

## **Human-Machine Interfaces and Future of Life**

Three doctoral students participating in the Stanford Design Studio University Innovation Fellowship Program pondered the question of whether society is entering a fifth stage of existence. They wrestle with age old questions. If I exist, where do I exist and how? These questions were prompted by an experience that involved watching a person with limb loss operate a prosthetic hand with tactile sensation that was in another room and separate from the rest of the body. If we can send human sensation to material objects, does it become possible to transfer human experience to other things and perhaps other worlds?

Advances in human-machine interface technologies are rapidly developing to expand the human. Are we prepared for an existence that might take place in multiple worlds or universes? What will life look and feel like if I can be almost anywhere at any time and practically anything? Will it matter if a thing appears alive or conscious if we cannot determine the difference? What kind of governmental systems, marketing enterprises, future work, and social structures will be necessary? What does a silicarbon future at the confluence of artificial intelligence, multi-sensory transfer, and augmented/virtual reality environs mean to the future of life? The students and a small group of faculty from several Northeast Ohio universities began pondering these questions as a part of three larger initiatives: (1) The Internet of Things Collaboration (IOTC); (2) Public Information Technology University Network (PIT-UN); (3) Human Fusions Initiative (HFI). A subgroup quickly formed into a team of students, faculty and other professionals to form a think tank called HELPPS (Human, Ethical, Legal, Phenomenological, Psychological and Societal) to begin a conversation on the impact of a silicarbon future.

It was clear that advances in technology were setting the stage to propel humanity into a fifth stage of existence – Society 5.0 (S5) and that we needed an approach to begin thinking about the potential societal impacts at the speed of technological innovation. With financial support from the PIT-UN and New America, the team quickly began working on the creation of an S5 graduate certificate. The curriculum would consist of four interdisciplinary courses: (1) Transdisciplinary Perspectives and Frameworks of Inquiry taught out of the Urban Studies; (2) Disability, Empathy, and Technology taught out of Engineering; (3) Humanity and Emerging Technologies taught out of the Philosophy; (4) Smart and Sensible Global Cities team taught by Cleveland State and two international partners from the University of Rijeka, Croatia (a PIT-UN affiliate) and the University of Twente, Netherlands who had developed cutting edge training tools around concepts such as “Constructive Controversing” and “Future Frictions.”

S5 had emerged as topic of intense interest and debate designed to be situated as an ongoing conversation as what a fifth stage of development might be like. As in the previous four stages of societal development, (1) hunter-gathering; (2) agrarian; (3) industrial, and (4) informational, the role of technology shaped everyday experience as well as aspirational hopes for a better and more prosperous, fair, and equitable future. S5 will further push at the limits of our understanding of human experience, reality, intelligence, and consciousness, while confronting the future of work, travel, relationships, governmental systems, legal applications, health care,

education, access, equity, and life in general. It will raise substantial questions concerning human-machine interfaces, knowledge formation, privacy, security, and what constitutes life and the living. S5 will usher in a new society centered around questions of existence.

[Image #1 about here] – Abby creating a new image to depict spectrum from S1-S5

Imagine a typical day in Society 5.0 (S5) that might begin with a holographic and/or avatar inhabited meetings in the NOW (Not Other World – think present world). The NOW is where our Earthly selves reside, and we inhabit our existing physical presence. NOW functions in similar ways as present day only with enhanced ability to be in multiple places with a click of a button. Therefore, a work meeting in Denmark is followed by another in Cleveland and then lunch with favorite friends and food while socially gathering on a remote ocean side table. The technologies supporting the NOW have also led to advances in prosthetics and other muscular-neurological-skeletal disabilities. What was once considered disabled, such as, limb loss or muscular-skeletal degeneration, are reconfigured to expand human capability. So much so, that there is policy debate on the degree of human-machine enhancement. Furthermore, society is wrestling with how to improve education and access to advanced technologies. There are questions on what constitutes work and employment. There are concerns of lewd acts at the boundaries of morally acceptable behaviors. The news reports online crimes, such as virtual rapes, crypto currency robberies, and erasing murders in which online existences are wiped-out by criminal viruses. There are commercials for the VOW (Virtual Other Worlds). Within the VOW, you can be almost anything, anyone, or anywhere with fully immersive multi-sensory experience for a price. These worlds are created by commercial and open-source users, access is limited, and dark worlds proliferate the marketplace.

### **Sounds like science fiction?**

Afterall, weren't we supposed to be in flying cars by now and Star Trekking the universe? There is no doubt that we may not be able to fully achieve the degree of S5 existence described above, but there is substantial evidence that we are on our way. NASA recently sent a holograph of a surgeon to International Space Station. Robotics are commonplace in surgery. Technology developed to transfer the sensation of touch over the internet is used in advanced prosthetics and already shaping human-machine interaction. Markets already exists for virtual experience software including haptics devices that emulate touch. Professional American football players have been using VR during training for many years. Furthermore, the National Football League is releasing in Fall 2022 the NFL PRO ERA virtual gaming technology for the fans. Artificial intelligence has been deployed in business planning and finance. Trading bots have been at work for over 10-years on the stock exchange. Government have been used AI and self-learning autonomous software on domestic, military, and international issues. Synthetic forms of life have been created at the molecular level (Xenobots) and have shown the ability to self-replicate.

### **Who is pushing this**

Substantial public and private funding is driving silicon future technologies. Facebook purchased the Oculus VR business in 2014 and is investing around \$10 billion into it's Reality

Labs division and metaverse. The Defense Advanced Research Projects Agency (DARPA) has spent over \$2 billion on advanced AI technologies over the past 5-years and plans to spend nearly half of their requested \$4.119 billion FY 2023 budget on advanced technology development. According to the Bureau of Labor Statistics, in 2021 the three fastest growing industries in America are health care, energy, and technology and data science- all industries which are increasingly incorporating advanced technologies. As we move rapidly towards Society 5.0, advanced technology is becoming more ubiquitous across most sectors and prevalent in almost all aspects of our world. In the 2016 report “[Preparing for the Future of Artificial Intelligence](#)” by the Obama administration’s National Science and Technology Council Committee on Technology, the first recommendation encourages public and private institutions “to examine whether and how they can responsibly leverage AI and machine learning in ways that will benefit society.” In 2018, the [Ford Foundation](#) blogged about public interest tech as “a growing field you should know about,” and pointed out that there is an increasing number of organizations seeking tech expertise. A 2019 piece by the [World Economic Forum](#) pleaded for greater collaboration between policy and technology, and to educate more public-interest technologists. Also in 2019, the [Carnegie Endowment for International Peace](#) argued, “Technological innovation is largely taking place beyond the purview of governments. In many cases, the rate of innovation is outpacing states’ ability to keep abreast of the latest developments and their potential societal impacts...A greater number and variety of actors must be involved to initiate, shape, and implement both technical and normative solutions. Yet, like governments, many of these other actors do not have (or simply do not invest in) the means to consider the broader, cross-border societal implications of their investments, research, and innovations.”

Therefore, it is critical for higher education to prepare students to develop, manage, understand, and lead not only the technologies, but also the broader, societal implications of these technologies. We must prepare our technologists, engineers, social scientists, urbanists, and computer scientists, to think beyond the technology they are creating. At the same time, we must prepare our public administrators, policy makers, business leaders, educators, and healthcare workers to understand the role these technologies are and will play in our work and lives. Universities should be leading this charge and doing so by applying transdisciplinary approaches.

### **What is Transdisciplinarity?**

Transdisciplinarity is designed to go beyond the academy and extend into the world. It appreciates that lived experience is as necessary as traditional forms of knowledge. It “is at once *between* the disciplines, *across* the different disciplines, and *beyond* all disciplines. Its goal is the understanding of the present world, of which one of the imperatives is the unity of knowledge” (Nicolescu 2014b, 19). This unity can be achieved by involving people from outside academia as equal partners: government agencies, practitioners, civil society, community members, and people with lived experiences. There is a transcendence of epistemologies rather than a borrowing as in interdisciplinarity. Integration and cross fertilization lead to the emergence of new knowledge (Lang et al. 2012; McGregor 2015).

[Image 2 about here] – transdisciplinary diagram

## **Building the Network and Driving the Dialogue**

Operationalizing S5 by applying a transdisciplinarity mindset and approach requires engaging in an evolving and interactive network of activity to include internal and external partners. While the S5 graduate curriculum and certificate serves as the connective tissue and is informed by an ever-expanding network of initiatives, the effort is designed to create ongoing mechanisms for discourse and dialogue to explicitly and implicitly influence the types of research questions asked and the curriculum and pedagogy shaping the teaching and learning experience to create a foundation for the next generation of thought leaders - S5 transdisciplinarians.

Internally, this involves the creation of tools and approaches to drive multi-disciplinary research collaborations by drawing on existing research centers and interests. Simultaneously, it requires engaging faculty, staff and students internationally and nationally to collaborate with external partners. The result is ever-expanding dialogue that is continuously evolving, avoids hierarchy or central control, yet centered around questions and conversations brought on by Society 5.0 as the new stage of social evolution.

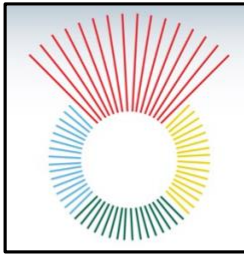
[Image 3 about here] – bubble diagram of network

Beginning in Fall 2022, the first courses in the S5 graduate certificate will be offered. Several of the courses have been imbedded in a National Science Foundation Research Traineeship Program designed out of engineering and focused on technologies for the disabled community. It involves faculty at Cleveland State University (CSU) associated with the Center for Human Machine Systems as well as connected to the Human Fusions Initiative operated out of Case Western Reserve University and includes partnerships with UCLA's robotics labs and University of Colorado's haptics and neuro-engineering programs. An S5 website serves as the central point of capturing and communicating activities related to S5. It is supported by an interdisciplinary center located at Cleveland State University – CSU T.E.C.H. Hub, which has been created out of a 4-year IOTC funding program from the Cleveland Foundation. An S5 board of advisors meets quarterly to discuss strategies and approaches. In total, there are over 130 faculty, students, and professionals directly involved in S5 across the network.

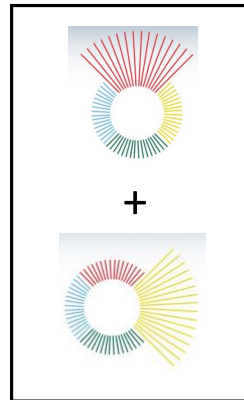
Over the next 5-years we plan to institute a S5 interdisciplinary podcast, from which several episodes have already been recorded. CSU will host two discussion forums in Fall 2022 and Spring 2023, while continuing to nurture the network partnerships to seed the curriculum, seek joint research funding, and produce scholarship for changing forward as we enter Society 5.0.

# Transdisciplinarity

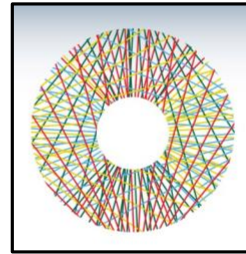
Monodisciplinary



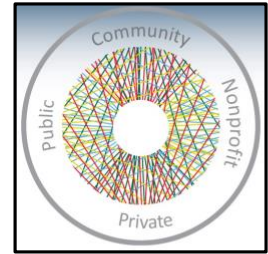
Multidisciplinary



Interdisciplinary



Transdisciplinary



CLEVELAND STATE UNIVERSITY

T.E.C.H. Hub

Center for Human-Machine Systems

Internet of Things Collaborative

National Science Foundation Research Traineeship Program

HELPPS Consortium

University Innovation Fellowship

Human Fusions

Public Interest Tech-University Network

University of Twente (emerging)

University of Rijeka (Inger Program)

S5