. Department:
    b. Position:
    c. Joined in:
    d. Number of members in work group:

KNOWLEDGE NETWORK

3. What are your area(s) of expertise related to the work group?
4. What are some of the key words related to your work group?
5. What are the top 5 tools that you use within your work group?
6. What are the top 5 methods/processes you use within your work group?
7. What are the top 5 theories or ideas that frame the work of your group?
8. What are your hobbies, avocations, and non-related areas of expertise?
    a. Do you share any of these hobbies and non-related areas of expertise with your colleagues in the work group?
        i. If yes, which ones and with whom?
    b. Do you think these hobbies and non-related areas of expertise influence your performance within your work group? If so, how?

RESEARCH PROJECTS

1. Please provide the following information about your top 3 ongoing research projects:
    a. Project 1
        i. Brief description:_____
        ii. Start year: _____
        iii. Is it collaborative? YES NO
        iv. Where are your collaborators?
            1. In work group.
            2. In same department.
            3. In another department(s).
            4. In same university.
            5. In another university.
            6. In other organization (please specify type):
    b. Project 2
        i. Brief description:_____
        ii. Start year: _____
        iii. Is it collaborative? YES NO
        iv. Where are your collaborators?
            1. In work group.
            2. In same department.
            3. In another department(s).
            4. In same university.

5. In another university.
6. In other organization (please specify type):

c. Project 3

i. Brief description:_____

ii. Start year: _____

iii. Is it collaborative? YES NO

iv. Where are your collaborators?

1. In work group.
2. In same department.
3. In another department(s).
4. In same university.
5. In another university.
6. In other organization (please specify type):

RESEARCH OUTPUT

1. Since you joined your current work group:

a. Have you published in research journals or similar academic publications? YES NO

i. If yes, please tell us in which publication (5 most recent at most):

b. Have you generated any patents? YES NO

i. If yes, how many?

c. Have you presented in conferences or similar events? YES NO

i. If yes, please tell us which events (5 most recent at most)

NATURE OF RESEARCH

1. Do you consider the work you do individually to be:
    a. Field-specific.
    b. Interdisciplinary.
    c. Multidisciplinary.
    d. Transdisciplinary.
    e. Other.
        i. Please explain briefly.
2. Do you consider your work group to be:
    a. Field-specific.
    b. Interdisciplinary.
    c. Multidisciplinary.
    d. Transdisciplinary.
    e. Other.
        i. Please explain briefly?

TRANSDISCIPLINARY APTITUDE TEST

Please rate on a scale of 1 to 5 (1 = Strongly Disagree, 5 = Strongly Agree) each of the following statements about knowledge:

1. One must study the natural world.
2. A controlled experiment is the only way to discover truth.
3. An idea cannot be true unless colleagues confirm it is.
4. Rational thinking provides the best option to look at the world.

5. One must look at the world objectively.
6. The pursuit of knowledge is the ultimate goal of humans.
7. The universe is ultimately made of systems and processes.
8. Diagramming is the best tool for problem solving.
9. Testing is the most important part of solving a problem.
10. Standards are more important than new solutions.
11. “Better” usually means “more efficiently”.
12. The goal of human knowledge is to find effective application for it.
13. The world is made of things that we humans make.
14. If we recognize patterns, we can find solutions.
15. Practicality matters more than knowledge.
16. Finding the appropriate solution is better than following a standard.
17. Empathy is the first step in solving a problem.
18. The goal of human knowledge is to provide solutions to human problems.
19. What matters in the world is human experience.
20. The best way to communicate knowledge is through metaphor.
21. Performance matters more than content.
22. We can only look at the world subjectively.
23. Imagination can be more useful than facts.
24. The ultimate goal of human knowledge is to find meaning.
25. To understand the world we must understand the human condition.
26. Knowledge derives from reflection and critique.

27. Questions are more important than answers.
28. Context is equally important to knowledge.
29. All ideas require a degree of interpretation.
30. The ultimate goal of human knowledge is to provide understanding.
31. One should focus on creating value in the world.
32. Competition is as important as collaboration.
33. An idea is not valid unless a group of average people support it.
34. Innovation matters more than standards.
35. Success means disseminating an idea.
36. The ultimate goal of human knowledge is to provide new ways to create value.
37. The world represents opportunities for learning.
38. Formation is more important than knowledge acquisition.
39. Engagement and collaboration are crucial for success.
40. Assessment matters more than knowledge.
41. One must care about others in order to engage with them.
42. The ultimate goal of humanity is to learn about the world.

TRANSDISCIPLINARY KNOWLEDGE TEST

For each question, please select the correct answers that apply.

1. The population I target is called:

    a. Sample
    b. Users
    c. Audience
    d. Public
    e. Market
    f. Crowd

g. Group
h. Class
i. Sector

2. A set of ideas and concepts is called:

a. Theory
b. Standard
c. Current
d. Trend
e. School
f. Model
g. Field

3. The main place where work can happen is:

a. A lab
b. A field
c. A studio
d. An office
e. A house
f. A school
g. A store

4. The main type of professional event is:

a. Conference
b. Symposium
c. Congress
d. Festival
e. Course
f. Seminar
g. Summit

5. My knowledge manifests as:

a. Research
b. Projects
c. Performances
d. Narratives
e. Artifacts
f. Designs
g. Products
h. Lessons

6. The ultimate goal of humanity is to create:

    a. Knowledge
    b. Applications
    c. Solutions
    d. Truth
    e. Meaning
    f. Experiences
    g. Value
    h. Learning
    i. Faith
    j. Fun

7. The way I do work is a:

    a. Method
    b. System
    c. Process
    d. Technique
    e. Craft
    f. Style
    g. Plan
    h. Map
    i. Habit
    j. Behavior

8. An early step for my work is:

    a. An abstract
    b. A diagram
    c. A statement
    d. A manifesto
    e. A proposal
    f. An outline
    g. A manuscript
    h. A sketch
    i. A note

9. The base line of my work is:

    a. A hypothesis
    b. A prototype
    c. A draft
    d. A concept
    e. A sample
    f. An outline
    g. An ideal
    h. A duty
    i. A mission

10. The principal way of evaluation is:

a. Peer review

b. Testing

c. Assessments

d. Critiques

e. Reviews

f. Focus groups

g. Feedback

h. Commentary

i. Adoption

Thank you for your answers.

APPENDIX C

INTERSUBJECTIVE PHENOMENOLOGICAL INTERVIEW

1. Please describe the culture of your lab/work group.
2. How have you experienced collaboration within your work group?
3. How have you experienced collaboration outside your work group?
    a. How does a collaboration start and how does it end?
4. How have you experienced creativity during your time in the work group?
5. How have you experienced innovation during your time in the work group?
6. How have you experienced learning during your time in the work group?
7. How have you been influenced by your experience in the work group?

APPENDIX D

PHENOMENOLOGICAL SELF-INTERVIEW

Tue, 12/15/2020 12:24PM • 46:43

Annotated: April 2021

SUMMARY KEYWORDS

collaboration, collaborators, project, film, learning, culture, collaborate, creative, production, requires, creativity, instance, chaos, tend, role, opportunity, industry, point, resources, lead

00:01

Hello, this is Alex Garcia Topete. I'm doing the self-interview of phenomenological intersubjective approach for transdisciplinary collaboration. And I'll be doing this interview by myself, with myself, as the first exercise in phenomenological methods, or dissertation doctoral work. I will, however, be doing this two times over, as my own experience with working groups is trifold: first, as a filmmaker with my sometimes regular, but always changing team, working in film; also, in my capacity as a film curator and Film Festival programmer that requires another set of skills and a different environment; and third, as a researcher, and doctoral fellow in a research lab.[487]

So, first, please describe the culture of your lab work group.

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[487][487] Research lab, in this context, has an almost exclusively academic meaning; *labor-atory* as a place for properly doing a specific type of work (*labor)*; and *re-search*, seek again or inquire; in other words, a 'place to work on finding answers' or new knowledge. However, labor of this does not necessarily always demand or produce new answers or new answers: it may also just give null results and new questions.

In regards to Nowadays Orange Productions, the Media Production Company, to which I belong and that I lead, we have a *culture*[488] of very much collaborative enterprise. We recognize that filmmaking is both an *industry and an art*[489] that requires *division of labor, and lots of collaboration*[490]. We would not be able to make any project happen (be that television, film, or other media, of the likes of video games and mobile apps) without the help of others. Other creatives and other technicians, and of researchers that know, who figure out the better ways of running the company, doing the creative operations, or even just the functioning of equipment. It's always about being a safe space for trial and error, being open to collaboration, being open to ideas *from the outside*[491], being open to exploring and portraying viewpoints outside of one's own. In the writing of stories, we try to not only empathize, but really get to the mindset and the skin, so to speak, of characters and others. In our culture, particularly of the four partners, and

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[488] By culture here I understand both a tradition and set of values, and a "way of doing things" (set of practices); while I personally at times may make myself the 'protagonist' of a project because I haven't quite found a way to inspire others to participate in it, the latter part of the statement is evidence of that culture of collaboration that I mention in the interview: the goal of working by myself at first isn't about heroics or getting things done, but rather as a starting point to build a project (and communicate about it) in ways that attract others to collaborate.

[489] *Industry* here means, in its simplest form, a system with the aim of generating material value such as goods and profits. Meanwhile, *art* refers to the oh-so-human activities (and needs) of self-expression, storytelling, and delight in aesthetic forms, which provide subjective value to both individuals and society.

[490] *Division of labor* here presupposes not only the separation of tasks to deconstruct complex projects (such as a movie), but also the specialization of those working on the tasks. Different from 'classic' assembly line work, this division of labor does not aim to make tasks so simple *anyone* can do them, but rather to divide them so that specialists can apply their expertise without interference from others (in theory only, realistically speaking)—musicians do music, actors act, executives find and provide the funding, etc. In contrast, *collaboration* in such settings involves recognizing the division of labor and expertise, while also communicating and finding a consensus together on what the project should ultimately be—musicians don't do just any music but the music meant for the mood of the film, actors don't just act their favorite play but perform the characters of that story, executives don't just fund the project but also hire a team of creators who share sensibilities and can work together… In a sense, collaboration of this kind, involving knowledge and Creativity, entails awareness of the system, awareness of one's and others' roles in it, and awareness plus agreement of what the work is and the results should/will be—misalign any of these, and the project will fail, either during due to conflict, or afterwards by a lack of purpose/substance/cohesion.

[491] *Outside* meaning other fields, other projects, other people… Those that have a different perspective.

our very close collaborators that are about a dozen of them, it's all about *learning*[492] from each other. learning from each other and learning from our environment, learning from opportunities, growing both individually and together, trying to make the next project better than the one before. Without getting stuck on perfectionism and just trying to get the one project to perfection because that hinders *growth*,[493] that hinders progress. And that ultimately hinders collaboration itself, because if one member of the team is stuck on getting this thing perfected, and the rest of the team doesn't seem to accomplish the end product, then there's a rift.

Second question, how have you experienced collaboration within your work group?

Collaboration has been at times very seamless and others full of conflict. However, the ones with conflict tend to be the ones that, when they don't fail, are the most productive. The cases of seamless collaboration happen when everybody is on the same page. We'll have the same vision for a particular project or a particular aspect of a project, let's say, the casting of the film or just the overall story. So, everybody is in "yes, and…"-type of mentality: we build and add value to the project with each turn of pitching. In the ones with *conflict*[494], and there have been quite a few in the past… Well, there are the cases definitely where there's dissent regarding the spirit of

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[492] *Learning* in this culture and context, means at once *about others*, so that we can communicate better; *from others*, so that in the merging of skills and growing of minds the project and ultimate result both benefit; and *with others*, for the experience enriches everyone (when done right at least). Learning, in a way, is a better measure of *time + experience* than any other feature, for it correlates to them according to the quality of both: a lot can be learned in very little time with great collaborators, or nothing may be learned despite years of working together…

[493] *Growth* here understood as learning for the individuals, and as *development* for the team as a collective and for the company (which would flounder without growth and output).

[494] *Conflict* of this sort refers not only to arguments and disagreements, but also to smaller frictions and clashes of beliefs/values/ideas; as explained in the example, some can be fatal to the project, because they just mean the collaborators cannot work on it anymore; others are essential, for then a dialectic result (synthesis) can emerge after the clash of "thesis – antithesis"—richer and broader and better suited for the purposes of the project. But the whole team needs to manage and embrace conflict (and doing it 'right') in order for the latter to occur/work.

the project. So, for instance, there was one film, about five years ago, where two longtime collaborators we had worked with for two or three years in other projects before; we had to basically dissolved the partnership because the movie that we were working on, the collaborators included people with not the best of ethics, or the best interest of actors in mind. We were in the preliminary talks before fully starting to work together, and these new collaborators that were attached to one of the longtime collaborators, they were invited to add fresh ideas, but theirs were ideas contrary to the culture of the company and team. They wanted to treat actors as a resource to exploit rather than collaborators to work alongside. And because of the ownership of the project itself, since it was the original idea and intellectual property of the collaborator, the collaborator who had brought these new producers, these new people into the project. And he really wanted to work with them. Because they had a back then a relatively more prestigious trajectory in the film industry than the rest of us collaborators, basically he sided with them. I personally, and with the support of the rest of my team, stepped off the project, then decided not to work with that compromised collaborator anymore. That was a break in collaboration with these particular individual, two years of projects that have all been culminated. And they were supposed to lead to this big film project. But the fact that so easily, values of our culture could be put on the chopping block, or just overall, ignored and overridden really put a pause, and eventually, we decided to dissolve the collaboration and all further collaborations. Number one, because it went against the ethics and the culture of the group, but also out of legal protections instead of being involved with a group that clearly played fast and loose with what was legal in terms of how to treat labor [workers] and collaborators and intellectual property of others. There were other times where collaborations that happen with friction in them lead to better, better

continuous and better products. Recently, we worked with other close collaborators in a web series, and the original vision for the series was a full half-hour project with 12 episodes. But out of resources and trying to harness the Creativity and willpower and the enthusiasm of all the collaborators involved, we decided to downsize the project. Some were a little skeptical about the downsizing. Others were very enthusiastic. Get the project to a point where the current resources can make for a full product or a full story, therefore a full project, that we're able to show and celebrate. During the filming itself, there were several points where decisions regarding our casting, even the flow of production itself as in "should we try to shoot the scene because they're really good, or do we need to cut them just because we are about to run out of hours of the day." There were discussions between all of the creatives but that's the nature of collaboration: you need to know when to fight for the piece of the of the script that you truly believe is at the core of the story; and other times, it means letting go of a particular scene that might just not unfold in reality the way that you might see it on the page. And that's how constructive and critical collaboration can work—when everybody believes that there's compromises to be made, that there's a better vision or a better reality that can be accomplished in the back-and-forth of opinions and dialogue and deliberations.

How does collaboration start and end?

As a mentioned, collaborations usually start by having a shared vision, or at first, a shared intention. Having a project that is really exciting because of the story, because of the topic, or because of an opportunity. There are times where we help others, new collaborators or even old collaborators, bring to fruition a project or a vision that they've had for a while. There are times when we collaborate with interns and students to help them learn how to become a filmmaker

and a collaborator during the shepherding through the process of development, pre-production, and sometimes even production, post-production, and the afterlife of a film project, the part where you're supposed to put it in festivals and put it in front of a public, and how to navigate and accomplish all of that. But it all starts with a shared motivation that shared enthusiasm for a particular story or opportunity. A collaboration *ends*[495] I think in three types. Number one, they die out because enthusiasm or the road to be walked together ends and the project may or may not be finished. But in the example that I mentioned, the collaboration ended because we very clearly departed in the values and the culture and the goals. So that bifurcation of values definitely is one of the things that ends a collaboration. Another one can be also a bifurcation but mostly of trajectories. We don't always collaborate afterwards with, for instance, interns because they go on to have their own careers. But that was the point: to accompany them through one particular project, to help them learn and then having them be on their own road to Success or a different career. So, it's an end because we are not on the same road anymore. And sometimes they just don't end, they pause and come back. We have several collaborators, very dear collaborators in Los Angeles (so the difference in geography makes us not be a constant), but about once a year we tend to collaborate on even a small project of writing or envisioning a project. And that may be put on hold or paused for a couple of weeks. And that working together gets restarted by a different project, or sometimes the same one that we worked on, because they found some new interest in it or a new opportunity for that idea. So, some collaborations never

[495] *Beginnings and endings* presume a *time progression* that is linear; however, it may also be cyclical from the perspective of the people involved. Collaborators may finish *a project* but their collaboration continues even if paused/inactive for years. Beginnings in such a context then tend to be clearer: the moment when people meet, for instance. Endings, on the other hand, can be abrupt, diffused, or somewhere in-between—all depending on the perception of time.

end, they just keep transforming, like energy. But for that to be done, it requires trust, it requires alignment in values and shared motivations. Because even if we agree on the what, and the how, if you don't agree on the why, eventually you will have a conflict that will put the collaboration into pause, into question and may ultimately have it terminated.

How have you experienced creativity during your time in the workgroup?

Well, I have discovered that I am more *creative*[496] in collaboration and companionship than by myself. I require, for instance, for comedy, it's always better to have somebody to confirm that the joke is good, rather than laughing at yourself. Um, definitely ideas are conceived in a group creatively and critically, in a group, that individually would not have happened. Somebody else will always have a perspective or a viewpoint that you might not have considered, whether positive or negative, and either of those need to be taken into account when working creatively. So yes, it's a very inner driven endeavor. But I do believe, especially after my experience, that it's very much a social practice. One can be for instance, creative in writing, and be very good at experimenting on your own, but you won't truly grow without outside perspectives, outside influences. The nature and the drive can come from within but the nurture and the materials to grow need to come from the outside. So, I think there is an inherent interplay of social practice and inner drive that meet in creativity and particularly in collaboration.

How have you experienced innovation during your time in the work group?

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[496] *Creative* for me here synthetizes two meanings that may typically be separate for others: *imaginative*, as in can think of novel/fresh things, and *productive*, as in I can do more in quantity and quality than when alone.

Innovation has come mostly from having to adapt to circumstances and resources. And yes, it has also come from a drive of: how can we do this *better or differently*[497] from those that are already doing it? So, for instance, how can we do production in Dallas, which is not inherently a media prone space like Los Angeles or Miami, or even recently in New Orleans and Atlanta. How can we foster that? In the thinking, thinking about of the resources at hand, the alignment of motivations and opportunities, and according to the collaborators that we can call, including institutional ones, like the state's Film Commission—how can we harness all of the energy and resources and put them into something that is doable, and worthwhile, not just another movie, but something that stands out and gets everybody excited and can have a future. We have been innovating in the ways of presenting stories. Sometimes maybe it's not a movie that we need, it's a small TV series. It is just a standalone special. Maybe it's a game. Is *this* a better way to present this story, then, or the concept of hand, than a movie? So, it's very much a phenomenon and opportunity that unfolds as we are trying to get things done. It's not the goal. It's an aspect or a corollary, innovation. It's a phenomenon that happens in the making of new things, in the making of worthwhile things. And the fact that they're new or innovative, sometimes is part of the point. But it's not the end, the end objective of the doing. Innovation is not the point of the collaboration. Innovation, it's a byproduct, that a lot of the times helps a collaboration. But it's very seldom the purpose.

How have you experienced learning during your time in that workgroup?

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[497] *Better* and *different* are the implicit biases of invoking *innovation*; most people may think *newness*, but in reality they refer to those two instead. Something new that isn't better than what's already in use will never be adopted, unless it's at least different enough to *feign some improvement.*

Learning has occurred as a product of experience itself. Just the fact of doing the things leads to some kind of learning: learning about the craft, learning about oneself, learning about how the team operates, learning about collaborators, and how to collaborate better in the future, learning about the industry and the ecosystem that we live in, or how it may have changed from the last time that we interacted with it. So, for instance, a film festival might be better suited now than it was a couple of years prior to be the place to exhibit the films and materials that we work on. Learning never stops and learning is an integral part of collaboration. Collaboration means trying to learn how others do things, how one can absorb some of that or how one can complement some of that. So how can I be the better manager if one of my collaborators leans more towards the creative side but then needs somebody to balance that out with management skills? How can we contribute more to the storytelling and craft side of a project if somebody is putting more of the time and money resources? Learning how to balance and how to complement, and sometimes just learning how to not make the same mistakes. As simple as that. Mistakes are always made. But if one learns from them, then they are not as catastrophic as they can be.

How have you been influenced by your experience in the workgroup?

Well, it has my experience as a filmmaker and collaborator in that arena, has certainly led me to believe that collaboration is the core of the industry. It’s is a cornerstone. It's not about the genius of a particular artist, or even about the prowess of a particular studio or production house. It's about the explicit and implicit collaboration of the entire ecosystem. And knowing how to navigate that is a very central, very central aspect of being a good filmmaker and a good collaborator. The best ones in history have been those with very close collaborators that everybody knows, (or that at least historians know about) and those that knew that [filmmaking]

wasn't just about the movie that they were making, but how to get it to the public, how to acknowledge and work alongside the entire pipeline [of labor] and the entire ecosystem of film. And I believe that that's a phenomenon that exists in other industries. So that's just part of the nature of industries. That it's about all the pieces working together, all the pieces being *attuned*[498] with each other, and weigh into the purpose of that particular industry. It's not about profit making. I mean, those are important, but they are not the end goal. The purpose of the food industry, it's not to make money, the purpose of the food industry is to create food and get it to the people that consume it and consider it food. That's not a particularly elegant example. I have come to believe that film is very much a *transdisciplinary*[499] endeavor, one that requires engineers and scientists and artists; as I like to point out, it's the Academy of Motion Picture Arts and Sciences, not the Academy of Motion Picture artists, or the or the Academy of Motion Picture executives. Everybody goes under that umbrella. Everybody's recognized as having a role. We can have debates about their level of importance, in which I would argue that everybody has an equal import equally important role. But that's a different discussion. But the differences in perspectives and worldviews, in types of intelligence, in expertise, are an integral part of how filmmaking has come to be and how it evolves. Even the differences in values, of some thinking of it more as a profit-making machine and others thinking of it as an art, that tension that helps in-between. And collaborators that can mediate and negotiate that tension are

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[498] *Attuned* meant as 'in harmony' or 'adequate alignment.'

[499] Truly meant as not only "going beyond disciplines" (it's literal, etymological meaning), but a system in which the expertise/knowledge of the people in it produce results together that are "greater than the sum of its parts." A movie executive may be great at raising funds or selling the movies, but they themselves wouldn't be able to single-handedly make a movie classic (evidence: none of the "movie moguls" have done that in 140 years of the industry), just as no director has made a classic on their own: they needed a cast, a crew, and a timeless audience to make it a classic.

all part of "the genius of the system" as one of the film historians crafted the phrase. That has influenced not only the way that I collaborate and the way that I work, but also the way that I see the world—yes, it has influenced my own worldview, turning into from one that was more at that encounter of art and the rest of the world into more of a transdisciplinary, integrative, integral, holistic view of the world and industries and everything in between.

Now in relation to the ArtSciLab and they work in research and knowledge production, please describe the culture of the work group.

The ArtSciLab has a very peculiar culture that is very hybrid. We tend to view things with the objective viewpoint posed by the science side. But we push for creativity and experimentation in a very artistic way. Not necessarily that in which you have to have independent and dependent variables determined in the beginning before you go and try things out. Rather, trying things out may reveal *what* are the variables we should take into consideration. It's a culture where leadership is more about nurture and service than it is about commanding and management. Overall, management is more in relation to resources than it is in relation to people. So, the culture is a true *hybrid*[500] that never falls neatly in one camp, one version, but always either zig-zags between two spaces, or sits comfortably in the in-between.

How have you experienced collaboration within your work group?

It's always a source of creative chaos in that particular space. There are so many viewpoints so many unassigned roles, compared to film where everybody can have opinions and collaborate in the filmmaking process but everybody has *a role* (everybody, there's departments and everybody

[500] *Hybrid* in this context means mainly "a mix of styles"—of thinking, of practice, of understanding. There's not "one true way" but rather several to be tried and complemented.

is in charge of a particular task). And in the ArtSciLab, knowledge production means when you're trying to have discoveries and breakthroughs. And it's not quite clear, who's supposed to be doing what unless previously discussed. The roles, the job titles tend to be ambiguous and open ended. The roles then tend to shift. So, somebody who might be specializing in writing one day might be the one specializing in running a meeting the other. Everything needs to be flexible[501]. That the chaos is where the creativity and the breakthrough collisions (collisions in the positive sense when two things smash together and create something greater just because they smashed) happens in this very, very non-uniformed and very, not deterministic fashion. It's more of waiting for things to emerge from the creative chaos than trying to engineer them within. Even though I do believe that there are ways to make sure that the creative chaos doesn't take longer than it should, that it can be engineered a little bit, but not so much that it's not creative chaos anymore.

How have you experienced collaboration outside of your work?

Outside, there's always a rift with the hybrid culture of the lab. Other people have their own, other groups and other people have their own expectations, their own goals, their own motivations, that may not necessarily align perfectly, particularly because we're such a hybrid and peculiar group. But coming to terms (and by that I literally mean like, writing it down on paper what we can agree on and what parts might be widely different) helps with the whole process of collaboration. The best collaboration that we have, are not with groups that think

[501] A better word here would've been "*adaptive*" in an evolutionary sense: always changing and improving in order to increase the chances of survival and reproduction (in the case of ideas and knowledge, the latter means their spread and adoption); the lab collective makes a point to not delude ourselves about being "stable/static" because nothing in this universe is; so we aim for a manageable *flow*, just like an ecosystem or energy system does.

exactly like ours, but with groups that appreciate that we bring that difference to the collaboration, even when they might disagree and very much come into conflict with some of the manners that we work since we're not necessarily highly rigorous, as other labs might require. But then we come together and we agree that we can bring in a compartmentalize chaos that can bring insights and fresh perspectives to a process or a system that is very well oiled, but may be so well-engineered that there's no opportunity for something new to emerge. Everything is expected. So, it's a matter of agreeing on the motivations and perhaps the end goals. And let the process be more of a dialogue back-and-forth, and an emergent discussion or an emergent creation and collaboration, a poetic phenomenon that gets done in the making, rather than planned through.

How does a collaboration start and how does it end?

It starts usually with a conversation that becomes an idea for a for a shared project, which then becomes a serious discussion. Coming to an understanding, almost a verbal contract, sometimes it's literally a non-binding but clear Memorandum of Understanding contract, in order to know that everybody's talking about the same things. We have discussions and set the expectations and the goal; it's not necessarily a roadmap to how we're going to do things, but it is definitely a compact or a covenant on what each collaborator is meant to bring to the project. Promises are made on how to get to the joint (or disjointed) destination. But we know that we can help each other get there faster. Even if, whether a project wrap up or just a dissolution of the terms, the project is no longer fruitful, the collaboration might have extended its period or it's just fullness, so it's just dissolved. Or it evolves and it becomes something else. We do tend to have more of a wrap-up experience than my previous experience with projects that may just die out or people

just stop answering emails. And in this case, it's more of a, "okay, I don't have time for this anymore"—it's more formal the way that it ends, positively or negatively. Rarely [does] it a fade out.

How have you experienced creativity during a time in the work group?

Again, it's chaos. But that's the point. At the ArtSciLab is more about seeing who might have the *insight*[502] that nobody has thought about. So that means having a lot of contributions that can be tossed out and not having and not taking it personally, or negatively, but rather, as a sign of the processes working. We're having so many ideas that we have to toss them out. And we have to focus on certain ones. That means that chaos is functioning. We also need to be careful that the chaos doesn't get out of hand so that nothing gets done, because everything is just fodder. So, it's a, it's an intricate balance.

How have you experienced innovation during the time in the ArtSciLab?

Innovation has really come from mixing viewpoints, from somebody coming from a different field and injecting the methods, views, values, and knowledge from that field into the projects that we're working on.[503] For instance, having ethnographers coming to the lab, and put that ethnographic slant on the project that we're working on. Having specialists in machines and machine-human interactions come to the table and say, *hey we think this project can be enhanced with a little bit of artificial intelligence.* Now that doesn't become a point of the project but it can be enhanced by it. innovation has come from facilitating those boundaries, those boundary

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[502] Meaning, a perspective, idea, or understanding that reframes and enriches the existing knowledge/understanding of a particular phenomenon under consideration/study. It could be equated to a "eureka" moment or contribution.

[503] In a way, innovation happens mostly at *intersections*—one never wills it out of nothing or pureness.

objects or those bounded areas that are hybrid and allow for more interaction of ideas that have never met before. Intellectual dating or intellectual matching, that's a common phrase within the group promoted by one of the leaders. Innovation happens in the spaces where ideas that have never met, get become friends.

How have you experienced learning during your time in the ArtSciLab?

It has been a peer-to-peer experience more than a collective one. I have learned a lot from others in the lab. And I have learned a lot about how the lab works as a constellation, as a very disparate collective. But the learning is always shared. It's a sharing, social process rather than just inside, from within. We learn about each other. In collaboration we learn about each other, just by sharing the things that excite us and from which we have been absorbing new insights. The learning has not happened just by sitting together in the same room learning different things and just being. It has been through an informal but very purposeful sharing of ideas and sharing of experiences.

How have you been influenced by your experience in the work group?

My take on filmmaking has become more reach in vocabulary in terms of transdisciplinarity and how we collaborate. Everything has been more open-ended and integrative. And I have learned new ways to corral chaos for the benefit of creativity and learning. I believe that chaos is great. It's a source of newness. But putting some mechanisms to control the chaos is important to bring order and bring sense-making and meaning to the ideas that emerge. Chaos is data, and in order to turn data into knowledge, some way of reading, some rules and syntax, is needed. And my experiences in the ArtSciLab have definitely cemented that. My belief in that experience has been empirical.

APPENDIX E

TDI APPRENTICESHIP SYLLABUS

I. COURSE DESCRIPTION

This course explores transdisciplinary intelligence, the capacity to understand and collaborate in knowledge production and exchange with multiple experts and publics beyond a single field of knowledge. We'll begin with a survey of key cultural differences among disciplines, and then present sets of skills and capabilities necessary for successful collaboration and professional boundary crossing, all through historical exemplars of transdisciplinary intelligence.

II. LEARNING OBJECTIVES

At the end of this apprenticeship, you will be able to:

1) engage with the current trends, discourses, methods, and applications of transdisciplinarity;

2) thrive within diverse professional environments; and

3) understand, bridge, and translate knowledge between different disciplines and industries.

III. PROCESS

The structure of the apprenticeship follows the learning principles of:

- *chunking,* dividing the knowledge in graspable pieces;
- *primacy,* what's presented first will be remembered more easily;
- *recency,* what's presented last will also be remembered more easily;
- *intensity,* examples that connect to emotions and real-life work better; and
- *freedom,* self-directed activities reinforce motivation and learning.

These principles inform the modules, which have the following general format:

- Presentation of first historical exemplar.
- Initial assessment to reveal previous knowledge and biases.
- Interactive connection of concepts and skills to first exemplar.
- Presentation of second historical exemplar.
- Iterative knowledge-check based upon second and first exemplars ("quiz").
- Summary of knowledge.
- Call to Action to implementation activity in real life ("homework assignment").
- Reflection/report regarding call of action (day later).

Exemplars have been picked not only for historical and thematic relevance, but also to accomplish diversified disciplinary and national representation, and gender parity.

Modules are intended to be taken over a 30-minute period at the beginning of a learning week, and use the rest of the days to implement/try out the activities provided in the Call to Action, then write a reflection/report on the activities to conclude the module.

IV. MODULES

	THEME	EXEMPLARS	CONTENT
0	Intro	Bioacoustics	• Transdisciplinary Intelligence • Disciplines' profiles. • Meaning, uses & impact.
1	Think like a Scientist	Galileo Galilei The Curies	• Objectivity • Observation • Rigor • Experimentation • Classification • Rationality
2	Think like an Engineer	Lillian Gilbreth Leonardo DaVinci	• Systems & processes • Testing • Prototyping

			• Standards • Effectiveness • Application
3	Think like a Designer	The Eames Buckminster Fuller	• Design thinking • Empathy • Modelling • Patterns • Synthesis & Solutions • Practicality & Ingenuity • Appropriateness
4	Think like an Artist	Frida Kahlo Pablo Picasso	• Creativity • Subjectivity • Human experience • Metaphor, analogy & allegory • Performance • Meaning • Imagination • Reflective practice
5	Think like a Humanist	Sor Juana Ines W. E. B. Du Bois	• Critique • History • Context • Archive • Justice • Evaluation • Understanding • Questioning • Interpretation
6	Think like an Entrepreneur	Madam C.J. Walker Raoul Cortez	• Risk • Value • Innovation • Market cycle • Job-to-be-done • Competition • Segmentation • Validation
7	Think like an Educator	Maria Montessori Friedrich Frobel	• Learning • Cognition • Care • Engagement • Formation • Mentor-apprentice

			• Communication
8	Think like a Mentor	Albert Einstein & Michele Besso Stella Adler & New Hollywood	• The six roles of mentors • The ten commandments of mentoring successfully.
9	Think like an Apprentice	Benjamin Franklin Ada Lovelace	• Curiosity • Humility • Open-mindedness • Inquiry • Growth mindset
10	Think like an Expert	Gary Kasparov Wangari Maathai	• Game theory • Complexity • Strategy • Communities & boundaries • Knowledge management • Deliberate practice • Heuristics
11	Think like a Collaborator	Gertrude Stein Vannevar Bush	• Group dynamics • Leadership types • Team building • Trust • Dialogue • Alignment & harmony
12	Think like a Hybrid	Diana Dabby Julio Ottino	• Cultural brokerage • Multi-Modal Literacy • Translation • ArtScience • T-shape knowledge • Professional identities
13	Think like an Amphibian	Hedy Lamarr Charles Csuri	• Transdisciplinary Exchange • Reputation management • Publics architecture • Socio-cultural impact • Intellectual Pioneering

APPENDIX F

TDI SIMULATION – GAME DESIGN DOCUMENT

1. Game Overview

1.1. Game Concept

- The Transdisciplinary Intelligence Simulation aims to train users in the nuances and difficulties of running a transdisciplinary team or project.

1.2. Genre

- Single-user simulation with turn-based strategy (TBS) game elements.

1.3. Target Audience

- Anyone in need of transdisciplinary training.

1.4. Game Flow Summary

- The user serves as the leader of a fictional transdisciplinary project, making decisions for **20 turns** that lead to either success or failure.
- Each turn allows for 3 decisions/activities, which then affect the scores of six "Resource" types: **Trust, Reputation, TD IQ, Funding, Diversity,** and **Knowledge Output**.

1.5. Look and Feel

- The simulation will be mostly text-based with some illustrations.

2. Gameplay and Mechanics

2.1. Gameplay

2.1.1. Game Progression

- 20 turns, with 3 picks of Activities for each turn; each activity has both positive and negative impacts for two or more Resources.
- Every 5 turns, there's a Project Phase/Stage change, for a total of 4 Stages as the full progression of a session representing a TD project.
- Each transition between Stages has the possibility of triggering an End to the simulation as a Failure, or of triggering a Bonus for the user, all according to score milestones and/or minimums of Resources.

- For instance, depleting the Trust resource between Stages will trigger a Failure because members will leave the project or the institutional leadership will cut its support.

2.1.2. Mission Structure

- User has to reach 100 of Knowledge at or before the 20th turn, while balancing the other Resources.

2.1.3. Puzzle Structure

- The Trust and Reputation Resources are of 2 kinds each, one Collective (project group or team) and one Institutional/Ecosystem (respectively); each kind has a max score of 50, making 100 total for that Resource; reaching a score of below 70 overall leads to Failure.
- The TD IQ and Diversity Resources have seven and three sub-kinds respectively, each representing the proportion of each sub-kind to that Resource; having a single sub-kind go above 70% leads to Failure.
- The Funding and Knowledge Resources have amount values instead of percentage scores, representing that these are expendable-yet-cumulative Resources.
- In each Stage, there will be one Leadership Decision Activity that must be chosen by the User, or it will lead to Failure in the next Stage.

2.2. Mechanics

2.2.1. Progression

- Each turn, the user will select 3 Activities (out of 12 possible, not counting variants of the Activities as described in Section 2.2.2), which will affect the Resource scores for the next turn.

2.2.2. Actions

Activity	Variants	Increases	Decreases
Recruit	Staffer, Colleague, Community Partner	Diversity, Trust, Knowledge TDIQ	Funding

Mentor	Team member, Seek mentor	Trust, Reputation TDIQ	Knowledge
Broker	Visit other department, Participate local project, Host a guest/visitor	Trust, Reputation	Knowledge
Bureaucracy	Update supervisor, File admin paperwork	Trust	Knowledge
Publish	Journal, Conference, Community Event	Reputation, Trust	Knowledge, Funding
Outreach	Public project, Public event, Volunteer work	Reputation, TDIQ Knowledge	Funding
Call a Meeting	Collaborators, Supervisors, Funders, Community	Reputation, Trust, Funding	Knowledge
Research	Team-only, Socially-engaged experiment, Partner project	Knowledge Reputation TDIQ Diversity	*null*
Request Funding	Fed agency, Foundation, Private/Corporation, International Organization.	Funding Reputation	Trust
Leader Decision	1 Leadership Style, 2 Collaboration Style, 3 Expand or Focus project, 4 Sunset/Offload/Spinoff	*variable*	*variable*
Reflect/Assess	Get advice	TDIQ	*null*
Move	Move to shared space, Switch institution(s)	Trust	Reputation, Knowledge

2.3. Replaying and Saving

- There will be a simply Save function, which will allow the user to return to the session later.
- Users won't be able to have more than one session saved at a time; in case of restarting a session, they will lose the existing one.

3. **Levels**

   3.1. Levels

   - There's only the one level/mission, which is designed to be iterative and slightly different each time depending on the sequence of user decisions and some random events as described in Section 2.

4. **Interface**

   4.1. Visual System.

   - The GUI will rely mostly on text information, instructions, and options, with some illustrations for aesthetic and gameplay purposes; however, the images will not be critical to the gameplay.

   4.2. Control System

   - The user will input text and click on screen buttons.

   4.3. Audio, music, sound effects

   - The simulation will have background music that prompts relaxation (for better learning), and minimal sound effects meant simply to guide the gameplay.
   - Additional audio options for accessibility will also be included.

   4.4. Help System

5. **Technical**

   5.1. Target Hardware

   - All operating systems with web navigation capabilities.

   5.2. Development hardware and software, including Game Engine

   - The simulation will be developed either with Unity, GameMaker, or Unreal Engine.

   5.3. Network requirements

   - Users will need an internet connection to access the simulation.

BIBLIOGRAPHY

Aageson, Thomas H. "Cultural Entrepreneurs: Producing Cultural Value and Wealth." In *The Cultural Economy*, 92–107. 1 Oliver's Yard, 55 City Road, London EC1Y 1SP United Kingdom: SAGE Publications Ltd, 2008. https://doi.org/10.4135/9781446247174.n8.

Aboelela, Sally W, Elaine Larson, Suzanne Bakken, Olveen Carrasquillo, Allan Formicola, Sherry A Glied, Janet Haas, and Kristine M Gebbie. "Defining Interdisciplinary Research: Conclusions from a Critical Review of the Literature." *Health Services Research* 42, no. 1 Pt 1 (February 2007): 329–46. https://doi.org/10.1111/j.1475-6773.2006.00621.x.

"About The Edith O'Donnell Institute at UT Dallas." Accessed June 21, 2021. https://arthistory.utdallas.edu/about/.

Acosta, Adrian. "Departamentalización y contexto organizacional: la experiencia de la Universidad de Guadalajara" 7, no. 1 (2005): 18.

Adams, Martin. "Practising Phenomenology: Some Reflections and Considerations." *Journal-Society for Existential Analysis* 12, no. 1 (2001): 65–84.

Adams, Will W. "The Primacy of Interrelating: Practicing Ecological Psychology with Buber, Levinas, and Merleau-Ponty." *Journal of Phenomenological Psychology* 38, no. 1 (2007): 24–61. https://doi.org/10.1163/156916207X190238.

Aenis, Thomas. "A Communication Model for Transdisciplinary Consortium Research," 2010, 10.

Agarwal, Rajshree, Martin Ganco, and Rosemarie H. Ziedonis. "Reputations for Toughness in Patent Enforcement: Implications for Knowledge Spillovers via Inventor Mobility." *Strategic Management Journal* 30, no. 13 (2009): 1349–74.

Ang, Soon, and Linn Van Dyne. *Handbook of Cultural Intelligence*. Routledge, 2015.

Apter, Emily. *The Translation Zone: A New Comparative Literature*. Princeton University Press, 2011.

Archibald, Mandy M, Michael Lawless, Gillian Harvey, and Alison L Kitson. "Transdisciplinary Research for Impact: Protocol for a Realist Evaluation of the Relationship between Transdisciplinary Research Collaboration and Knowledge Translation." *Open Access*, 2018, 8.

Armstrong, Andrea, and Douglas Jackson-Smith. “Forms and Levels of Integration: Evaluation of an Interdisciplinary Team-Building Project,” n.d., 19.

Armstrong, J Scott and others. “Predicting Job Performance: The Moneyball Factor.” *Foresight: The International Journal of Applied Forecasting* 25 (2012): 31–34.

Aycan, Zeynep, Rabindra N. Kanungo, and Jai B. P. Sinha. “Organizational Culture and Human Resource Management Practices: The Model of Culture Fit.” *Journal of Cross-Cultural Psychology* 30, no. 4 (July 1999): 501–26. https://doi.org/10.1177/0022022199030004006.

Aylett, R., and S. Louchart. “Towards a Narrative Theory of Virtual Reality.” *Virtual Reality* 7, no. 1 (December 1, 2003): 2–9. https://doi.org/10.1007/s10055-003-0114-9.

Bachmann-Medick, Doris. “Translational Turn.” In *Handbook of Translation Studies*, edited by Yves Gambier and Luc van Doorslaer, 4:186–93. Amsterdam: John Benjamins Publishing Company, 2013. https://doi.org/10.1075/hts.4.tra17.

Balio, Tino. *MGM*. Routledge Hollywood Centenary. London ; New York: Routledge/Taylor & Francis Group, 2018.

Balsamo, Anne. *Designing Culture: The Technological Imagination at Work*. Duke University Press, 2011.

Balsiger, Philip W. “Supradisciplinary Research Practices: History, Objectives and Rationale.” *Futures* 36, no. 4 (May 2004): 407–21. https://doi.org/10.1016/j.futures.2003.10.002.

Bambach, Charles. “THE TIME OF THE SELF AND THE TIME OF THE OTHER.” *History and Theory* 50, no. 2 (May 2011): 254–69. https://doi.org/10.1111/j.1468-2303.2011.00582.x.

Bammer, Gabriele. *Disciplining Interdisciplinarity: Integration and Implementation Sciences for Researching Complex Real-World Problems*. ANU E Press, 2013.

Baptista, Bianca Vienni, Isabel Fletcher, Maciej Maryl, Piotr Wciślik, Anna Buchner, Catherine Lyall, Jack Spaapen, et al. “SHAPE-ID: Shaping Interdisciplinary Practices in Europe Deliverable 2.3: Final Report on Understandings of Interdisciplinary and Transdisciplinary Research and Factors of Success and Failure Project Information,” 2020.

Baptista, Bianca Vienni, Maciej Maryl, Piotr Wciślik, Isabel Fletcher, Anna Buchner, Doireann Wallace, Christian Pohl, et al. “SHAPE-ID: Shaping Interdisciplinary Practices in Europe Deliverable 2.1: Preliminary Report of Literature Review on Understandings of Interdisciplinary and Transdisciplinary Research Project Information,” 2020, n.d.

Barad, Karen. *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning*. Duke University Press, 2007.

Barile, Sergio, Giacomo Franco, Giancarlo Nota, and Marialuisa Saviano. "Structure and Dynamics of a 'T-Shaped' Knowledge: From Individuals to Cooperating Communities of Practice." *Service Science* 4, no. 2 (June 2012): 161–80. https://doi.org/10.1287/serv.1120.0014.

Barnes, Brooks. "Scrounging for Hits, Hollywood Goes Back to the Video Game Well." *The New York Times*, May 24, 2021, sec. Business. https://www.nytimes.com/2021/05/24/business/media/video-game-movies-sony-playstation.html.

Bassnett, Susan. *Translation Studies, Third Edition*, n.d.

Becher, Tony. "The Counter-Culture of Specialisation." *European Journal of Education* 25, no. 3 (1990): 333. https://doi.org/10.2307/1503322.

———. "The Significance of Disciplinary Differences." *Studies in Higher Education* 19, no. 2 (January 1994): 151–61. https://doi.org/10.1080/03075079412331382007.

Ben-David, Joseph, and Randall Collins. "Social Factors in the Origins of a New Science: The Case of Psychology." *American Sociological Review* 31, no. 4 (August 1966): 451. https://doi.org/10.2307/2090769.

Berg, Charles Ramírez. *Latino Images in Film: Stereotypes, Subversion, and Resistance*. Austin, UNITED STATES: University of Texas Press, 2002. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=3442970.

Berk, Sarabeth. *More Than My Title: The Power of Hybrid Professionals in a Workforce of Experts and Generalists*. Networlding Publishing, 2020.

Berk, Sarabeth G. "The ABC's of Art Teacher Professional Identity: An A/r/Tographic Investigation into the Interstitial Spaces," n.d., 266.

Bernal, Dolores Delgado. "Critical Race Theory, Latino Critical Theory, and Critical Raced-Gendered Epistemologies: Recognizing Students of Color as Holders and Creators of Knowledge." *Qualitative Inquiry* 8, no. 1 (2002): 105–26.

Bernstein, Jay H. "Disciplinarity and Trandisciplinarity in the Study of Knowledge," 2014.

———. "The Data-Information-Knowledge-Wisdom Hierarchy and Its Antithesis." *NASKO* 2, no. 1 (November 4, 2011): 68–75. https://doi.org/10.7152/nasko.v2i1.12806.

———. "Transdisciplinarity: A Review of Its Origins, Development, and Current Issues." *Journal of Research Practice* 11, no. 1 (2015): 17.

Bhabha, Homi K. *The Location of Culture*. Routledge, 2012.

Bina, Olivia, Marta Varanda, and Marite Guevara, eds. *INTREPID Knowledge. Interdisciplinary & Transdisciplinary Research and Collaboration*. COST Action TD1408, 2019. http://intrepid-cost.ics.ulisboa.pt.

Bogost, Ian. "Procedural Rhetoric." *Persuasive Games: The Expressive Power of Videogames*, 2007, 1–64.

Bohm, David. *On Dialogue*. Routledge, 2013.

Bohm, David, and Basil J. Hiley. *The Undivided Universe: An Ontological Interpretation of Quantum Theory*. Routledge, 2006.

Bohm, David, and F. David Peat. *Science, Order, and Creativity*. Toronto ; New York: Bantam Books, 1987.

Bohr, Niels. *Atomic Theory and the Description of Nature: Four Essays with an Introductory Survey*. Cambridge University Press, 2011.

———. *Causality and Complementarity: Supplementary Papers*. Ox Bow Press, 1998.

———. *Essays 1932-1957 on Atomic Physics and Human Knowledge*. Ox Bow Press, 1958.

———. *Essays 1958-1962 on Atomic Physics and Human Knowledge*. Ox Bow Press, 1963.

Bontempo, Robert N., William P. Bottom, and Elke U. Weber. "Cross-Cultural Differences in Risk Perception: A Model-Based Approach." *Risk Analysis* 17, no. 4 (August 1997): 479–88. https://doi.org/10.1111/j.1539-6924.1997.tb00888.x.

Boon, Mieke, and Sophie Van Baalen. "Epistemology for Interdisciplinary Research – Shifting Philosophical Paradigms of Science," 2018, 35.

Boon, Wouter P.C., Maryse M.H. Chappin, and Jaap Perenboom. "Balancing Divergence and Convergence in Transdisciplinary Research Teams." *Environmental Science & Policy* 40 (June 2014): 57–68. https://doi.org/10.1016/j.envsci.2014.04.005.

Bowker, Geoffrey C, and Susan Leigh Star. *Sorting Things out: Classification and Its Consequences*. MIT press, 2000.

Boyd, Davina, Marleen Buizer, Renato Schibeci, and Catherine Baudains. "Prompting Transdisciplinary Research: Promising Futures for Using the Performance Metaphor in Research." *Futures* 65 (January 2015): 175–84. https://doi.org/10.1016/j.futures.2014.10.014.

Brassler, Mirjam, and Jan Dettmers. “How to Enhance Interdisciplinary Competence—Interdisciplinary Problem-Based Learning versus Interdisciplinary Project-Based Learning.” *Interdisciplinary Journal of Problem-Based Learning* 11, no. 2 (July 31, 2017). https://doi.org/10.7771/1541-5015.1686.

Brennen, Bonnie S. *Qualitative Research Methods for Media Studies*. Routledge, 2012.

Bridle, Helen, Anton Vrieling, Monica Cardillo, Yoseph Araya, and Leonith Hinojosa. “Preparing for an Interdisciplinary Future: A Perspective from Early-Career Researchers.” *Futures* 53 (September 2013): 22–32. https://doi.org/10.1016/j.futures.2013.09.003.

Brister, Evelyn. “Disciplinary Capture and Epistemological Obstacles to Interdisciplinary Research: Lessons from Central African Conservation Disputes.” *Studies in History and Philosophy of Science Part C: Studies in History and Philosophy of Biological and Biomedical Sciences* 56 (April 2016): 82–91. https://doi.org/10.1016/j.shpsc.2015.11.001.

Brzeski, Patrick, and Patrick Brzeski. “Sony Pictures Not for Sale, Says CEO Yoshida Kenichiro.” *The Hollywood Reporter* (blog), May 27, 2021. https://www.hollywoodreporter.com/business/business-news/sony-pictures-not-for-sale-1234960009/.

Buckley, A. M. *Pixar: The Company and Its Founders*. ABDO, 2011.

Bunch, Craig. “Art and Books at the Guadalajara International Book Fair.” *The Art Book* 16, no. 3 (2009): 74–75. https://doi.org/10.1111/j.1467-8357.2009.01049.x.

Burdea, Grigore C., and Philippe Coiffet. *Virtual Reality Technology*. John Wiley & Sons, 2003.

Burt, Ronald S. “Structural Holes and Good Ideas.” *American Journal of Sociology* 110, no. 2 (September 2004): 349–99. https://doi.org/10.1086/421787.

Bush, Vannevar. *Endless Horizons*. Literary Licensing, LLC, 2012.

———. *Science Is Not Enough*. Morrow, 1967.

Calder, Judy. “Teaching Tools & Techniques.” *Journal of Teaching in Marriage and Family* 6 (2006).

Cárdenas Castillo, Cristina. “Progreso y Mentalidades En Conflicto. Un Nuevo Acercamiento a La Desaparición Del Instituto de Ciencias Del Estado de Jalisco (1883).” In *Episodios de La Universidad de Guadalajara: Perspectivas Diversas. Guadalajara*. Universidad de Guadalajara, 2009.

Carey, Heather, Rebecca Florisson, and Lesley Giles. “Skills, Talent and Diversity in the Creative Industries,” n.d., 72.

Carroll, Leigh, Mohammed K. Ali, Patricia Cuff, Mark D. Huffman, Bridget B. Kelly, Sandeep P. Kishore, K. M. Venkat Narayan, Karen R. Siegel, and Rajesh Vedanthan. "Envisioning a Transdisciplinary University." *The Journal of Law, Medicine & Ethics* 42, no. 2_suppl (December 2014): 17–25. https://doi.org/10.1111/jlme.12183.

Casner-Lotto, Jill, and Linda Barrington. *Are They Really Ready to Work? Employers' Perspectives on the Basic Knowledge and Applied Skills of New Entrants to the 21st Century US Workforce.* ERIC, 2006.

Castillo, Cristina Cárdenas. "Universidad, representaciones sociales e identidad regional en Guadalajara durante el siglo XIX," n.d., 12.

Castro, Alberto De. "Introduction to Giorgi's Existential Phenomenological Research Method," no. 11 (2003): 13.

Catmull, Ed, and Amy Wallace. *Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration*. 1st edition. Random House, 2014.

Caton, Patrick, Howard Ernst, Karen Flack, Joseph P. Smith, and Kurtis Swope. "Amping-Up Pedagogy through Interdisciplinary Instruction." *Journal of Interdisciplinary Studies* 6, no. 1 (n.d.): 2017.

Chan, Selena. "From Job to Calling: Vocational Identity and the Role of Apprenticeship." *Vocations and Learning*, April 13, 2019. https://doi.org/10.1007/s12186-019-09220-5.

Chavoya Peña, María Luisa. *Episodios de La Universidad de Guadalajara: Perspectivas Diversas*. Guadalajara, Mexico: Universidad de Guadalajara, 2009. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=3193921.

Chen, Jer-Ming, and Johannes M Luetz. "Mono-/Inter-/Multi-/Trans-/Anti-Disciplinarity in Research." *Quality Education, Encyclopedia of the UN Sustainable Development Goals. Springer Nature, Cham, Switzerland*, 2020, 1–16.

Christensen, Clayton M. *How Will You Measure Your Life?(Harvard Business Review Classics)*. Harvard Business Review Press, 2017.

Chun, Wendy Hui Kyong. *Control and Freedom: Power and Paranoia in the Age of Fiber Optics:* Vol. 195, 2007. https://insights.ovid.com/crossref?an=00005053-200703000-00024.

Churchill, Scott D, and Frederick J Wertz. "An Introduction to Phenomenological Research in Psychology: Historical, Conceptual, and Methodological Foundations," n.d., 30.

Cilliers, Paul, and Basarab Nicolescu. “Complexity and Transdisciplinarity – Discontinuity, Levels of Reality and the Hidden Third.” *Futures* 44, no. 8 (October 2012): 711–18. https://doi.org/10.1016/j.futures.2012.04.001.

Colapinto, Cinzia, and Colin Porlezza. “Innovation in Creative Industries: From the Quadruple Helix Model to the Systems Theory.” *Journal of the Knowledge Economy* 3, no. 4 (December 1, 2012): 343–53. https://doi.org/10.1007/s13132-011-0051-x.

“Collection: The University of Texas at Dallas Oral History Collection | Special Collections Archives.” Accessed March 8, 2021. https://libarchives.utdallas.edu/repositories/5/resources/368.

Collins, Harry, and Robert Evans. “A Sociological/Philosophical Perspective on Expertise: The Acquisition of Expertise through Socialization.” In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 21–32. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.002.

Conklin, Thomas A. “Method or Madness: Phenomenology as Knowledge Creator.” *Journal of Management Inquiry* 16, no. 3 (September 2007): 275–87. https://doi.org/10.1177/1056492607306023.

Cooper, M. G., and J. Marx. “Crisis, Crisis, Crisis: Big Media and the Humanities Workforce.” *Differences* 24, no. 3 (January 1, 2013): 127–59. https://doi.org/10.1215/10407391-2391977.

Cooper, Mark Garrett, and John Marx. *Media U: How the Need to Win Audiences Has Shaped Higher Education*. Columbia University Press, 2018.

Coryn, Chris L S, and John A Hattie. “The Transdisciplinary Model of Evaluation,” 2008, 8.

Cotsomitis, John A. “Is the Learning Economy a Viable Concept for Understanding the Modern Economy?” *International Journal of Social Economics* 45, no. 3 (January 1, 2018): 492–507. https://doi.org/10.1108/IJSE-01-2017-0025.

———. “The Learning Economy Regime.” *Journal of the Knowledge Economy*, February 12, 2021. https://doi.org/10.1007/s13132-021-00756-3.

Cowan, Krista. “Collective Biography.” In *Research Methods for History*, edited by Simon Gunn and Lucy Faire. Edinburgh, United Kingdom: Edinburgh University Press, 2011. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1363938.

Crawford-Lee, Mandy, and Sam Moorwood. “Degree Apprenticeships: Delivering Quality and Social Mobility?” *Higher Education, Skills and Work-Based Learning* 9, no. 2 (May 13, 2019): 134–40. https://doi.org/10.1108/HESWBL-05-2019-123.

Crawley, Edward, John Hegarty, Kristina Edström, and Juan Cristobal Garcia Sanchez. *Universities as Engines of Economic Development: Making Knowledge Exchange Work*. Cham: Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-47549-9.

Crenshaw, Kimberle. "Demarginalizing the Intersection of Race and Sex: A Black Feminist Critique of Antidiscrimination Doctrine, Feminist Theory and Antiracist Politics." *U. Chi. Legal F.*, 1989, 139.

Cross, Nigel. "Designerly Ways of Knowing." *Design Studies* 3, no. 4 (1982): 221–27.

Crowston, Kevin, Alison Specht, Carol Hoover, Katherine M. Chudoba, and Mary Beth Watson-Manheim. "Perceived Discontinuities and Continuities in Transdisciplinary Scientific Working Groups." *Science of The Total Environment* 534 (November 2015): 159–72. https://doi.org/10.1016/j.scitotenv.2015.04.121.

Croyle, Robert T. "The National Cancer Institute's Transdisciplinary Centers Initiatives and the Need for Building a Science of Team Science." *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S90–93. https://doi.org/10.1016/j.amepre.2008.05.012.

Dadfar, Hossein, and Peter Gustavsson. "Competition by Effective Management of Cultural Diversity: The Case of International Construction Projects." *International Studies of Management & Organization* 22, no. 4 (1992): 81–92.

Dalai, Giampero, Berta Martini, and Luciano Perondi. "Beyond the Discipline: A Metadisciplinary Approach for the Didactics of Communication Design," n.d., 31.

D'Alessandro, Anthony, and Anthony D'Alessandro. "Spider-Man Back In Action As Sony Agrees To Disney Co-Fi For New Movie, Return To MCU: How Spidey's Web Got Untangled." *Deadline* (blog), September 27, 2019. https://deadline.com/2019/09/sony-walt-disneys-marvel-team-on-third-spider-man-homecoming-title-with-superhero-to-appear-in-future-marvel-pics-1202746497/.

Dall'Alba, Gloria. "Learning Professional Ways of Being: Ambiguities of Becoming." *Educational Philosophy and Theory* 41, no. 1 (January 2009): 34–45. https://doi.org/10.1111/j.1469-5812.2008.00475.x.

———. "Reframing Expertise and Its Development: A Lifeworld Perspective." In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 33–39. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.003.

Daniel, David. "Creating the Future: Annual Report 2011." The University of Texas at Dallas, 2011. utdallas.edu/president/annualreport/2011.

Davidson, Cathy N. *The New Education: How to Revolutionize the University to Prepare Students for a World In Flux*. Basic Books, 2017.

Davidson, Cathy N., and David T. Goldenberg. "A Manifesto for the Humanities in the Digital Age." *The Chronicle of Higher Education* 50, no. 23 (2004): 6.

Davis, Katie, Joanna Christodoulou, Scott Seider, and Howard Gardner. "The Theory of Multiple Intelligences." *The Cambridge Handbook of Intelligence*, n.d., 19.

De Monticelli, Roberta. "Phenomenology Today: A Good Travel Mate for Analytic Philosophy?" *Phenomenology and Mind, No 1 (2011)*, November 27, 2016. https://doi.org/10.13128/phe_mi-19640.

Deißinger, Thomas, Ursel Hauschildt, Philipp Gonon, and Silke Fischer. *Contemporary Apprenticeship Reforms and Reconfigurations*. LIT Verlag Münster, 2019.

DeRobertis, Eugene Mario. *The Phenomenology of Learning and Becoming*. Palgrave Macmillan, 2017.

Dew, Nicholas, Anusha Ramesh, Stuart Read, and Saras D. Sarasvathy. "Toward Deliberate Practice in the Development of Entrepreneurial Expertise: The Anatomy of the Effectual Ask." In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 389–412. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.022.

Dewey, John. *Art as Experience*. Penguin, 2005.

———. *Democracy and Education: An Introduction to the Philosophy of Education*. Macmillan, 1923.

———. *How We Think*. Standard Publications, Incorporated, 1935.

Dheeman, Chatterji, Hayes Schildwachter, and Jeffrey S Harrison. "Sony Corporation: Reinventing Itself to Rediscover the Technological Edge," n.d., 26.

Díaz-Faes, Adrián A., Paula Otero-Hermida, Müge Ozman, and Pablo D'Este. "Do Women in Science Form More Diverse Research Networks than Men? An Analysis of Spanish Biomedical Scientists." Edited by Cassidy R. Sugimoto. *Plos One* 15, no. 8 (August 27, 2020): e0238229. https://doi.org/10.1371/journal.pone.0238229.

Dieleman, Hans. "Transdisciplinary Hermeneutics: A Symbiosis of Science, Art, Philosophy, Reflective Practice, and Subjective Experience," n.d., 30.

Dieleman, Hans, Basarab Nicolescu, and Atila Ertas, eds. *Transdisciplinary & Interdisciplinary Education and Research*. TheATLAS Publishing, 2017.

Dienstfrey, Eric. “Under the Standard: MGM, AT&T, and the Academy’s Regulation of Power.” *JCMS: Journal of Cinema and Media Studies* 59, no. 3 (2020): 23–45. https://doi.org/10.1353/cj.2020.0028.

Dimeny, Ervin and others. “Skilling Up: The Scope of Modern Apprenticeship.” *Urban Institute*, 2019.

Downey, Gary Lee, and Juan C. Lucena. “Knowledge and Professional Identity in Engineering: Code-switching and the Metrics of Progress.” *History and Technology* 20, no. 4 (December 2004): 393–420. https://doi.org/10.1080/0734151042000304358.

———. “National Identities in Multinational Worlds: Engineers and ‘Engineering Cultures.’” *International Journal of Continuing Engineering Education and Life-Long Learning* 15, no. 3/4/5/6 (2005): 252. https://doi.org/10.1504/IJCEELL.2005.007714.

Dufour, Frank. “La composition musicale comme expérience,” n.d., 8.

Dykes, Thomas H., Paul A. Rodgers, and Michael Smyth. “Towards a New Disciplinary Framework for Contemporary Creative Design Practice.” *CoDesign* 5, no. 2 (June 2009): 99–116. https://doi.org/10.1080/15710880902910417.

D Magazine. “Early Influencers: Margaret McDermott Was The Dallas Changemaker.” Accessed June 21, 2021. http://www.dmagazine.com/publications/d-ceo/2020/november/early-influencers-margaret-mcdermott-was-the-dallas-changemaker/.

Eco, Umberto. *A Theory of Semiotics*. Indiana University Press, 1976.

———. *Opera Aperta*. Harvard University Press, 1989.

Elfenbein, Daniel W., Barton H. Hamilton, and Todd R. Zenger. “The Small Firm Effect and the Entrepreneurial Spawning of Scientists and Engineers.” *Management Science* 56, no. 4 (2010): 659–81.

Eliot, Thomas Stearns, and Professor T. S. Eliot. *Complete Poems and Plays*. Houghton Mifflin Harcourt, 1971.

Elron, Efrat. “Top Management Teams within Multinational Corporations: Effects of Cultural Heterogeneity.” *The Leadership Quarterly* 8, no. 4 (December 1, 1997): 393–412. https://doi.org/10.1016/S1048-9843(97)90021-7.

Ericsson, K. Anders. “An Introduction to the Second Edition of *The Cambridge Handbook of Expertise and Expert Performance* : Its Development, Organization, and Content.” In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 3–20. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.001.

Feng, Jieyin. “International Book Fairs as Intercultural Catalysts for Libraries and Publishers: Frankfurt, Guadalajara, Zimbabwe and Beyond.” *Library Collections, Acquisitions, and Technical Services* 23, no. 1 (March 1, 1999): 104–6. https://doi.org/10.1016/S1464-9055(98)00108-0.

Fennell, Hayden, Joseph A. Lyon, Aasakiran Madamanchi, and Alejandra J. Magana. “Computational Apprenticeship: Cognitive Apprenticeship for the Digital Era.” Preprint. SocArXiv, September 28, 2019. https://doi.org/10.31235/osf.io/jy328.

Fiore, Stephen M. “Interdisciplinarity as Teamwork: How the Science of Teams Can Inform Team Science.” *Small Group Research* 39, no. 3 (June 2008): 251–77. https://doi.org/10.1177/1046496408317797.

Fleming, Lee. “Perfecting Cross-Pollination.” *Harvard Business Review*, 2004, 4.

Foucault, Michel. “History of Systems of Thought.” *Language, Counter-Memory, Practice*, 1980, 199–205.

———. “The Discourse on Language.” In *Truth*, edited by Jos Medina and David Wood, 315–35. Ames, Iowa, USA: Blackwell Publishing, 2005. https://doi.org/10.1002/9780470776407.ch20.

———. *The Order of Things*. Routledge, 2005.

Frater, Patrick, and Patrick Frater. “Sony Pictures Poised to Benefit as Independent Studio in Streaming Era, Tony Vinciquerra Claims.” *Variety* (blog), May 28, 2021. https://variety.com/2021/biz/asia/sony-pictures-independent-studio-streaming-era-tony-vinciquerra-1234982927/.

Friend, Stacie. “Collaboration in the Third Culture.” *Projections* 12, no. 2 (December 1, 2018): 39–49. https://doi.org/10.3167/proj.2018.120206.

Frodeman, Robert, Julie Thompson Klein, and Roberto Carlos Dos Santos Pacheco. *The Oxford Handbook of Interdisciplinarity*. Oxford University Press, 2017.

Garcia Topete, Alex. *The Spirit of UTD: What’s at the Core of Being a Comet?*, 2011. https://vimeo.com/23135124.

———. “Transdisciplinary Intelligence: Training Hybrids and Amphibians.” July 2019. 10.13140/RG.2.2.30915.96805/1.

Garcia Topete, Alex, Chaz Lilly, Cassini Nazir, and Roger F. Malina. “ArtSciLab: Experimental Publishing & Knowledge Production in Collaborative Transdisciplinary Practices.” In *Routledge International Handbook of Art, Science, and Technology Studies*, edited by Hannah Rogers, Megan Halpern, Dehlia Hannah, and Kathryn de Ridder-Vignone, 11. United Kingdom: Taylor & Francis, 2021.

Garcia Topete, Alex, Roger F. Malina, Carol Strohecker, and Robert Thill. “SEAD Exemplars: Evidence of the Value of Transdisciplinary Projects.” SEAD Committee, December 2017. https://seadexemplars.org/wp-content/uploads/2018/01/SEADExemplarsReport-December-2017.pdf.

Gasset, José Ortega y. *Meditación de la técnica y otros ensayos sobre ciencia y filosofía*. Alianza, 1982.

———. *Misión de la universidad y otros ensayos sobre educación y pedagogía*. Revista de Occidente en Alianza Editorial, 1982.

Gasset, Jose Ortega y. *Phenomenology and Art*. Translated by Philip W. Silver. W. W. Norton & Company, 1975.

Geertz, Clifford. “The Way We Think Now: Toward an Ethnography of Modern Thought.” In *Local Knowledge: Further Essays in Interpretive Anthropology*. Basic Books, 2000.

Gehlert, Sarah. “Turning Disciplinary Knowledge Into Solutions.” *Journal of Adolescent Health* 52, no. 5 (May 2013): S98–102. https://doi.org/10.1016/j.jadohealth.2013.02.015.

Gershon, Richard A. “The Sony Corporation: Market Leadership, Innovation Failure and the Challenges of Business Reinvention.” In *Handbook of East Asian Entrepreneurship*, edited by Tony Fu-Lai Yu and Ho-Don Yan. London, United Kingdom: Taylor & Francis Group, 2014. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1811063.

Gertner, Jon. *The Idea Factory: Bell Labs and the Great Age of American Innovation*. Penguin, 2013.

Gessler, Michael. “Concepts of Apprenticeship: Strengths, Weaknesses and Pitfalls.” In *Handbook of Vocational Education and Training*, edited by Simon McGrath, Martin Mulder, Joy Papier, and Rebecca Suart, 1–34. Cham: Springer International Publishing, 2019. https://doi.org/10.1007/978-3-319-49789-1_94-1.

Gibbons, Michael, ed. *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London ; Thousand Oaks, Calif: SAGE Publications, 1994.

Gibson-Graham, J. K. *The End of Capitalism (as We Knew It): A Feminist Critique of Political Economy*. 1st University of Minnesota Press ed., 2006. Minneapolis: University of Minnesota Press, 2006.

Giorgi, Amedeo. "The Question of Validity in Qualitative Research." *Journal of Phenomenological Psychology* 33, no. 1 (2002): 1–18. https://doi.org/10.1163/156916202320900392.

Glazer, Evan M., and Michael J. Hannafin. "The Collaborative Apprenticeship Model: Situated Professional Development within School Settings." *Teaching and Teacher Education* 22, no. 2 (February 2006): 179–93. https://doi.org/10.1016/j.tate.2005.09.004.

González, Carlos Manuel García. *La descentralización de la Universidad de Guadalajara: diez años después*--. Universidad de Guadalajara, 2004.

Goodman, David. "The Apprenticeship Experience at University:" 26, no. 2 (2019): 14.

Granberry, Julian. *The Americas That Might Have Been: Native American Social Systems Through Time*. University of Alabama Press, 2005.

Gray, Barbara. "Enhancing Transdisciplinary Research Through Collaborative Leadership." *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S124–32. https://doi.org/10.1016/j.amepre.2008.03.037.

Grieveson, Lee, and Haidee Wasson, eds. *Inventing Film Studies*. Duke University Press, 2008.

Grmek, Mirko D. *History of AIDS: Emergence and Origin of a Modern Pandemic*. Princeton University Press, 1993.

Groenewald, Thomas. "A Phenomenological Research Design Illustrated." *International Journal of Qualitative Methods* 3, no. 1 (March 2004): 42–55. https://doi.org/10.1177/160940690400300104.

Gudaitis, Christina. "The Ongoing Battle of Cultures Between Pixar and Disney Animation Studio: How Business Culture Affected the Success of Both Studios." *Augsburg Honors Review* 8, no. 1 (2015): 13.

Gudykunst, William B. *Cross-Cultural and Intercultural Communication*. SAGE, 2003.

Gudykunst, William B., Bella Mody, and Molefi Kete Asante. *Handbook of International and Intercultural Communication*. SAGE, 2002.

Guerra, Delin. “Guadalajara International Book Fair: The Largest Book Fair in the Spanish-Speaking World.” In *American Libraries*, 48:36–36. American Library Association, 2017. https://libproxy.utdallas.edu/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=125343854&site=ehost-live.

Guimarães, Maria Helena, Christian Pohl, Olivia Bina, and Marta Varanda. “Who Is Doing Inter- and Transdisciplinary Research, and Why? An Empirical Study of Motivations, Attitudes, Skills, and Behaviours.” *Futures*, July 2019, 102441. https://doi.org/10.1016/j.futures.2019.102441.

Gunn, Simon. “Analysing Behaviour as Performance.” In *Research Methods for History*, edited by Simon Gunn and Lucy Faire. Edinburgh, United Kingdom: Edinburgh University Press, 2011. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1363938.

Hah, Sixian. “Valuation Discourses and Disciplinary Positioning Struggles of Academic Researchers—A Case Study of ‘Maverick’ Academics.” *Palgrave Communications* 6, no. 1 (December 2020): 51. https://doi.org/10.1057/s41599-020-0427-2.

Hall, Gary. *Pirate Philosophy: For a Digital Posthumanities*. MIT Press, 2016.

Hall, Kara L., Amanda L Vogel, Brooke A Stipelman, Daniel Stokols, Glen Morgan, and Sarah Gehlert. “A Four-Phase Model of Transdisciplinary Team-Based Research: Goals, Team Processes, and Strategies.” *Translational Behavioral Medicine* 2, no. 4 (December 2012): 415–30. https://doi.org/10.1007/s13142-012-0167-y.

Halloun, Ibrahim. “Differential Convergence Education from Pluridisciplinarity to Transdisciplinarity,” n.d., 33.

Hansen, Morten T. “Introducing T-Shaped Managers.” *Harvard Business Review*, 2001, 13.

Haraway, Donna. *Simians, Cyborgs, and Women: The Reinvention of Nature*. Routledge, 2013.

———. “Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective.” *Feminist Studies* 14, no. 3 (1988): 575. https://doi.org/10.2307/3178066.

Harkness, Janet A., Fons J. R. van de Vijver, and Peter Ph Mohler. *Cross-Cultural Survey Methods*. J. Wiley, 2003.

Harper, Douglas. “Know | Origin and Meaning.” Dictionary. Etymonline. Accessed September 19, 2019. https://www.etymonline.com/word/know.

———. “Production | Origin and Meaning.” Dictionary. Etymonline. Accessed September 19, 2019. https://www.etymonline.com/word/production.

———. “Publication | Origin and Meaning.” Online Etymology Dictionary. Etymonline. Accessed June 19, 2021. https://www.etymonline.com/search?q=publication.

———. “Research | Origin and Meaning.” Dictionary. Etymonline. Accessed September 19, 2019. https://www.etymonline.com/search?q=research.

Harris, Frances, and Fergus Lyon. “Transdisciplinary Environmental Research: Building Trust across Professional Cultures.” *Environmental Science & Policy* 31 (August 2013): 109–19. https://doi.org/10.1016/j.envsci.2013.02.006.

Harris, Lois R, and Gavin T L Brown. “Mixing Interview and Questionnaire Methods: Practical Problems in Aligning Data” 15, no. 1 (2010): 20.

Harrison, David A., and Katherine J. Klein. “What’s the Difference? Diversity Constructs as Separation, Variety, or Disparity in Organizations.” *Academy of Management Review* 32, no. 4 (October 2007): 1199–1228. https://doi.org/10.5465/amr.2007.26586096.

Harrison, David A, Kenneth H Price, Joanne H Gavin, and Anna T Florey. “Time, Teams, and Task Performance: Changing Effects of Surface-and Deep-Level Diversity on Group Functioning.” *Academy of Management Journal* 45, no. 5 (2002): 1029–45.

Hayden, Erik, and Erik Hayden. “MGM Sold to Amazon for $8.45 Billion in Blockbuster Deal.” *The Hollywood Reporter* (blog), May 26, 2021. https://www.hollywoodreporter.com/business/business-news/mgm-sold-to-amazon-deal-4075596/.

Heeremans, L. J. “In Your Face. An Inquiry into Historical and Contemporary Conditions of Virtual Reality,” 2017.

Heidegger, Martin. *Discourse on Thinking*. Harper Collins, 1969.

———. “The Question Concerning Technology,” 1977, 23.

Heisenberg, Werner. *Across the Frontiers*. Ox Bow Press, 1990.

———. *Philosophic Problems of Nuclear Science: Eight Lectures*. Faber, 1952.

Herrington, Jan, and Ron Oliver. “An Instructional Design Framework for Authentic Learning Environments.” *Educational Technology Research and Development* 48, no. 3 (2000): 23–48.

Hess, Andi. “Interdisciplinary Translation and Integration Science Initiative.” Oral Presentation presented at the Science of Team Science 2018 Conference, Clearwater Beach, FL., May 23, 2018. https://teamsciencetoolkit.cancer.gov/Public/TSResourceBiblio.aspx?tid=3&rid=4751.

Hofstede, Geert. “The Cultural Relativity of Organizational Practices and Theories.” *Journal of International Business Studies* 14, no. 2 (June 1, 1983): 75–89. https://doi.org/10.1057/palgrave.jibs.8490867.

Hofstra, Bas, Vivek V. Kulkarni, Sebastian Munoz-Najar Galvez, Bryan He, Dan Jurafsky, and Daniel A. McFarland. “The Diversity–Innovation Paradox in Science.” *Proceedings of the National Academy of Sciences* 117, no. 17 (April 28, 2020): 9284–91. https://doi.org/10.1073/pnas.1915378117.

Hoppers, Catherine Alum Odora. *Indigenous Knowledge and the Integration of Knowledge Systems: Towards a Philosophy of Articulation*. New Africa Books, 2002.

Huo, Dong, Kazuyuki Motohashi, and Han Gong. “Team Diversity as Dissimilarity and Variety in Organizational Innovation.” *Research Policy* 48, no. 6 (July 2019): 1564–72. https://doi.org/10.1016/j.respol.2019.03.020.

Husserl, Edmund. *The Crisis of European Sciences and Transcendental Phenomenology: An Introduction to Phenomenological Philosophy*. Northwestern University Press, 1970.

Huutoniemi, Katri, Julie Thompson Klein, Henrik Bruun, and Janne Hukkinen. “Analyzing Interdisciplinarity: Typology and Indicators.” *Research Policy* 39, no. 1 (February 2010): 79–88. https://doi.org/10.1016/j.respol.2009.09.011.

Ihde, Don. *Experimental Phenomenology: An Introduction*. SUNY Press, 1986.

———. *Experimental Phenomenology, Second Edition: Multistabilities*. SUNY Press, 2012.

———. *Postphenomenology and Technoscience: The Peking University Lectures*. SUNY Press, 2009.

———. *Postphenomenology: Essays in the Postmodern Context*. Northwestern University Press, 1995.

———. “Postphenomenology—Again.” *Aarhus, Department of Information & Media Studies*, 2003.

———. *Technics and Praxis*. Boston Studies in the Philosophy of Science 24. Dordrecht: Reidel, 1979.

Ihde, Don, and Richard M. Zaner, eds. *Interdisciplinary Phenomenology*. Selected Studies in Phenomenology and Existential Philosophy 6. The Hague: M. Nijhoff, 1977.

Innovates, Dallas. “Richardson’s Innovation Quarter — Aka The IQ — Is Making Big Moves as a Living Lab and Nerve Center » Dallas Innovates.” *Dallas Innovates* (blog), June 1, 2021. https://dallasinnovates.com/richardsons-innovation-quarter-aka-the-iq-is-making-big-strides-as-a-living-laboratory-and-nerve-center/.

"Internships and Trainee Programs | Careers at Sony Pictures Entertainment." Accessed June 20, 2021. https://www.sonypicturesjobs.com/internships.

Ito, Joichi. "The Antidisciplinary Approach." *Research-Technology Management* 60, no. 6 (November 2, 2017): 22–28. https://doi.org/10.1080/08956308.2017.1373047.

Jacoby, Tamar, and Robert I Lerman. "Industry-Driven Apprenticeship," n.d., 84.

Jahn, Thomas. "Transdisciplinarity in the Practice of Research." *Transdisziplinäre Forschung: Integrative Forschungsprozesse Verstehen Und Bewerten. Campus Verlag, Frankfurt/Main, Germany*, 2008, 21–37.

Jang, Sujin. "The Most Creative Teams Have a Specific Type of Cultural Diversity," 2018, 4.

Johnson, Melissa, and Katie Spiker. "Broadening the Apprenticeship Pipeline," 2018, 12.

Julier, Guy. "From Design Culture to Design Activism." *Design and Culture* 5, no. 2 (July 2013): 215–36. https://doi.org/10.2752/175470813X13638640370814.

Kackman, Michael. "History and Historiography." In *The Craft of Criticism: Critical Media Studies in Practice*, edited by Michael Kackman and Mary Celeste Kearney. Routledge, 2018.

Kagan, Jerome. *The Three Cultures: Natural Sciences, Social Sciences, and the Humanities in the 21st Century*. Cambridge University Press, 2009.

Kämäräinen, Pekka. "Research as Mediator between Vocational Learning, Work Process Knowledge and Conceptual Innovation–on the Role of Research in the Modernisation of Vocational Education and Training (VET)," n.d.

Kanter, Jake, and Jake Kanter. "Sony Pictures Television Plans U.S. TV Adaptation Of Italian Medical Drama 'Doc.'" *Deadline* (blog), October 15, 2020. https://deadline.com/2020/10/sony-pictures-television-plans-u-s-tv-adaptation-of-italian-medical-drama-doc-1234597360/.

Karjalainen, T-M, M Koria, and M Salimäki. "Educating T-Shaped Design, Business and Engineering Professionals," 2009, 5.

Keegan, Rebecca, and Rebecca Keegan. "Reanimating Pixar: How Pete Docter Steered the Studio Out of Scandal." *The Hollywood Reporter* (blog), January 6, 2021. https://www.hollywoodreporter.com/movies/movie-news/reanimating-pixar-how-pete-docter-steered-the-studio-out-of-scandal-4111715/.

Kegan, Robert. *The Evolving Self*. Harvard University Press, 1982.

Keil, Frank, Courtney Stein, Lisa Webb, Van Dyke Billings, and Leonid Rozenblit. “Discerning the Division of Cognitive Labor: An Emerging Understanding of How Knowledge Is Clustered in Other Minds.” *Cognitive Science: A Multidisciplinary Journal* 32, no. 2 (March 2008): 259–300. https://doi.org/10.1080/03640210701863339.

Kenneth A. Frank, and Kyle Fahrbach. “Organization Culture as a Complex System: Balance and Information in Models of Influence and Selection.” *Organization Science* 10, no. 3, (n.d.). http://www.jstor.org/stable/2640331.

Kessel, Frank, and Patricia L. Rosenfield. “Toward Transdisciplinary Research.” *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S225–34. https://doi.org/10.1016/j.amepre.2008.05.005.

Kirby, David A. “Hollywood Knowledge: Communication Between Scientific and Entertainment Cultures.” In *Communicating Science in Social Contexts*, edited by Donghong Cheng, Michel Claessens, Toss Gascoigne, Jenni Metcalfe, Bernard Schiele, and Shunke Shi, 165–80. Dordrecht: Springer Netherlands, 2008. https://doi.org/10.1007/978-1-4020-8598-7_10.

Kirsner, Scott. *Inventing the Movies: Hollywood’s Epic Battle Between Innovation and the Status Quo, from Thomas Edison to Steve Jobs*. Scott Kirsner, 2008.

Klein, Julie T. “Evaluation of Interdisciplinary and Transdisciplinary Research.” *American Journal of Preventive Medicine* 35, no. 2 (August 2008): S116–23. https://doi.org/10.1016/j.amepre.2008.05.010.

Klein, Julie Thompson. *Crossing Boundaries: Knowledge, Disciplinarities, and Interdisciplinarities*. University Press of Virginia, 1996.

———. *Interdisciplinarity: History, Theory, and Practice*. Wayne State University Press, 1990.

———. “Reprint of ‘Discourses of Transdisciplinarity: Looking Back to the Future.’” *Futures* 65 (2015): 10–16. https://doi.org/10.1016/j.futures.2015.01.003.

———. “Reprint of ‘Discourses of Transdisciplinarity: Looking Back to the Future.’” *Futures* 65 (January 2015): 10–16. https://doi.org/10.1016/j.futures.2015.01.003.

Klein, Julie Thompson, and Carol Geary Schneider. *Creating Interdisciplinary Campus Cultures: A Model for Strength and Sustainability*. Hoboken, United States: John Wiley & Sons, Incorporated, 2009. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=477754.

Kobayashi, José María Kazuhiro, Pilar Gonzalbo Aizpuru, Dorothy Tanck de Estrada, Anne Staples, Josefina Zoraida Vázquez, Alejandro Martínez Jiménez, James D. Cockcroft, et al. *La educación en la historia de México*. 1st ed. El Colegio de México, 1992. https://doi.org/10.2307/j.ctv5137rb.

Kraidy, Marwan M. "Cultural Hybridity and International Communication." In *Hybridity, or the Cultural Logic of Globalization*, 1–14. Temple University Press, 2005. http://www.jstor.org/stable/j.ctt1bw1k8m.5.

Kroeber, Alfred Louis, and Clyde Kluckhohn. "Culture: A Critical Review of Concepts and Definitions." *Papers. Peabody Museum of Archaeology & Ethnology, Harvard University*, 1952.

Kuhn, Thomas S. *The Structure of Scientific Revolutions*. University of Chicago Press, 1996.

Kumar Giri, Ananta. "The Calling of a Creative Transdisciplinarity." *Futures* 34, no. 1 (February 2002): 103–15. https://doi.org/10.1016/S0016-3287(01)00038-6.

Kumar, Manjit. *Quantum: Einstein, Bohr and the Great Debate About the Nature of Reality*. Icon Books Ltd, 2008.

Lang, Daniel J., Arnim Wiek, Matthias Bergmann, Michael Stauffacher, Pim Martens, Peter Moll, Mark Swilling, and Christopher J. Thomas. "Transdisciplinary Research in Sustainability Science: Practice, Principles, and Challenges." *Sustainability Science* 7, no. S1 (February 2012): 25–43. https://doi.org/10.1007/s11625-011-0149-x.

Latour, Bruno. *An Inquiry Into Modes of Existence*. Harvard University Press, 2013.

———. *Science in Action: How to Follow Scientists and Engineers Through Society*. Harvard University Press, 1987.

Latour, Bruno, and Steve Woolgar. *Laboratory Life: The Construction of Scientific Facts*. Princeton University Press, 2013.

Lazear, E.P. "Entrepreneurship." *Journal of Labor Economics* 23, no. 4 (2005).

Leach, James. "'Being in Between': Art-Science Collaborations and a Technological Culture." *Social Analysis* 49, no. 1 (2005): 141–62.

———. "Leaving the Magic Out: Knowledge and Effect in Different Places." *Anthropological Forum* 22, no. 3 (November 2012): 251–70. https://doi.org/10.1080/00664677.2012.723611.

———. "Modes of Creativity and the Register of Ownership." *CODE: Collaborative Ownership and the Digital Economy* 29 (2005): 38.

———. “The Self of the Scientist, Material for the Artist: Emergent Distinctionsin an Interdisciplinary Collaboration.” *Social Analysis* 55, no. 3 (January 1, 2011). https://doi.org/10.3167/sa.2011.550308.

Leahey, Erin, Sondra N. Barringer, and Misty Ring-Ramirez. “Universities’ Structural Commitment to Interdisciplinary Research.” *Scientometrics*, January 25, 2019. https://doi.org/10.1007/s11192-018-2992-3.

Leckenby, Denise, and Sharlene Nagy Hesse-Biber. “Feminist Approaches to Mixed-Methods Research.” In *Feminist Research Practice: A Primer*, edited by Sharlene Nagy Hesse-Biber and Patricia Lina Leavy, 249–91, 2007.

Lekshmi, Durga Lekshmi. “4 A Plan for Instruction: An Innovative Instructional Plan for Multi-Discipline.” *Purakala with ISSN 0971-2143 Is an UGC CARE Journal* 31, no. 46 (2020): 209–24.

Levinas, E. *Totality and Infinity: An Essay on Exteriority*. Springer Science & Business Media, 1979.

Lewis, Linda H, and Carol J Williams. “Experiential Learning: Past and Present.” *New Directions for Adult and Continuing Education* 1994, no. 62 (1994): 5–16.

Lewis, Michael. *Moneyball: The Art of Winning an Unfair Game*. W. W. Norton & Company, 2004.

Leydesdorff, Loet. “The Triple Helix, Quadruple Helix, …, and an N-Tuple of Helices: Explanatory Models for Analyzing the Knowledge-Based Economy?” *Journal of the Knowledge Economy* 3, no. 1 (March 1, 2012): 25–35. https://doi.org/10.1007/s13132-011-0049-4.

Leydesdorff, Loet, Caroline S. Wagner, and Lutz Bornmann. “Betweenness and Diversity in Journal Citation Networks as Measures of Interdisciplinarity–A Tribute to Eugene Garfield–.” *ArXiv Preprint ArXiv:1705.03272*, 2017.

Pixar Animation Studios. “Life at Pixar.” Accessed June 8, 2021. https://www.pixar.com/life-at-pixar.

Liu, Alan. *The Laws of Cool: Knowledge Work and the Culture of Information*. University of Chicago Press, 2004.

Machlup, Fritz. *Knowledge: Its Creation, Distribution and Economic Significance, Volume I: Knowledge and Knowledge Production*. Princeton: Princeton University Press, 1981. https://doi.org/10.1515/9781400856008.

Magner, Siobhan, and Naomi Jackson. “Apprenticeships: Bringing College to the Workplace,” n.d., 6.

Mäkinen, Elina. “Complexity Leadership Theory and the Leaders of Transdisciplinary Science.” *Informing Science: The International Journal of an Emerging Transdiscipline* 21 (2018): 133–55. https://doi.org/10.28945/4009.

Malina, RF, C Strohecker, and C LaFayette. *Steps to an Ecology of Networked Knowledge and Innovation*. Cambridge, MU: The MIT Press, 2015.

Manen, Max van. “Linking Ways of Knowing with Ways of Being Practical.” *Curriculum Inquiry* 6, no. 3 (1977): 205. https://doi.org/10.2307/1179579.

Manen, Max Van. “Phenomenology of Practice.” *Phenomenology & Practice* 1, no. 1 (October 28, 2007). https://doi.org/10.29173/pandpr19803.

Marks, Michelle A., Mark J. Sabella, C. Shawn Burke, and Stephen J. Zaccaro. “The Impact of Cross-Training on Team Effectiveness.” *Journal of Applied Psychology* 87, no. 1 (2002): 3–13. https://doi.org/10.1037/0021-9010.87.1.3.

Maruyama, Magoroh. “Paradigmatology and Its Application to Cross-Disciplinary, Cross-Professional and Cross- Cultural Communication.” *Dialectica* 28, no. 3/4 (1974): 135–96.

Mastro, Dana E., and Elizabeth Behm-Morawitz. “Latino Representation on Primetime Television.” *Journalism & Mass Communication Quarterly* 82, no. 1 (March 2005): 110–30. https://doi.org/10.1177/107769900508200108.

Max-Neef, Manfred A. “Foundations of Transdisciplinarity.” *Ecological Economics* 53, no. 1 (April 2005): 5–16. https://doi.org/10.1016/j.ecolecon.2005.01.014.

McCall, Leslie. “The Complexity of Intersectionality.” *Signs: Journal of Women in Culture and Society* 30, no. 3 (2005): 1771–1800.

McCarthy, E Doyle. *Knowledge as Culture: The New Sociology of Knowledge*. Psychology Press, 1996.

McDermott, Margaret Milam. *Reflections*. Bright Sky Press, 2012.

McGregor, Sue L. T., and Gabrielle Donnelly. “Transleadership for Transdisciplinary Initiatives.” *World Futures* 70, no. 3–4 (May 19, 2014): 164–85. https://doi.org/10.1080/02604027.2014.934625.

McGregor, Sue LT. “Transdisciplinary Axiology: To Be or Not to Be.” *Integral Leadership Review* 11, no. 3 (2011).

Mejía, G Mauricio, Cassini Nazir, Roger F Malina, Alex Garcia Topete, Felipe C Londoño, Andrés F Roldán, Priscila L Farias, and João Silveira. “An Emerging Role for Design Methods in Transdisciplinary Practice.” In *Proceedings of the 24th International Symposium on Electronic Art (ISEA 2018), Durban*, 67–71, 2018.

Merleau-Ponty, Maurice. *Phenomenology of Perception*. Motilal Banarsidass Publishe, 1996.

Michael G. Pratt, Kevin W. Rockmann, and Jeffrey B. Kaufmann. “Constructing Professional Identity: The Role of Work and Identity Learning Cycles in the Customization of Identity among Medical Residents.” *The Academy of Management Journal* 49, no. 2 (2006): 235–62.

Mieg, Harald A., and Julia Evetts. “Professionalism, Science, and Expert Roles: A Social Perspective.” In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 127–48. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.009.

News Center. “Milestone Reached: UT Dallas Qualifies for State’s ‘Tier One’ Fund.” Accessed June 21, 2021. https://news.utdallas.edu/campus-community/milestone-reached-ut-dallas-qualifies-for-states-t/.

Miller, Raymond C, and Raymond C Miller. “Varieties of Interdisciplinary Approaches in the Social Sciences: A 1981 Overview.” *Issues in Interdisciplinary Studies*, 1982.

Misra, S, D Stokols, and L Cheng. “The Transdisciplinary Orientation Scale: Factor Structure and Relation to the Integrative Quality and Scope of Scientific Publications.” *Journal of Collaborative Healthcare and Translational Medicine* 3, no. 2 (2015): 1042.

Mitchell, Alfred T. “Al’s Short History - UT Dallas Chronology.” *Special Collections at UT-Dallas*, October 16, 2014. https://utd-ir.tdl.org/handle/10735.1/4119.

———. “UT Dallas Chronology, 1960-1989 (Abbreviated),” October 16, 2014. https://utd-ir.tdl.org/handle/10735.1/4118.

———. “UT Dallas Chronology, 1969-1971 (Detailed),” October 16, 2014. https://utd-ir.tdl.org/handle/10735.1/4120.

Mitchell, Cynthia, Dana Cordell, and Dena Fam. “Beginning at the End: The Outcome Spaces Framework to Guide Purposive Transdisciplinary Research.” *Futures* 65 (2015): 86–96. https://doi.org/10.1016/j.futures.2014.10.007.

Mitrany, Michal, and Daniel Stokols. “Gauging the Transdisciplinary Qualities and Outcomes of Doctoral Training Programs.” *Journal of Planning Education and Research* 24, no. 4 (June 2005): 437–49. https://doi.org/10.1177/0739456X04270368.

Mobjörk, Malin. “Consulting versus Participatory Transdisciplinarity: A Refined Classification of Transdisciplinary Research.” *Futures* 42, no. 8 (October 2010): 866–73. https://doi.org/10.1016/j.futures.2010.03.003.

Moon, Hanna. “Unleashing Apprenticeship: From Onboarding to Professional Development.” *European Journal of Training and Development* 42, no. 1–2 (February 19, 2018): 110–24. https://doi.org/10.1108/EJTD-06-2017-0056.

Moreno Rodríguez, Ramón. “Sobre Juan Real Ledezma, Universidad de Guadalajara, ‘síntesis histórica.’” *Historia Mexicana* 71, no. 4 (April 1, 2022). https://doi.org/10.24201/hm.v71i4.4097.

Moreno, Roxana, and Richard Mayer. “Interactive Multimodal Learning Environments.” *Educ Psychol Rev*, 2007, 19.

Morse, Wayde Cameron, Max Nielsen-Pincus, Jo Ellen Force, and J. D. Wulfhorst. “Bridges and Barriers to Developing and Conducting Interdisciplinary Graduate-Student Team Research.” *Ecology and Society* 12, no. 2 (2007): art8. https://doi.org/10.5751/ES-02082-120208.

Mostashari, Ali. “Sociotechnical Systems: A Conceptual Introduction.” In *Socio-Technical Networks*, edited by Jiang Xie, 1–11. CRC Press, 2010. https://doi.org/10.1201/b10327-2.

“Narrative - Creating the Future Since 1969 - The University of Texas at Dallas.” Accessed March 8, 2021. https://www.utdallas.edu/create/narrative.html.

Neeley, Kathryn A, and Bernd Steffensen. “The T-Shaped Engineer as an Ideal in Technology Entrepreneurship: Its Origins, History, and Significance for Engineering Education,” 2018, 32.

Negrón-Muntaner, Frances. “The Latino Media Gap.” *The Center for the Study of Ethnicity and Race Columbia University. Retrieved from: Http://Www. Columbia. Edu/Cu/Cser/Downloads/AdvancedExectutiveSummary. Pdf*, 2014.

Nicolescu, Basarab. “Methodology of Transdisciplinarity.” *World Futures* 70, no. 3–4 (May 19, 2014): 186–99. https://doi.org/10.1080/02604027.2014.934631.

———. “The Transdisciplinary Evolution of Learning,” 1996, 11.

———. “Transdisciplinarity - Past, Present and Future,” 2005, 24.

Nietzsche, Friedrich. *Thus Spoke Zarathustra*. Penguin UK, 1974.

Nonaka, Ikujiro. “A Dynamic Theory of Organizational Knowledge Creation.” *ORGANIZATION SCIENCE* 5, no. 1 (1994): 25.

Nonaka, Ikujirō, and Hirotaka Takeuchi. “The Knowledge-Creating Company.” *Harvard Business Review* 85, no. 7/8 (2007): 162.

Norris, Patricia E., Michael O’Rourke, Alex S. Mayer, and Kathleen E. Halvorsen. “Managing the Wicked Problem of Transdisciplinary Team Formation in Socio-Ecological Systems.” *Landscape and Urban Planning* 154 (October 2016): 115–22. https://doi.org/10.1016/j.landurbplan.2016.01.008.

Nowotny, Helga. “The Potential of Transdisciplinarity.” *H. Dunin-Woyseth, H. and M. Nielsen, Discussing Transdisciplinarity: Making Professions and the New Mode of Knowledge Production, the Nordic Reader, Oslo School of Architecture, Oslo, Norway*, 2004, 10–19.

Oliveira, Talita Moreira de, Livio Amaral, and Roberto Carlos dos Santos Pacheco. “Multi/Inter/Transdisciplinary Assessment: A Systemic Framework Proposal to Evaluate Graduate Courses and Research Teams.” *Research Evaluation*, May 17, 2018. https://doi.org/10.1093/reseval/rvy013.

Omi, Michael, and Howard Winant. *Racial Formation in the United States*. Routledge, 2014.

Ortega y Gasset, José. *The Revolt of the Masses*. W.W. Norton, 1993.

Oskam, I F. “T-Shaped Engineers for Interdisciplinary Innovation: An Attractive Perspective for Young People as Well as a Must for Innovative Organisations,” 2009, 11.

Pixar Animation Studios. “Our Story.” Accessed June 8, 2021. https://www.pixar.com/our-story-pixar.

Paik, Karen, and Leslie Iwerks. *To Infinity and Beyond!: The Story of Pixar Animation Studios*. Chronicle Books, 2007.

Paletz, Susannah, Laurel Smith-Doerr, and Itai Vardi. *National Science Foundation Workshop Report: Interdisciplinary Collaboration in Innovative Science and Engineering Fields*. Boston, MA, 2010.

Parsons, Allan. “The Ego-Logical and the Eco-Logical.” *Poiesis and Prolepsis* (blog), 2013. http://prolepsis-ap.blogspot.com/2013/04/the-ego-logical-and-eco-logical.html.

Peirce, Charles Sanders. *Pragmatism as a Principle and Method of Right Thinking: The 1903 Harvard Lectures on Pragmatism*. Edited by Patricia Ann Turrisi. Albany: SUNY Press, 1997.

Peña, Nonny de la, Peggy Weil, Joan Llobera, Bernhard Spanlang, Doron Friedman, Maria V Sanchez-Vives, and Mel Slater. “Immersive Journalism: Immersive Virtual Reality for the First-Person Experience of News.” *Presence: Teleoperators and Virtual Environments* 19, no. 4 (August 2010): 291–301. https://doi.org/10.1162/PRES_a_00005.

Peregrina, Angélica. “La desaparición del Instituto de Ciencias de Jalisco (1883),” 1883, 20.

Piña, Ulices. “The Different Roads to Rebellion: Socialist Education and the Second Cristero Rebellion in Jalisco, 1934-1939,” 2017, 28.

Pirtle, Caleb. *Engineering the World: Stories from the First 75 Years of Texas Instruments*. Southern Methodist University Press, 2005.

Pluck, G., and H. L. Johnson. “Stimulating Curiosity to Enhance Learning.” *GESJ: Education Sciences and Psychology* 2 (19) (December 31, 2011). http://gesj.internet-academy.org.ge/en/title_en.php?b_sec=edu.

Pohl, Christian, Julie Thompson Klein, Sabine Hoffmann, Cynthia Mitchell, and Dena Fam. “Conceptualising Transdisciplinary Integration as a Multidimensional Interactive Process.” *Environmental Science & Policy* 118 (April 2021): 18–26. https://doi.org/10.1016/j.envsci.2020.12.005.

Polk, Merritt. “Transdisciplinary Co-Production: Designing and Testing a Transdisciplinary Research Framework for Societal Problem Solving.” *Futures* 65 (2015): 110–22. https://doi.org/10.1016/j.futures.2014.11.001.

Porter, Alan L., and Ismael Rafols. “Is Science Becoming More Interdisciplinary? Measuring and Mapping Six Research Fields over Time.” *Scientometrics* 81, no. 3 (December 2009): 719–45. https://doi.org/10.1007/s11192-008-2197-2.

Priaulx, Nicky, and Martin Weinel. “Connective Knowledge: What We Need to Know about Other Fields to ‘Envision’ Cross-Disciplinary Collaboration.” *European Journal of Futures Research* 6, no. 1 (December 2018). https://doi.org/10.1186/s40309-018-0150-z.

Price, David A. *The Pixar Touch*. Knopf Doubleday Publishing Group, 2008.

Ramachandran, Naman, and Naman Ramachandran. “Sony Pictures Television Sets First Look Deal With Nigeria’s EbonyLife Media For Scripted TV Projects.” *Variety* (blog), February 4, 2021. https://variety.com/2021/tv/global/sony-pictures-television-first-look-deal-nigeria-ebonylife-mo-abudu-1234899559/.

Ravindran, Manori, and Manori Ravindran. “Sony Pictures Television U.K. Channels Sold to U.S. Investment Firm Narrative Capital (EXCLUSIVE).” *Variety* (blog), May 14, 2021. https://variety.com/2021/tv/global/sony-channels-uk-sold-narrative-1234972645/.

Repko, Allen F. *Interdisciplinary Research: Process and Theory*. SAGE, 2008.

Research, Committee on Facilitating Interdisciplinary, National Academy of Sciences, and National Academy of Engineering. *Facilitating Interdisciplinary Research*. National Academies Press, 2004.

Rittel, Horst WJ, and Melvin M Webber. “Dilemmas in a General Theory of Planning.” *Policy Sciences* 4, no. 2 (1973): 155–69.

Rivera, Luis M. *Documentos fundatorios de la Universidad de Guadalajara*. Gobierno del Estado de Jalisco, Secretaría General de Gobierno, Unidad Editorial, 1989.

Robasky, Kimberley, Rebecca Boyles, Kira C. Bradford, Margaret Gold, W. Christopher Lenhardt, Shannon McKeen, Sandy Skipper, and Stan Ahalt. “How to Launch Transdisciplinary Research Communication.” RTI Press, April 17, 2020. https://doi.org/10.3768/rtipress.2020.rb.0022.2004.

Rodgers, Paul, and Craig Bremner. “Alterplinarity–‘Alternative Disciplinarity’in Future Art and Design Research Pursuits.” *Studies in Material Thinking* 6 (2011): 1–16.

Root-Bernstein, Robert Scott, and Michèle Root-Bernstein. *Sparks of Genius: The Thirteen Thinking Tools of the World’s Most Creative People*. Houghton Mifflin Harcourt, 2001.

Rosenfield, Patricia L. “The Potential of Transdisciplinary Research for Sustaining and Extending Linkages between the Health and Social Sciences.” *Social Science & Medicine* 35, no. 11 (1992): 1343–57.

Rossing, Boyd E., and Huey B. Long. “Contributions of Curiosity and Relevance To Adult Learning Motivation.” *Adult Education* 32, no. 1 (September 1, 1981): 25–36. https://doi.org/10.1177/074171368103200102.

Rousseau, Ronald. “On the Leydesdorff-Wagner-Bornmann Proposal for Diversity Measurement.” *Journal of Informetrics* 13, no. 3 (August 2019): 906–7. https://doi.org/10.1016/j.joi.2019.03.015.

Ruef, Martin. “The Emergence of Organizational Forms: A Community Ecology Approach.” *American Journal of Sociology* 106, no. 3 (November 2000): 658–714. https://doi.org/10.1086/318963.

Salas, Eduardo, and Janis A. Cannon-Bowers. “The Science of Training: A Decade of Progress.” *Annual Review of Psychology* 52, no. 1 (February 2001): 471–99. https://doi.org/10.1146/annurev.psych.52.1.471.

Salas, Eduardo, Gerald F. Goodwin, and C. Shawn Burke. *Team Effectiveness In Complex Organizations: Cross-Disciplinary Perspectives and Approaches*. New York, United States: Taylor and Francis, 2008. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=381324.

Salazar, Maritza, and Theresa Lant. “Facilitating Innovation in Interdisciplinary Teams: The Role of Leaders and Integrative Communication.” *Informing Science: The International Journal of an Emerging Transdiscipline* 21 (2018): 157–78. https://doi.org/10.28945/4011.

Sampson, Tony D. *Virality: Contagion Theory in the Age of Networks*. U of Minnesota Press, 2012.

Sandholtz, Kurt, and Walter W Powell. “Amphibious Entrepreneurs and the Origins of Invention.” In *Oxford Handbook on Entrepreneurship and Collaboration*, edited by Jeffrey Reuer and Sharon Matusik, 45, 2018.

Sarpong, David, Azley AbdRazak, Elizabeth Alexander, and Dirk Meissner. “Organizing Practices of University, Industry and Government That Facilitate (or Impede) the Transition to a Hybrid Triple Helix Model of Innovation.” *Technological Forecasting and Social Change* 123 (October 2017): 142–52. https://doi.org/10.1016/j.techfore.2015.11.032.

Schein, Edgar H. “Culture: The Missing Concept in Organization Studies.” *Administrative Science Quarterly* 41, no. 2 (June 1996): 229. https://doi.org/10.2307/2393715.

Schrödinger, Erwin. *The Interpretation of Quantum Mechanics: Dublin Seminars (1949-1955) and Other Unpublished Essays*. Ox Bow Press, 1995.

Schumpeter, Joseph Alois. *Capitalism, Socialism and Democracy*. Routledge, 1976.

Shahin, Jamal, Trisha Meyer, Dariusz Kloza, and Katja Biedenkopf. “Building Bridges, Breaking Barriers. The Smart Approach to Distance Between Disciplines in Research Projects.” European Commission, 2014.

Shane, Scott, and S. Venkataraman. “The Promise of Enterpreneurship as a Field of Research.” *The Academy of Management Review* 25, no. 1 (January 2000): 217. https://doi.org/10.2307/259271.

Shannon, Claude E. “A Mathematical Theory of Communication.” *The Bell System Technical Journal* 27, no. 3 (1948): 379–423.

Shneiderman, Ben. “Creativity and Collaboration: Revisiting Cybernetic Serendipity.” *Proceedings of the National Academy of Sciences* 116, no. 6 (2019): 1837–43.

Shore, Bradd. “Unconsilience: Rethinking Two-Cultures Conundrum Anthropology,” n.d., 19.

Siegel, Tatiana, and Tatiana Siegel. “Five Years Later, Who Really Hacked Sony?” *The Hollywood Reporter* (blog), November 25, 2019. https://www.hollywoodreporter.com/movies/movie-features/five-years-who-hacked-sony-1257591/.

Silveira, João Ricardo Aguiar da, Roger F. Malina, and Denise Lannes. “Arteciência: Um Retrato Acadêmico Brasileiro.” *Ciência e Cultura* 70, no. 2 (April 2018): 46–55. https://doi.org/10.21800/2317-66602018000200013.

Simonton, Dean Keith. “Historiometric Methods.” In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 21–32. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.002.

Snow, C. P. “The Two Cultures.” *Leonardo* 23, no. 2/3 (1990): 169. https://doi.org/10.2307/1578601.

———. *The Two Cultures*. Canto ed. London ; New York: Cambridge University Press, 1993.

Sonesh, Shirley C., Christina Lacerenza, Shannon Marlow, and Eduardo Salas. “What Makes an Expert Team? A Decade of Research.” In *The Cambridge Handbook of Expertise and Expert Performance*, edited by K. Anders Ericsson, Robert R. Hoffman, Aaron Kozbelt, and A. Mark Williams, 2nd ed., 21–32. Cambridge University Press, 2018. https://doi.org/10.1017/9781316480748.002.

Stahl, Günter K., Kristiina Mäkelä, Lena Zander, and Martha L. Maznevski. “A Look at the Bright Side of Multicultural Team Diversity.” *Scandinavian Journal of Management* 26, no. 4 (December 2010): 439–47. https://doi.org/10.1016/j.scaman.2010.09.009.

Sternberg, Robert J. “Culture and Intelligence.” *American Psychologist* 59, no. 5 (2004): 325.

Sternberg, Robert J, and D.K. Detterman. *What Is Intelligence? Contemporary Viewpoints on Its Nature and Definition.* Norwood, NJ: Ablex., 1986.

Stockhausen, Lynette, and Craig Zimitat. “New Learning: Re-Apprenticing the Learner.” *Educational Media International* 39, no. 3–4 (January 2002): 331–38. https://doi.org/10.1080/0952398022000036164.

Stokes, Donald E. *Pasteur’s Quadrant: Basic Science and Technological Innovation*. Brookings Institution Press, 2011.

Sweeney, Patrick, Michael D. Matthews, and Paul B. Lester. “Trust.” In *Leadership in Dangerous Situations: A Handbook for the Armed Forces, Emergency Services, and First Responders*, 163–81. Naval Institute Press, 2011.

Taras, Vas, and Piers Steel. “Beyond Hofstede: Challenging the Ten Commandments of Cross-Cultural Research.” In *Beyond Hofstede: Culture Frameworks for Global Marketing and Management*, edited by Cheryl Nakata, 40–60. London: Palgrave Macmillan UK, 2009. https://doi.org/10.1057/9780230240834_3.

Tett, Gillian. *The Silo Effect: The Peril of Expertise and the Promise of Breaking down Barriers*. Simon and Schuster, 2015.

Texas House Bill No. 303: The University of Texas at Dallas, Pub. L. No. 303, 3 (1969).

“The Nicolescu and Zurich Approaches to Transdisciplinarity.” Accessed June 9, 2021. http://integralleadershipreview.com/13135-616-the-nicolescuian-and-zurich-approaches-to-transdisciplinarity/.

Fortune. “The Reincarnation of Bell Labs.” Accessed June 21, 2021. https://fortune.com/2015/02/02/bell-labs-real-estate-revival/.

Thiry, Heather, and Sandra L. Laursen. “The Role of Student-Advisor Interactions in Apprenticing Undergraduate Researchers into a Scientific Community of Practice.” *Journal of Science Education and Technology* 20, no. 6 (December 2011): 771–84. https://doi.org/10.1007/s10956-010-9271-2.

Turner, Fred. *From Counterculture to Cyberculture: Stewart Brand, the Whole Earth Network, and the Rise of Digital Utopianism*. University of Chicago Press, 2010.

News Center. “University Marks 50th Anniversary of Signature Moment in Its History.” Accessed June 21, 2021. https://news.utdallas.edu/campus-community/50th-anniversary-bill-signing/.

Unoki, Ko. “Sony’s Movie Entertainment Empire.” In *Mergers, Acquisitions and Global Empires: Tolerance, Diversity and the Success of M&a*. London, United Kingdom: Taylor & Francis Group, 2012. http://ebookcentral.proquest.com/lib/utd/detail.action?docID=1047040.

“UT Dallas Chronology. | Special Collections Archives.” Accessed March 8, 2021. https://libarchives.utdallas.edu/repositories/5/archival_objects/34088.

Van Manen, Max. “‘ Doing’ Phenomenological Research and Writing: An Introduction,” 1984.

———. “Practicing Phenomenological Writing.” *Phenomenology+ Pedagogy* 2, no. 1 (1944): 36–69.

Van Rijnsoever, Frank J., Marijn A. Van Weele, and Chris P. Eveleens. “Network Brokers or Hit Makers? Analyzing the Influence of Incubation on Start-up Investments.” *International Entrepreneurship and Management Journal* 13, no. 2 (June 2017): 605–29. https://doi.org/10.1007/s11365-016-0416-5.

Venuti, Lawrence. *The Translator’s Invisibility: A History of Translation*. London; New York: Routledge, 1995. http://site.ebrary.com/id/10097452.

Vermersch, Pierre. “Bases de l’auto-explicitation (1),” 2007, 31.

Wallerstein, Immanuel Maurice. *The Uncertainties of Knowledge*. Temple University Press, 2004.

Wang, Lan, and Rick Cotton. “Beyond *Moneyball* to Social Capital inside and out: The Value of Differentiated Workforce Experience Ties to Performance: Beyond Moneyball to Social Capital inside and Out.” *Human Resource Management* 57, no. 3 (May 2018): 761–80. https://doi.org/10.1002/hrm.21856.

Washington, Teresa N. *Our Mothers, Our Powers, Our Texts: Manifestations of Aje in Africana Literature*. Oya’s Tornado, 2015.

Watson, W. E., K. Kumar, and L. K. Michaelsen. “Cultural Diversity's Impact on Interaction Process and Performance: Comparing Homogeneous and Diverse Task Groups.” *Academy of Management Journal* 36, no. 3 (June 1, 1993): 590–602. https://doi.org/10.2307/256593.

Weiner, Eric. *The Geography of Genius: A Search for the World’s Most Creative Places from Ancient Athens to Silicon Valley*. Simon and Schuster, 2016.

Wenger, Etienne. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press, 1999.

Whittington, Jan, Ryan Calo, Mike Simon, Jesse Woo, Meg Young, and Peter Schmiedeskamp. “Push, Pull, and Spill” 30 (2019): 69.

Wickson, F., A.L Carew, and A.W. Russell. “Transdisciplinary Research: Characteristics, Quandaries and Quality.” *Futures* 38, no. 9 (November 2006): 1046–59. https://doi.org/10.1016/j.futures.2006.02.011.

Wildman, Paul. “From the Monophonic University to Polyphonic Multiversities.” *Futures* 30, no. 7 (September 1998): 625–33. https://doi.org/10.1016/S0016-3287(98)00070-6.

Wilson, E. O. *Consilience: The Unity of Knowledge*. Knopf Doubleday Publishing Group, 2014.

Wise, Timothy D. “Creativity and Culture at Pixar and Disney: A Comparison,” Journal Of The International Academy For Case Studies, 20 (2014).

Wolfe, Richard, Patrick M. Wright, and Dennis L. Smart. “Radical HRM Innovation and Competitive Advantage: TheMoneyball Story.” *Human Resource Management* 45, no. 1 (2006): 111–45. https://doi.org/10.1002/hrm.20100.

Wry, Tyler, Michael Lounsbury, and Mary Ann Glynn. “Legitimating Nascent Collective Identities: Coordinating Cultural Entrepreneurship.” *Organization Science* 22, no. 2 (April 2011): 449–63. https://doi.org/10.1287/orsc.1100.0613.

Zsambok, Caroline E., and Gary A. Klein, eds. *Naturalistic Decision Making*. Expertise, Research and Applications. Mahwah, N.J: L. Erlbaum Associates, 1997.

Zuzul, Tiona, and Mary Tripsas. “Start-up Inertia versus Flexibility: The Role of Founder Identity in a Nascent Industry.” *Administrative Science Quarterly*, April 17, 2019, 000183921984348. https://doi.org/10.1177/0001839219843486.

BIOGRAPHICAL SKETCH

Alex Josue Garcia Topete was born in Mexico City and grew up in Tampico, Mexico. He graduated high school from Tecnológico de Monterrey and spent a year writing, producing, and directing for a nationally broadcasted children's television program before being recruited to the McDermott Scholars Program at The University of Texas at Dallas in 2007. During his time at UTD, Garcia Topete worked for NPR, Sony Television International, and the Dallas Film Society, and founded and led multiple student media organizations. After graduating in 2011 with a Bachelor of Arts in Art & Performance with a concentration in Film Studies and Creative Writing and minors in Philosophy and Political Science, he founded his own production and multimedia publishing company, Nowadays Orange. He then returned to UT Dallas for a Master of Arts in Arts & Technology (2017), Master of Science in Innovation & Entrepreneurship (2020), and PhD in Arts, Technology & Emerging Communication. A serial entrepreneur and active community member, Garcia Topete has served in the Dallas International Film Festival as a programmer for international submission; mentored over half a dozen young filmmakers; and served as president of the Eugene McDermott Scholars Program Alumni Association, a charitable giving organization. Most recently, he won a 2020 Lonestar Emmy in the Documentary category for his work on *Nuestras Américas: Caminos Que Unen*. All of his work, creative and entrepreneurial, focuses on his core value of cosmopolitanism: that all stories are intertwined and inseparable, and we are so much the better for interrogating that which separates us from knowledge, from creativity, and from each other.

CURRICULUM VITAE

EDUCATION

University of Texas at Dallas, Richardson, TX.
PhD Arts, Technology & Emerging Communication **2017 – 2021**
Focus: Transdisciplinary Intelligence, Knowledge Production, Critical Industry Studies, and the Future Workforce.

University of Texas at Dallas, Richardson, TX.
MS Innovation & Entrepreneurship **2018 – 2020**
Focus: New Venture Development, Organizational Design, Knowledge Management.

University of Texas at Dallas, Richardson, TX.
MA Arts & Technology **2015 – 2017**
Focus: Art & Science Collaboration, Experimental Publishing, Quantum Aesthetics.

University of Texas at Dallas, Richardson, TX.
BA Arts & Performance Graduated Summa Cum Laude & School Honors GPA: 3.926 **2007 – 2011**
Concentrations: Film Studies and Creative Writing Minors: Political Science & Philosophy

AWARDS

Eugene McDermott Graduate Fellowship, University of Texas at Dallas	2017 – 2021
Miami Web Fest, Best Sitcom	2021
Lonestar Regional Emmy Outstanding Achievement, Documentary Cultural/Historical	2020
Eugene McDermott Scholars Program, University of Texas at Dallas	2007 – 2011
Jules Verne International Science Fiction Award – Best Essay, Guadalajara, Mexico.	2006

EXPERIENCE

Deputy Co-Director of Transdisciplinary Strategy & Innovation – ArtSciLab at UT Dallas, Dallas, TX.	2019 – 2021
Innovation & Collaboration Strategist – ArtSciLab at UT Dallas, Dallas-Dallas, TX.	2017 – 2019
Director of Programming – Festival de Cine Latino Americano, Dallas-Fort Worth, TX.	2016 – to date
Research Assistant - University of Texas at Dallas, Richardson, TX	2016 – 2017
President – Eugene McDermott Scholars Program Alumni Association, Dallas, TX.	2014 – 2017
Board Member – Eugene McDermott Scholars Program Alumni Association, Dallas, TX.	2012 – 2019
Chief Creative Officer & Co-Founder Partner – Nowadays Orange Productions LLC, Dallas, TX.	2011 – to date
Lead Programmer – Latino & International Programming – Dallas International Film Festival, Dallas, TX.	2007 – to date

PUBLICATIONS AND PAPERS

*Garcia Topete, Alex. **2019**. "Transdisciplinary Intelligence: Training Hybrids and Amphibians." July. 10.13140/RG.2.2.30915.96805/1.*

*Garcia Topete, Alex, Chaz Lilly, Cassini Nazir, and Roger F. Malina. **2021**. "ArtSciLab: Experimental Publishing & Knowledge Production in Collaborative Transdisciplinary Practices." In* Routledge International Handbook of Art, Science, and Technology Studies*, edited by Hannah Rogers, Megan Halpern, Dehlia Hannah, and Kathryn de Ridder-Vignone, 11. United Kingdom: Taylor & Francis.*

*Garcia Topete, Alex, Roger F. Malina, Carol Strohecker, and Robert Thill. **2017**. "SEAD Exemplars: Evidence of the Value of Transdisciplinary Projects." SEAD Committee. https://seadexemplars.org/wp-content/uploads/2018/01/SEADExemplarsReport-December-2017.pdf.*

*Malina, Roger F., Alex Garcia Topete, and João Silveira. **2018**. "What Is the Evidence That Art-Science-Technology Collaboration Is a Good Thing?"* Leonardo *51 (1): 2. https://doi.org/10.1162/LEON_e_01555.*

*Mejía, G Mauricio, Danah Henriksen, Yumeng Xie, Alex García-Topete, Roger F Malina, and Kendon Jung. (**forthcoming**) "From Researching to Making Futures: A Design Mindset for Transdisciplinary Collaboration.," 22.*

Mejía, G Mauricio, Cassini Nazir, Roger F Malina, Alex Garcia Topete, Felipe C Londoño, Andrés F Roldán, Priscila L Farias, and João Silveira. ***2018****. "An Emerging Role for Design Methods in Transdisciplinary Practice." In Proceedings of the 24th International Symposium on Electronic Art (ISEA 2018), Durban, 67–71.*

"Future and Science Fiction?" (Translated edition) ***2016***
"Future and Science Fiction?" ***2008***
Essay published in the collection of the Jules Verne winners, Guadalajara, Mexico.

AFFILIATIONS

Associate Member - International Association of Innovation Professionals (IAOIP) ***2019 – to date***
Associate Member - Professional and Technical Consultants Association (PATCA) ***2019 – to date***
Expert Peer Reviewer – ISEA 2018 ***2018***
Expert Peer Reviewer – Festival de la Imagen ***2018***
Expert Peer Reviewer – LEONARDO/ISAST ***2016 – to date***
Member – Independent Book Publishers Association ***2014 – 2015***
Member – Texas Motion Picture Alliance ***2011 – to date***
Member – Dallas Film Society ***2009 – to date***
Member - Academy of Television Arts & Sciences ***2009 – to date***

SKILLS & LANGUAGES

Proficient with Microsoft Office, Microsoft Sharepoint, Final Cut Pro, Sony Vegas, Adobe Photoshop, Adobe Premiere, Adobe After Effects, Adobe Audition, Final Draft, MovieMagic Screenwriter, Unity, social-media networks, sound & video editing, videography and photography, coding in JavaScript, HTML5, Flutter, React, & Python.

Languages: Spanish (native), English (100%), French (80%), Italian (basic), Portuguese (basic), German (basic).

Certified by Collaborative Institutional Training Initiative (CITI Program) in Responsible Conduct in Research.