
The Case for Extended Intelligence

Technological Advancement in Service of People and Planet



COUNCIL ON
EXTENDED INTELLIGENCE

Request for Input

CXI was created to proliferate the ideals of responsible participant design, data agency and metrics of economic prosperity prioritizing people and the planet over profit and productivity.

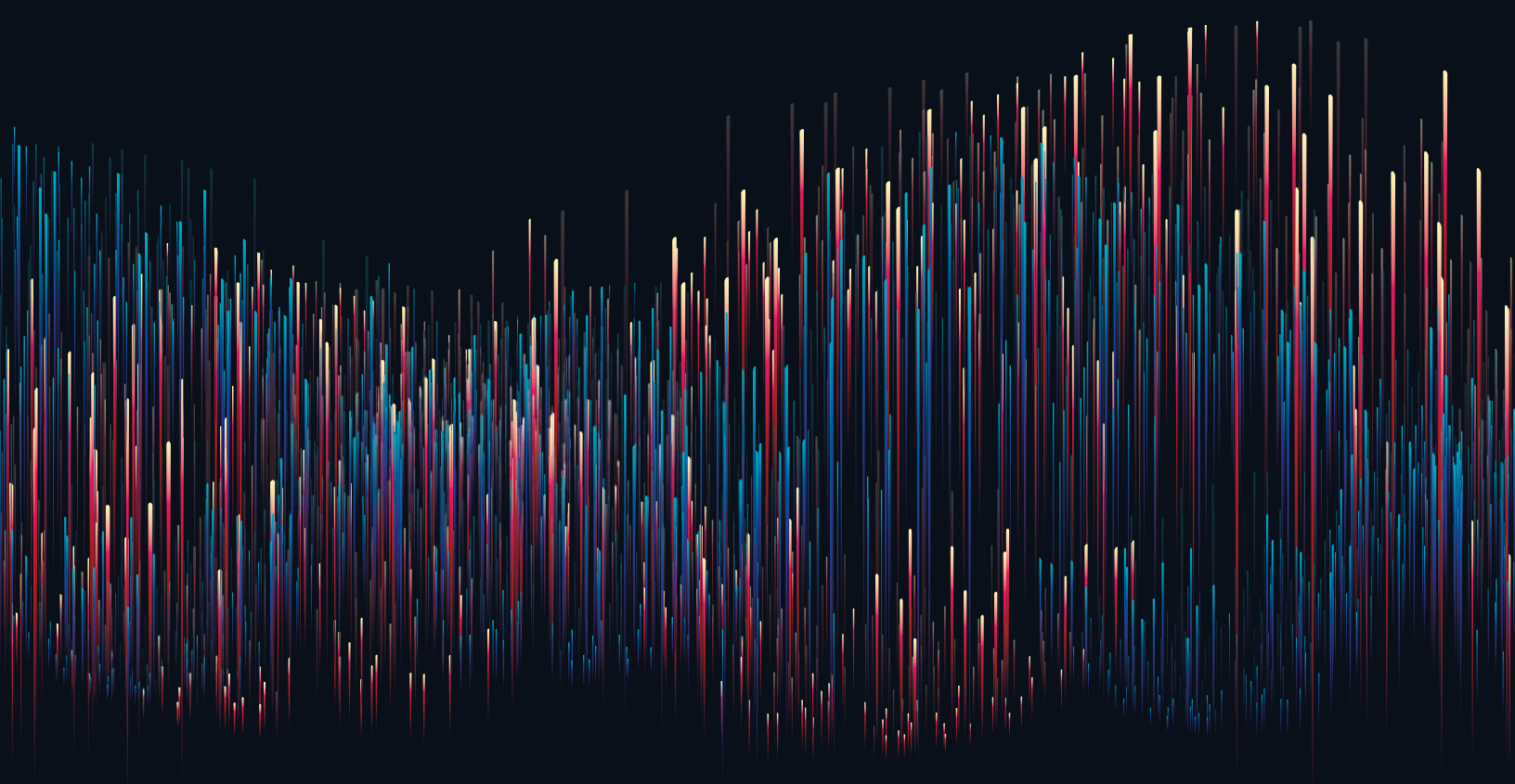


Table of Contents

Background pg 01

Extended Intelligence pg 03
CXI in Action pg 09
Participant Design – Your Turn pg 11

Digital Agency and Democracy pg 13
CXI in Action pg 22
Participant Design – Your Turn pg 23

**Developing “Enlightened” Indicators
of Sustainable Human Progress** pg 25
CXI in Action pg 38
Participant Design – Your Turn pg 41

References pg 43



“As technology augments and extends our complex social systems and extends our intelligence, it is vital to prevent over-reduction and depoliticization in engineered systems to assure societal understanding of and input into the design of these systems. The Council on Extended Intelligence has brought together experts from across the disciplines to create and deploy an appropriate framework for understanding, designing and deploying these systems.”

– **Joi Ito**

“The most critical question in the time of so-called “intelligent” technologies and systems is how to use them in order to reinvigorate, and not to undermine human autonomy, agency and self-determination at an individual and – most importantly – at a collective level. This desire is the driving force behind the creation of the global Council on Extended Intelligence.”

– **Konstantinos Karachalios**



The Case for Extended Intelligence

Technological Advancement in Service of People and Planet

Background

On December 20, 2017, a group of thinkers gathered to consider the relationship between society and technology to determine what steps were necessary to make sure that technological development might best support human and environmental flourishing.

The three lines of inquiry for participants were: how does human intelligence manifest itself in the era of the escalating processing power and speed of computers; what principles should guide the collection, processing, and sharing of personal data; and, by what measure should we evaluate human progress?

In the span of a few hours, the basis for [the vision of CXI](#) was galvanized, along with our mission statement: “CXI was created to proliferate the ideals of responsible participant design, data agency, and metrics of economic prosperity prioritizing people and the planet over profit and productivity.”

We assembled three Project Teams reflecting our vision and mission and formally launched CXI on June 22, 2018 with a list of [international members](#) including representatives from the EU Parliament, the UK House of Lords, and global thought leaders from the realms of academia, business, and policy.

The Case for Extended Intelligence represents the first manifestation of our collective work. The three sections of this report are the product of our three Project Teams working since June of 2018 and frame how CXI initially believes extended intelligence can be fully realized, measured and evaluated:

1. **Extended Intelligence.** This section provides the initial basis for our philosophical approach, along with the pragmatic framing of extended intelligence as developed by CXI members. The pragmatic framing is what we will utilize for our three “CXI in Action” programs taking place in 2019, driven by our three Project Teams. Results of the programs along with feedback received about ***The Case for Extended Intelligence*** will be presented in a follow-up report at the end of 2019.
2. **Digital Agency and Democracy.** This section provides a background and framing on the need for human “digital twins” that mirror our individual and collective values. When ‘twins’ and data representing our identity are accessible and controllable by individuals, truly participatory extended intelligence can exist.
3. **Developing Enlightened Indicators of Sustainable Human Progress.** This section provides an introduction to emerging, technology-enabled approaches to measuring human progress beyond purely economic metrics. The benefits of extended intelligence must be measured in worth not exclusively limited to material wealth.

***The Case for Extended Intelligence* is intended for the following audiences:**

- **Academics and technologists.** This community makes up the largest portion of CXI Members. Our hope is the research, ideas and ideals in these pages provide inspiration and impact.
- **Engineers, data scientists and programmers.** The autonomous and intelligent technologies and systems (A/IS) outlined in these pages have the capabilities to provide the infrastructure for our flourishing future. We need your help to build it.
- **Policy Makers.** A number of CXI Members are currently in policy trenches and we recognize the need for tangible, implementable interventions that will resonate with citizens around the globe.
- **The general public.** It is essential to have diverse participation if we are to construct a meaningful human relationship with A/IS.

Request for Input - Our Invitation

Whatever your background, your flourishing future is our goal. We would love your thoughts on any of the survey questions based on your perspectives which is why we have produced this paper as a Request For Input (RFI). At the end of each of our sections we have included questions and a [link to our master survey](#) where we would welcome your contributions.

Responses to our survey will be published by the summer of 2019 and will inform our follow up report.

Special Thanks

We wish to thank all our CXI Members for their efforts and contributions. We have also included direct quotes from CXI Members throughout *The Case for Extended Intelligence* to highlight their insights while honoring our focus on participant design.

Special thanks also to Beeban Kidron for her gracious editing / writing along with all the contributors to our report.

Happy reading and we look forward to your feedback.

CXI Leadership

- Joi Ito
- Konstantinos Karachalios
- John C. Havens (*Executive Director*)
- Andre Uhl
- Katryna Dow
- Tenzin Priyadarshi

For general or press inquiries: [John C. Havens >>](#)

To cite this paper: *The Case for Extended Intelligence: Technological Advancement in Service of People and Planet.* The Council on Extended Intelligence, February 2019.

*Disclaimer: All quotes from CXI members represent their personal views only and do not represent official positions of their organizations.

Extended Intelligence

Participatory Design in Service of People and the Planet

- John C. Havens, Beeban Kidron, and Andre Uhl

We believe all systems must be responsibly created by participatory design to best utilize science and technology for tangible social and ethical progress.

[- From the Vision Statement of The Council on Extended Intelligence >>](#)

Research communities in various fields of computer science have had very different visions regarding how computers were going to evolve and how machines and humans are supposed to interact. Some envisioned computers to become intelligent agents, while others saw them rather as extensions of the human mind. Eventually, the term “artificial intelligence” was adopted rapidly, without broader societal agreement over what influences are desired and what outcomes the institutions that create and control these tools should be working toward. A lack of deeper reflection on what individuals and communities value and how they would like to make use of technological systems risks technological determinism or reductionism—that is, setting the ambitions of these systems to the narrowest interests of the few communities who conceived them, rather than the rich opportunities they might afford.



The Council on Extended Intelligence (CXI) asserts it is not “artificial intelligence” in isolation, but the social, economic, political, and cultural systems within which these tools are integrated that must be addressed to avoid reductionist outcomes. It is necessary to invite values-driven participation from the diverse actors impacted by the technology in order to measure and harness the capabilities of machines in ways that prioritize human and environmental flourishing.

Our choice to refer to “capabilities” (versus “intelligence”) is a starting point for defining extended intelligence to begin to untangle potential confusion regarding the anthropomorphization of technology in general, and for “artificial intelligence” in particular. This elucidation is not intended to negate the transformational aspects of these technologies but rather to offer a view from which we can build a formal narrative that highlights the relationships and necessary interventions between individuals, technologies, and institutions.

“The notion of extended intelligence is a step forward from that of ‘AI’, which is not working. However, if we end this extension at ‘human-machine teaming where we are still yoking our intelligence to machines, we have not completed the journey.

We have to be careful using intelligence as a term to not fall into the trap of leaking agency to software.”

– Amandeep Gill



In *The Case for Extended Intelligence* we eschew the term “artificial intelligence” in favor of the phrase “autonomous and intelligent systems (A/IS).” Realizing it is inherently difficult to define “autonomy” and “intelligence” in their own right, our goal is to avoid the anthropomorphic and conflated aspects surrounding “AI” as it often exists in media messaging today. Further, we feel it makes sense to limit our scope of “intelligence” for practical purposes to computational systems using algorithms and data to address complex problems and situations. This may include the capability of a system to improve its performance based on evaluating previous decisions, in which case such systems could be considered as “intelligent” (as a synonym for its “capability” versus an inherent trait). Such systems could also be regarded as “autonomous” in a given domain as long as they are capable of accomplishing their tasks despite environmental changes within the given domain. This terminology is applied throughout *The Case for Extended Intelligence* to ensure the broadest possible application of ethical considerations in the design of the addressed technologies and systems.

Framing Extended Intelligence

Extended intelligence (XI): The awareness resulting from values-driven participant design in and among systems of individuals, institutions, and technology while prioritizing human and environmental flourishing.

- **Awareness:** We will not create “The Case for Extended Intelligence” until we gain genuine insights via participant design from the stakeholders that are going to utilize the A/IS.ended Intelligence” until we gain genuine insights via participant design from the stakeholders utilizing the A/IS being developed for their use.
- **Values-Driven:** Reflecting the values of everyone in the participant value chain.
- **Prioritization:** The flourishing of people and the planet in unison is the goal of extended intelligence. The philosophical must manifest itself in the practical.

In particular, anthropomorphization, whether unintentional, implied, or overt, is oversimplification. This is why the use of “capabilities” for machines versus “intelligence” can bring clarity for design and deeper benefits for society as a whole.

In complement to the evolution of our framing of extended intelligence as we carry out our projects, members of CXI are also working to further explore the complex matters around intelligence and autonomy, and their potential manifestation as an extended, “ambient” intelligence. According to Konstantinos Karachalios’ and Joi Ito’s essay, [Humans and Systems Intelligence](#):

“It is not possible to exactly define ‘intelligence’ and ‘autonomy.’ They are phenomena of human activity with dimensions that go beyond what can be captured by the reductionist methods used to establish logical/scientific frameworks. We should thus resist the temptation to oversimplify when trying to explain them. However, in a kind of syncretistic approach, human intelligence and its machinic manifestations could be thought to be embedded in a broader resonant space, an ‘ambient intelligence,’ where our natural environment is not a passive recipient but rather an active resonator and producer of intelligence itself. What is new is the question of whether human artifacts, such as intelligent machines and systems, have the necessary sophistication and quality to be added to the mix.”

“A very important task is to reflect on what humans are and what their intelligence is constituted of in order to understand wherein we find the extension provided by AI. The only true intelligence in AI is it can recognize patterns and details. That’s the most important distinction between human and AI.”

– Sarah Spiekermann



Extended Intelligence

Summary

We are excited to further explore the philosophical and pragmatic definitions of extended intelligence as we further develop our work and will share our updated thoughts in our next publication.

Issues and Insights

The following are direct quotes taken from CXI members used to help develop our pragmatic definition of extended intelligence.

ISSUE TOPIC



Extended intelligence defines the benefits machines can bring as “capabilities” versus “intelligence.” This helps avoid the creation of confusing narratives for the general public while simplifying language for A/IS policy and manufacturing.



Vint Cerf – *“Faith is an aspect of trust. We should be careful to not allow people to place too much faith in artificial intelligence. These are tools, and we should use them. But when we make assumptions that may not materialize with these machines it may cause harm.”*

Edson Prestes – *“Machines are not intelligent. Machines don’t understand the meaning of the steps they take. We should use the term “intelligence” only for humans. But for machines, you can think of ‘capabilities’. Making this separation will help in the discussion. We need to be very careful, as people outside of the technical community don’t understand what artificial intelligence really means.”*

Alex ‘Sandy’ Pentland – *“Think of the AI and the human organization as a single continuous network of facilities. When you do that, what you’ve done is you’ve added new capabilities to the organization. AIs are just “capabilities” or “actors” with particular characteristics. They’re employed as appropriate.”*

Sara Rendtorff-Smith – *“The capabilities brought about by AI are not outside of us, but an extension of us. Therefore the questions we should be asking are “an extension of whom?” and “empowering whom?” These extensions are empowering but also allow for the ability to embody one’s values into autonomous and intelligent systems that have political and economic power.”*

Craig Campbell – *“If we focus on collaborating with machines rather than having a long discussion about how machines could develop on their own, we can better define our intention about how we’d like to work with a machine.”*

Nicolas Mialhe – *“The very notion of AI is obsolete. It does not render justice to the complexity of the dynamics at play between humans and machines. In its current state dominated by statistical models, artificial intelligence is neither artificial—it’s a collective; a complex socio-technical system with its topography, nor intelligent—not elegant mathematically or energy-wise as compared to biological intelligence.”*

Don Wright – *“Properly conceived, designed, and implemented, extended intelligence will allow autonomous and intelligent systems to free humans from the many monotonous and repetitive tasks of life and confidently focus instead on creative and inventive activities.”*



Unless A/IS systems reflect the values of all who participate in their design and use—how can they be trusted?



Amandeep Gill – *“Wisdom and intelligence are lower forms of awareness, which alone is the real jewel. To bring this to a practical point we need to look for shared values that are not culturally dependent—values which transcend. This should be our focus in reframing AI so we define it as an extension of humans, so that humans are at the center of it.”*

Micah Altman – *“There are highly complex and dynamically evolving interactions across the processes by which people design and build algorithmic systems; by which these systems alter and are altered by the communities that engage with them; and by which these systems influence and are influenced by regulatory systems. These interactions raise a completely new set of questions about how we engineer systems to support human agency.”*

Stephen Welby – *“In a world where our tools can react to their environments, it will require us to understand the behavior and performance of these systems in ways we don’t know how to achieve today. ‘Explainability’ in this regard is a key issue—how systems can describe their internal state. If we’re going to collaborate with these systems, we need to be able to recognize their boundaries while understanding and interpreting their behavior.”*

Jim Dratwa – *“Rather than starting from a ‘technology,’ consider for a moment what happens when starting with this crucial ethical question: What world do we want to live in together? Oh, wait, did I say “we”? It seems I did. Well that happens—and whenever that happens it is important to take a moment to reflect upon who is in the ‘we,’ and what is not, and how that is determined, and really this: Where are the others?”*

Kade Crockford – *“We have concerns about the way AI is used with predictive policing systems and risk assessments in criminal justice. We also have concerns about ways that asymmetries in power (both financial and informational) between Silicon Valley corporations and the rest of the world are going to be exacerbated by AI if we’re not careful.”*

Jonnie Penn – *“Intelligence has been used as a tool of domination in the West. If we’re going to frame this under or around language of intelligence, it’s useful to think of that expression as accomplishing means or ends. If we don’t agree on what it means, we can’t agree on the ends or values”*

John C. Havens – *“What if instead of our obsession with artificial intelligence, our focus was on increasing wisdom?”*



Where “machine intelligence” is equated with the holistic aspect of a human’s consciousness, experience, and wisdom, conflation can lead to confusion. Systems thinking should incorporate emotional intelligence and the wisdom of faith-based, cultural, and spiritual traditions to fully honor values-driven participant design.



Katina Michael – *“How can AI allow us to develop the inner self? We get in our car with air conditioning, go to work. Life has become a series of flashes. The cycle does not allow us to harmonize with the world and the people around us. We need to develop an ‘inner thriving’ to find a harmony with what we already have been endowed.”*

John C. Havens – *“As Westerners, we tend to be very binary, or “either or” in our choices. We need to look to the rest of the world to understand how non-duality can provide new models for the economy and wellbeing.”*

Hruy Tsegaye – *“But when we are talking about AI, which one are we addressing? Narrow AI is mostly deprived of emotional intelligence and its capacity is often not considered as an intelligence. The story is different for AGI (artificial general intelligence). This type of AI, even though not actualized yet, can be intelligent; AGI will not only have rational intelligence but the emotional type as well. AGI has the potential to be a conscious machine and the real question is, are we ready to cultivate and babysit such a powerful entity? If so, whose value system and notion of virtue will this alien learn?”*



Andre Uhl – *“Wisdom relates to awareness for one’s place, and responsibility, in the system; extended intelligence should be neither about machine nor human intelligence—it’s about an awareness for the complexity each one of us, and all of us as a species, are part of.”*

Eva Kaili – *“AI systems cannot be fully intelligent when at the current and foreseeable technological level they will lack one of the intrinsic aspects of human intelligence: emotional intelligence. Therefore the human touch will always be of absolute need in any AI capabilities system decision-making that affects people. Human intelligence and AI capabilities have and will continue to have a positive meaning and societal contribution only in synergy. “AI for good” systems will need to have embedded “ethics by design.” Furthermore, could we envisage a better future in which AI systems will make decision-making more free of biases and errors than humans in every aspect?”*

CXI in Action –

Participatory Design in Practice

CXI is collaborating with [Arizona State University's Consortium for Science, Policy & Outcomes](#) (CSPO) on The Future of the Internet project that is focused on showing how participatory design of complex technological issues can be done with the general public. The work will be led by CXI members Mahmud Farooque and Katina Michael in twelve cities across the globe.

Why Participatory Design?

As unique and compelling as new autonomous and intelligent systems are, if their benefits are unclear or irrelevant to the people who use it the technology will fall flat or may cause harm. Whether benign or malign, autonomous and intelligent systems (A/IS) are opaque to the majority of those who use them or who are impacted by them.

Participatory design has two primary benefits: The first is to create technological systems that better reflect the values and interests of the participants, society, and that increase environmental sustainability. The second is to offer open and honest platforms in which designers and institutions can properly enter into discourse on the benefits and values inherent in the A/IS systems they are proposing or creating.

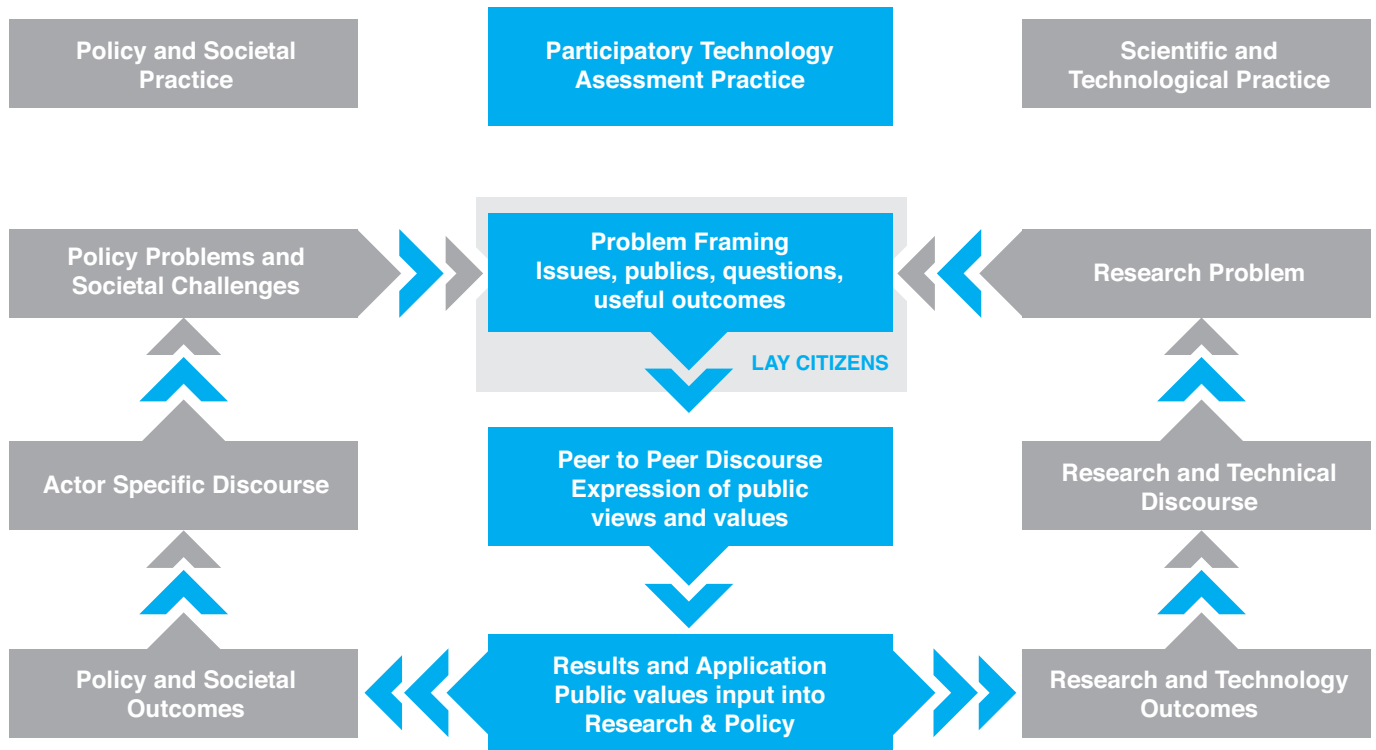
One technique utilized in participatory design is to “name and frame,” with all participants in the design process having a voice, including the users of a technology or system. Nicholas A. Felts describes this process in [Naming and Framing Citizen Concerns about Emerging Technology](#):

“As it currently stands, there are a number of domestic and international initiatives in the “science and democracy” ballpark. However, many of these operate from a deficit standpoint, meaning that the real problem is usually articulated as a matter of citizens lacking scientific literacy. A proper understanding of the issue at hand is certainly important, but so too is the manner in which issues are named and framed. If issues are named and framed in technical ways that fail to consider what is valuable to citizens, there will be great difficulty in engaging citizens and promoting productive conversations. After all, these issues are matters of judgment—ones in which citizens in communities must collectively decide what they ought to do about the problems that confront them. What can be done to jump-start the routines through which citizens and communities begin to exercise the judgment necessary to confront these thorny issues?”

A similar participatory design methodology can be seen in the following diagram, [Integrating Public Deliberation into Engineering Systems: Participatory Technology Assessment of NASA's Asteroid Redirect Mission](#)¹ from *Astropolitics*, The International Journal of Space Politics & Policy:¹

¹ David Tomblin, Zachary Pirtle, Mahmud Farooque, David Sittenfeld, Erin Mahoney, Rick Worthington, Gretchen Gano, Michele Gates, Ira Bennett, Jason Kessler, Amy Kaminski, Jason Lloyd, and David Guston. “Integrating Public Deliberation into Engineering Systems: Participatory Technology Assessment of NASA's Asteroid Redirect Mission.” *Astropolitics* 15, no. 2 (2017), 141-166, doi: 10.1080/14777622.2017.1340823

Iterative, Integrated, Trans-Disciplinary Knowledge Co-Production



Source: Mahmud Farooque

When considering the Future of the Internet pilots, Mahmud Farooque notes that:

“One of the criticisms we faced for past processes in our public engagement work was that we started with expert framing of the design problem at hand. In other words, our questions and contents were arrived at based on initial consultation with just expert stakeholders. The lay public was engaged only in the deliberation stage. Taking inspiration from a deliberative mapping approach (Bellamy et al. 2016) and combining it with Kettering Foundation’s approach to developing deliberation materials, we experimented with an [open issue framing approach](#) to produce an [issue guide for driverless cars](#). The [Future of the Internet pilots](#) taking place this year are part of an open framing approach to involve lay citizens along with expert stakeholders to arrive at the questions and content for the larger deliberations that will be taking place in 100 countries in 2019.”

“The capabilities brought about by AI are not outside of us, but an extension of us. Therefore the questions we should be asking are ‘an extension of whom?’ and ‘empowering whom?’ These extensions are empowering but also allow for the ability to embody one’s values into autonomous and intelligent systems that have political and economic power.”

– Sara Rendtorff-Smith



Participant Design – Your Turn

Extended Intelligence

Please click [this link >>](#) to go to our survey featuring all the questions for all three sections of our paper. We have provided full instructions in the survey where you can either list your name and title to be associated with your responses or remain anonymous at your discretion.

All responses (unless you tell us otherwise) will be published in a follow-up to this paper, where we'll feature responses as a primary tool for guiding our rewrites. You may answer as many or as few of the questions below from any section you choose.



Academics and technologists

- Have you heard the term, “extended intelligence” before? If so, where?
- Is “values-driven participatory design” a clear term? Why or why not?
- Do you utilize systems thinking from Donella Meadows (or others) in your work?



Engineers, data scientists and programmers

- How do you think A/IS systems would be built differently if the end goal was to prioritize people and the planet as a key performance indicator (instead of / in complement with profit?)
- Have you taken part in participatory design processes before? If so, when? What were the results?



Policy Makers

- What do you think of the idea of extended intelligence as described?
- How might XI help you in your work?
- How could you see participatory design being developed to help policy makers?



The general public

- Does it make you less fearful or confused to think of artificial intelligence as a “capability” instead of a “killer robot” or as a living thing? Why or why not?
- What human values would you like to see being included as standard in the design of A/IS systems?
- Would you want to be a part of a participant design project if it were offered by the government or a design/tech company? Why or why not?

Digital Agency and Democracy

How to reclaim our digital identity in the algorithmic age

- Katryna Dow, Beeban Kidron, and Alpesh Shah

Business models based on tracking behavior and using outdated modes of consent are compounded by the appetites of states, industries, and agencies for all data that may be gathered. Such widespread surveillance, combined with social-engineering techniques, has eroded trust and can ultimately lead to authoritarianism and the proliferation of systems that reinforce systemic biases rather than correct them. The Council is actively working against this paradigm—in which people have no agency over their identity and their data—as being fundamentally at odds with an open and free society.



[- From the Vision Statement of The Council on Extended Intelligence >>](#)

Introduction

In today's world, humans and things have a dual existence—physical and digital. While we have made significant progress with respect to physical rights, our early stage of development in the digital age is challenging many of these hard-fought freedoms.

Our collective human progress includes the abolishment of slavery along with the development of a Human Bill of Rights. This Bill acknowledges intellectual and physical property rights, including rights of access, use, and protection. Humans have largely achieved rights of sovereignty with respect to their physical self and property, meaning they have rights of recourse where physical harm or misuse of property can be evidenced. In many parts of the world these physical rights and protections also extend legally to things, such as buildings, methods of transportation, borders, and information.



“This is no longer an on-off world, but an augmented reality where the assumptions of A/IS impact our behaviors and outcomes across our entire lived experience. It is not so much personal data that we need to control, but the purposes behind data exploitation. It is not a “me” question as much as “what world do we want, and who do we trust to design it?”

– Beeban Kidron



For the first time in human history, however, we are challenged with the emergence of a parallel existence, one where our physical actions are mirrored by digital actions which generate an in-part replicate version of ourselves—often referred to as a “digital twin.” This parallel existence requires a context-relevant adaptation or evolution of established rights, as pointed out by CXI member Alex ‘Sandy’ Pentland:

“Almost everywhere in the world, people have rights over their physical identity and behavior, and ownership rights over physical things. As we develop a digital version of the world, we need to offer the same rights for digital identity, so people can stand in the marketplace and negotiate.

That’s the basis for having a viable economy.

– Alex ‘Sandy’ Pentland



Digital twins emerge through the digital shadowing of everyday physical acts like listening to music, ordering food, reading a newspaper, using public transportation, or simply walking through a city. The digital exhaust that mirrors our digital transactions—like swiping a credit card, online browsing, and scanning a biometric to access a physical space—all generate very detailed data.

However, the legal right to “federate” (unify all data to a central view), track, or access our digital twins is now the subject of widespread debate from a political, cultural, and commercial perspective. Agency to access, act, and control our digital selves currently resides with entities that have either the technical means or legal rights to federate our identities, behavior, and preferences. Increasingly, this digital agency (also known as data agency) is not controlled by the individual (human), and an increasing lack of understanding or awareness of this paradigm results in humans divesting physical rights through digital actions. As CXI leadership team member Katryna Dow notes:

“People may not actually understand their rights in the physical world, let alone their digital rights. Without thoughtful design, people may lose some of their human rights if we don’t get digital agency right.”

– Katryna Dow



Digital Agency and Democracy

The Need for Digital Agency

Information is power; if people lack control over information, both personal and public, they lack power. Digital agency can be understood as a choice: data could be characterised like “oil,” “infrastructure,” or “air.” If data is treated as an asset, like “oil” then a handful of barons will be incentivized to hoard it. If data were “infrastructure,” then its value could be derived democratically through sustained public management, as with roads, bridges, and public WiFi. If, however, data were treated like “air,” then it follows that without access to this critical resource, one’s life would be at stake. The question we must ask ourselves is, which future are we prepared to accept?

History has shown that human rights have been a more effective tool to correct systemic power imbalances versus the distribution of assets. We are seeing system-fatal levels of centralized power, greed, and inequality that require a recalibration of our collective understanding and control. Where A/IS can access and influence our behavior without our direct intervention, we lose agency. Where we don’t have technologies or methodologies that allow us ways to express our values and unfettered opinions, democracy doesn’t exist. Where data is used for short-term corporate gain and not for the benefit of society as a whole, we don’t have human flourishing. Data must be enshrined in law as a default public resource, with access, and access to justice, guaranteed to all.

As the collection of data accelerates on every individual, there is a greater need for each individual to have access to a complete set of what information is captured about them, as well as the ability to self-control the type of data, level of data, and ability of data to be forgotten. Furthermore, each individual should have the ability to renegotiate the terms of the use of their data and to determine their value on their own terms and conditions, in a context in which the technology is designed to support these freedoms and a legislative framework that upholds them.

The Framing of Digital Agency

In framing the concept of agency, it helps to understand the three existing predominant socioeconomic and jurisdictional frameworks that seem to differ in their approach to digital agency and rights:

1. **Europe**—which aims to empower the individual
2. **Asia**—which aims to empower the state
3. **United States**—which aims to empower the corporation

Additionally, there are still significant parts of the world that are not yet substantially online, where the concept of digital agency is still constructed around access. These groups include developing nations, recently or partially connected nations, and refugees, most of which are either undocumented or unbanked. The rapid move to a digital identity, such as India’s Aadhaar program, has resulted in significant consequences in attempting to balance technological advancement alongside the agency and rights of individuals. As recently as September 2018, India’s Supreme Court upheld the digital identity program with a ruling of 4-1, despite one of the judges calling the program “wholly unconstitutional.”

How society reconciles the rights of citizens, communities, governments, and corporations will become the primary test of our digital emancipation. Striking the right balance between privacy, security, and freedom is the key point of tension. Society must either reconcile these tensions through transparency, the application of collective values, and technological advancement, or face an imminent future where our physical agency and rights will be significantly diminished by the lack of agency afforded to our digital twins.

“We need to ask a question around legal frameworks and data. What legal doctrines exist, and where do we need new doctrines?”

– Nicolas Mialhe



The following are issues and insights generated from CXI members about the need for digital agency.

The current atmosphere of surveillance capitalism² and lack of universal governmental protections regarding data hacks puts human identity, security, and democracy at risk.

The rise of surveillance capitalism has resulted through ineffective or lack of regulation, governance, and a digital bill of rights. Commercial organizations with the financial means have developed centralized, global operations which include personal data, biometrics, behavior, sexual identity, and political preferences. The lack of security requirements has enabled these centralized systems to be routinely compromised and hacked. At the time of publication, courts in several jurisdictions are investigating the power of these centralized commercial operations on democracy, including the outcome of elections. The role of government to protect and represent the citizen has given way to multinationals with both economic and influential power beyond sovereign countries.

The expectation in the age of A/IS must be that all new technologies incorporate by design the basic principles of human rights, children’s rights, rule of law, and democracy. While these principles are subject to geopolitical and cultural differences, they nonetheless provide a clear baseline for the design of digital services. In a borderless digital world we must find ways to reconcile data collection and processing as well as human rights of individuals in specific contexts while developing global solutions for citizens in digital environments.

Europe’s aim to increase digital rights and transparency through the General Data Protection Regulation is a start; however, it is very early days, and as of this publication, data breaches, hacking, and identity theft continue to increase. We have yet to see a significant improvement in the rights of the European digital citizen.



Paul Nemitz – *“The rules we have for GDPR are about collecting, processing, or passing on the data. The rules don’t pertain at all to engineers in regard to the hardware and software they produce. Of course, the people controlling personal data know they’re supposed to have privacy by design (PBD) in their processes. There’s a business incentive to say you’re utilizing PBD. But legally all the technology, for whoever sells software or hardware products but doesn’t process data themselves—they’re completely off the hook. It is therefore vital that software and hardware developers build into their technology, from the outset, what is necessary to comply with GDPR, thus fully signing up to privacy by design. Along these lines, if a data subject asks a data controller for the deletion of data, if we don’t have technology to check in the system if the deletion has taken place, how will we know if it’s been deleted or not?”*



² This is a term coined by Shoshana Zuboff in her book, [The Age of Surveillance Capitalism: The Fight for a Human Future at the new Frontier of Power](#).

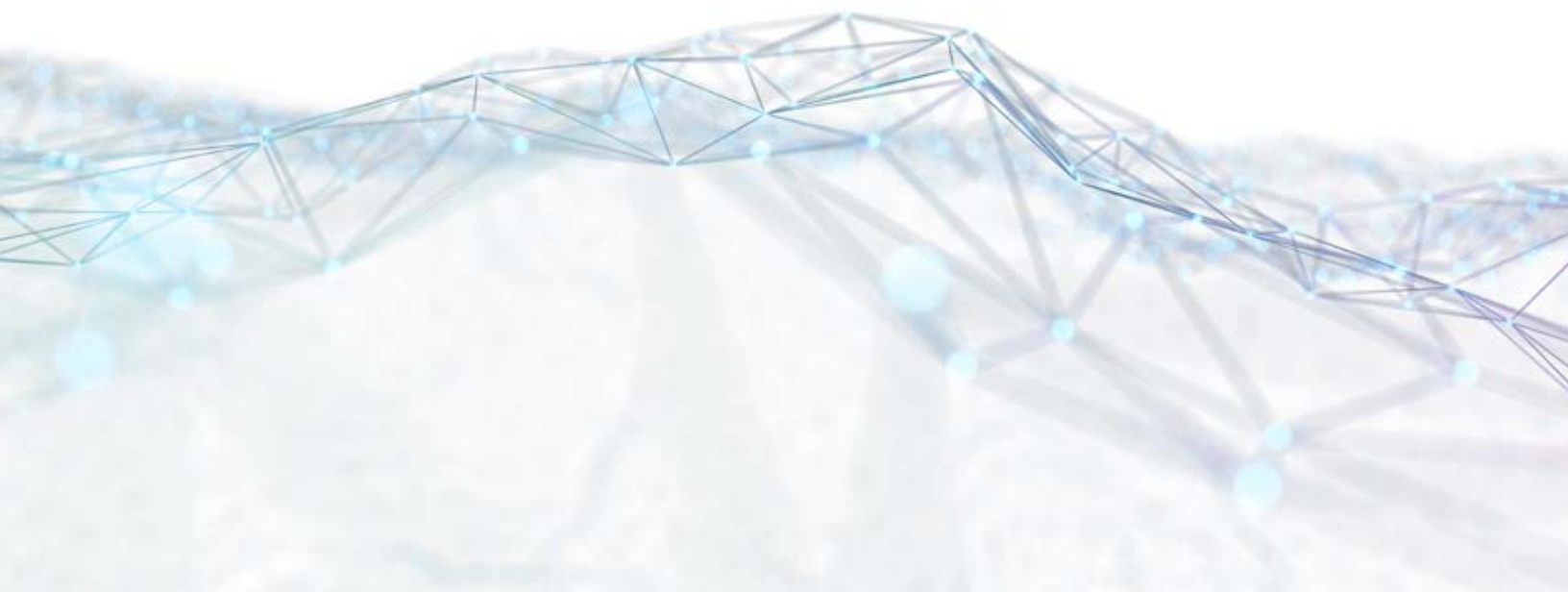
Digital Agency and Democracy



Beeban Kidron – *“The temptation has been to follow commercial companies in characterizing data as property, but the battleground might be better seen as a struggle for autonomy from commercially driven human outcomes. Understanding the relationship between data collection, processing, and deployment on an individual’s and society’s ability to act freely in their own self/collectively determined interests is what needs to be explored.”*

Greg Adamson – *“While agency is critical in managing our personal data, there are types of data which should never be requested even if we would accede to the request, as they diminish our human dignity. For example, information which would enslave us, or images which degrade us.”*

Steve Mann – *“There is a risk of loss of integrity that is inherent in surveillance, because surveillance is the veillance that has the power to create a one-sided form of sensing, i.e., to sense while not being sensed, and in this way challenges democracy. Surveillance is a form of “Big Watching” analogous to “Big Data,” and must therefore be balanced with sousveillance (“Little Watching”) and distributed “Little Data” technologies like blockchain. The word “surveillance” itself is a French word that means “over” (“sur” as in “surtax” or “surcharge”) and “sight” (“veillance”): surveillance is “oversight” and requires an equal and opposite “undersight” to keep it in check. Emergent democracy requires a plurality of veillances including sousveillance (“undersight,” from “sous” as in “sous-chef”) and metaveillance (the sight of sight itself, i.e., auditability of the veillances).”*



Policymakers and civil society do not recognize how human and other rights (such as property rights) translate, or fail to translate, into the digital environment.

One of the significant challenges of this technological epoch change is the ability (or lack thereof) for our politicians and citizens to comprehend the rate of change. Of critical importance is the ability to understand the consequences of the decisions we are currently making.

There is a tension between the lack of observance of rights in the digital environment (for example, rights to privacy, to gender equality, to unfettered information, to be free of commercial information) and the enactment of human and children's rights as a whole. As government and civil society are increasingly digital and connected, it is no longer possible to separate one's experiences; therefore the failure to deliver rights in the digital sphere is a catastrophic regression on delivering human and children's rights overall.

As society becomes more connected, a growing impact to civil rights includes an increasing digital divide. For example, will justice in the future only be available to those with the financial and technological means to defend themselves? Or in the case of data rights, if we do not control or own our digital self but the majority of actions and outcomes are mediated by decisions involving that self/persona, are we denied/robbed of the greater part of our identity?



Alex 'Sandy' Pentland – *“From the legal point of view, there's a big distinction between ownership and ownership rights regarding data. Ownership rights are often shared. You can't own data uniquely the way you'd own a physical object. Ownership rights are about controlling what happens to data and the value derived from it. This is not the same as absolute ownership.”*

Alpesh Shah – *“It would be good to use the potential of data agency as a way to create an incentive structure. This could provide a tax-based incentive program for businesses to accelerate the adoption of what we're saying along with providing a strong policy perspective.”*

Nicolas Mialhe – *“Anchoring the discussion around data in property and property rights has its lineage in philosophy. At the heart of this is the idea of ownership around our bodies, our labor, and the notion of being your own person and not being enslaved.”*

Steve Mann – *“While it is necessary to preserve the rights to privacy, another competing human right is the right to see, to sense, and to be human. Where this matters most is in sensory augmentation, such as a computerized seeing aid to assist the visually impaired. Property owners often prohibit wearable cameras or other kinds of seeing aids, under the guise of “privacy,” i.e., an alleged fear that a computer-vision seeing aid impacts the privacy of other customers in their establishment. There is a hypocrisy of such establishment owners who typically use surveillance technologies extensively while prohibiting anyone else from any form of data collection or real-time sensory processing. In this sense privacy can foster information asymmetry and therefore become surveillance—the dominant veillance that prohibits all other veillances. The opposite of hypocrisy is integrity, and in this sense, such establishments lack integrity. Therefore while crafting public policy on privacy and democracy we must be vigilant to make sure that “privacy” does not just become another form of surveillance.”*



People aren't aware of the full benefits digital agency could bring. There is a lack of clarity or awareness of how technological advances could better support digital agency infrastructure.

As we deal with emerging technologies, our existing legal and social paradigms are being challenged but we have not yet formulated an architecture that will replace them.

Digital agency is required for humanity to organize its collective values (governance, rights, trust), and for individuals to express their personal values. Ultimately digital agency is best understood as a currency that can move through society to articulate value and that can be exchanged—on the basis of free will. In other words, digital agency would drive a new societal architecture.

We are reaching for both new methods and a new language to describe this hybrid state of physical and digital. Trendwolves, a European research agency specializing in mapping youth trends, coined the term “phygital”—the fusion of both states where many tasks begin in the physical and end in the digital. Understanding the hand-over places, where liability shifts and where ownership ceases, is essential to designing how society will govern the evolution of rights.

A more explicit articulation of our needs is required to help society appreciate the potential and full benefits digital agency could bring. Candid policy debates that acknowledge where clarity is lacking will contribute the most to raising awareness. Acknowledging the gap between physical and digital agency provides necessary insight to our technological advancement.



Karen McCabe – *“We need to address capacity-building so that digital intelligence includes ideas around digital agency as well as identity. This can run a spectrum, from basics to practices and policies around securing your identity and how to use emerging technologies safely. It’s important to help people be more attuned with these issues on a deeper level.”*

Micah Altman – *“Our research has begun to move into an area we designate roughly as ‘informational agency.’ Threats to agency include intrusion into private domains of activity or space; disclosure and misuse of information about individuals or groups; and violation of intellectual property or moral rights over information created or modified by individuals and groups.”*

Alex ‘Sandy’ Pentland – *“Most of the notion of ‘agency’ is rather aspirational. The legal standing of ‘AI agents’ is not clear. One of the things we’re focused on is establishing a framework so that an AI agent can truly act as a legal fiduciary for people utilizing smart contracts that have the full force of law. It’s possible to have inexpensive legal agents that could effectively represent individuals in disputes along these lines.”*

Craig Campbell – *“It’s challenging to define ‘digital agency’ where digital agency isn’t a social norm. For instance, in the local government, the rights individuals have over their information differs in different policy areas. There is a meaningful difference between data systems where every individual in a given jurisdiction has a unique identification, such as with tax records or voter registrations, and systems for providing a direct service or enforcing a law, like criminal justice or child protective services. These systems don’t talk to each other by design. Different types of data warrant different considerations*



Evolving legal frameworks in conjunction with technological infrastructures can make digital agency and access to justice a reality in the Algorithmic Age.

If history is to be our teacher, then we have evidence of extended periods where the spaces of individual and societal self-determination have contracted (medieval times) alongside periods of great expansion (the Renaissance) of such spaces.

Historians, philosophers, and futurists describe our current period as the 4th Industrial Revolution. The evolution of robotics together with intelligent technologies and systems give rise to both doom and opportunity with respect to the workforce, health, manufacturing, and transportation.

However, these significant changes require us to rethink the legal and governance frameworks that will enable society to flourish. As we move through this period of significant change it is likely we will get as much wrong as we do right. Now, in this early period of extended intelligence, outcomes rely on the quality of the ‘training data.’ Where there is bias (gender, age, ethnicity, culture, belief, politics) there is an increased likelihood that justice will also be impacted.

The application of existing frameworks and infrastructures—for example, the application of human rights, children’s rights, broadcast standards, equality legislation, or health and safety legislation in digital environments and so on—offers one opportunity to reflect wider social values in support of digital/data agency. In addition, we are seeing the invention of new legal structures, for example the EU General Data Protection Regulation (GDPR) or the Age Appropriate Design Code in the UK.



Nicolas Mialhe – *“We need to ask a question around legal frameworks and data. What legal doctrines exist, and where do we need new doctrines?”*

Audrey Tang – *“We’re having multi-stakeholder discussions here in Taiwan around 數位通貨 (roughly translates to ‘digital good-exchange.’) It’s interesting that we don’t use the character 幣 (money) or other terms stemming from banking or traditional financial systems. The characters 通 mean “connected; interoperable” and 貨 ‘beneficial good; things of value.’ That’s a useful conceptual framework—it’s broad enough to include all the different uses of DLT tokens, and the semantic meaning extends beyond distributed ledgers.”*

Alex ‘Sandy’ Pentland – *“The other thing to remember is there’s a lot of money to support this. Corporations are very frustrated with non-interoperable, paper-based versions of contracts. They’d like to see their own version of AI agents so that things could be done more accurately and transparently. The heads of legal services for most big corporations are really interested in supporting this. We could utilize these same methodologies to achieve the sorts of access to justice and anti-corruption capabilities everyone deserves.”*





Summary



“Future generations will look back at this time with disbelief. Just as with the evolution from feudalism to property rights, voting, and human rights, society will come to understand that our digital twins require rights of protection, access, and control.”

– Katryna Dow

The “phygital” transition state described in this section brings both high expectations and fears. We are collectively reassessing how all new technologies will function in the age of autonomous and intelligent systems (A/IS). We must design how to incorporate these new capabilities to extend life, insight, and agency.

Our prevailing model of economic development has resulted in surveillance capitalism. Business models have incentivised a race for industries, states, and agencies to take part in, with both the economic and technological means to dominate and control the digital landscape. This widespread surveillance, combined with social engineering, is eroding trust and contributing to the proliferation of systems that reinforce systemic biases rather than correct them.

This situation will only persist if we allow it to. Therefore, our digital agency depends not on what is technically possible, but on what new boundaries and rights of control we will afford our digital selves in keeping with the hard-won rights of humankind.

CXI is actively working to contribute to the awareness, education, and enlightenment of policy makers and politicians, such that we can jointly design a society where humankind is able to maintain agency over their identity and data, thus enabling our phygital selves to participate in an open and free society.

CXI in Action –

Advocating for Agency

The United Kingdom’s Information Commissioner’s Office (ICO) is producing an [Age Appropriate Design Code](#), which will outline the design standards that providers of online services and apps used by children will be required to meet when they process their data. The Code is a requirement of the Data Protection Act 2018 (the Act). The Act supports and supplements the implementation of the EU General Data Protection Regulation (GDPR) which requires special consideration of children’s data.

As part of our work for 2018, The Council on Extended Intelligence provided a submission to the call for evidence issued by the ICO regarding their Age Appropriate Design Code. Our submission directly reflects the hypothesis of this paper, highlighting the urgent need to create new paradigms of digital agency.

Here are some excerpts from our submission:

- (In terms of smart legal contracts) CXI recommends the introduction of a child’s own machine-readable privacy terms. Created by the child (or on their behalf by a parent/carer), these would encapsulate their preferences and attributes as they see them, could attest to their development stage, and be universally machine-readable.
- (In terms of a values-driven approach for technology overall) In determining the meaning and coverage of the Code it is critical to prioritize societal, rather than technical or economic, metrics of success.
- (In terms of the application of children’s rights in relation to the autonomy, creativity, privacy, and “best interests” of children) Data in the digital economy represents the legal proxy for a child in real, digital, algorithmic, and virtual environments. Data is able to describe a child and their interactions in tremendous detail, which has significant legal and ethical implications.

By submitting these recommendations on the Code, CXI was able to present a position on behalf of children that has ramifications for our thinking about all digital participants.

CXI has also offered to engage with the ICO as they develop the Code, which is expected in draft format in early 2019. Specifically, CXI members will offer their technical expertise and recommend approaches and designs of service that give children greater privacy and autonomy to fully reflect their rights and best interests.

The link to CXI’s full submission can be found [here >>](#)

Participant Design – Your Turn

Digital Agency and Democracy

Please click [this link >>](#) to go to our survey featuring all the questions for all three sections of our paper. We have provided full instructions in the survey where you can either list your name and title to be associated with your responses or remain anonymous at your discretion.

All responses (unless you tell us otherwise) will be published in a follow-up to this paper, where we'll feature responses as a primary tool for guiding our rewrites. You may answer as many or as few of the questions below from any section you choose.

Academics and technologists



- Do you feel existing human rights law is fully and contextually applicable to the digital environment or should it be updated in some way?
- Would a “digital twin” allowing individuals to have their own terms and conditions honored in the digital environment be viable as a global solution or only in certain circumstances? Why or why not?
- Do you think having a “digital twin” would help individuals better value their rights and agency? Why or why not?

Engineers, data scientists and programmers



- Do you feel “privacy by design” as part of the initial basis for design is in widespread use today? If so, is it considered best practice versus being mandated?
- What benefits and challenges do you see in working to design “digital twins” for individuals and the infrastructure that would make this possible?



Policy Makers

- What existing rights do users have over their identity, data, or behaviors that could be simply translated to the digital environment?
- Is there a conflict between the needs of individuals to protect their data and the need of society to use it for common good?
- How could the relationship between government/public data and data gathered for commercial purposes be better articulated and/or divided?
- What protections from the gathering of data, rather than the processing of data, do citizens need?
- What cultural or regional norms will affect how digital agency plays out regarding A/IS?



The general public

- What data would you most be willing to share, and what protections would you like to have in return?
- What data should be protected from commercial exploitation under all circumstances?
- What would you like in return for data given up for commercial purposes?
Does it depend on who is taking it?

Developing “Enlightened” Indicators of Sustainable Human Progress

Rethinking our metrics for success

- Sara Rendtorff-Smith and Vikash K. Mansinghka

We need to develop and use broader metrics that capture the flourishing of people and of our Earth as our habitat, not as an “externality” of global production chains and markets. These metrics for success must be utilized in the setting of standards, ethical principles, and policy that holistically reflect the explicit values and expectations of the communities where metrics are deployed (including developing countries and vulnerable groups worldwide). This will drive technological progress to serve inclusive and sustainable development that increases political autonomy and global democracy.

[- From the Vision Statement of The Council on Extended Intelligence >>](#)



Introduction

Is it possible to develop “enlightened” indicators of human progress? Responsible governance requires that human progress be assessed as objectively as possible, while simultaneously accounting for the diversity and subjectivity of human values, as well as the inherent uncertainty in any honest assessment.

Decades of research has shown that it can be harmful to measure progress in purely economic terms. Widely used measures such as GDP do not reflect considerations such as (i) environmental health; (ii) individual health, both physiological and psychological; (iii) social aspects of wellbeing, such as empathy or the felt sense of community; (iv) equitability of progress; or (v) long-term sustainability, which depends on ongoing investments being made in the care of individuals, communities, and the environment.



“In their hearts, policy makers know existing measures we have—like GDP, productivity-related measures—aren’t useful in giving us a true and whole picture”

– Sophia Adams Bhatti

A number of existing indicator frameworks begin to address some of these challenges. The [United Nations Sustainable Development Goals](#) (SDGs), for example, incorporate measures of sustainability (see specifically Goals 11-15), the importance of agency, and the protection of rights and freedoms (see specifically Goal 16). The Goals and associated indicators have been broadly agreed by technical experts and political leaders from the UN's 193 member countries. The OECD Better Life Index also explicitly incorporates measures of resources for future wellbeing and combines observed and self-reported indicators, which begins to address the need for a more holistic measure, including individual, community, and societal levels of wellbeing (see the [OECD Framework](#) for measuring wellbeing and progress). The Social Progress Index (SPI) prioritizes about a third of its indicators for the measurement of "opportunity," including protections of personal rights and personal freedom and choice, inclusiveness, and access to advanced education (see the [SPI model](#)). All these frameworks represent important progress in moving beyond merely measuring aggregate economic performance to proposing multidimensional indices of people's quality of life, or what we in this paper refer to as human progress.

The Council on Extended Intelligence believes that emerging technologies offer opportunities for building on and complementing existing frameworks such as these by (i) collecting new types of data, and (ii) developing new methods for gathering insights from existing data. This is due to emerging data sources, web interfaces, and modeling approaches from autonomous and intelligent systems (A/IS) development methodologies and could, for example, support efforts by the UN Inter-Agency and Expert Group on the SDGs (IAEG-SDGs) to develop new methods for measuring [tier III SDG indicators](#), which are indicators for which no internationally established methodology or standards are yet available, according to a 2018 report by the UN.

Emerging technologies could also help change the governance structure of indicators. Historically, indicators have largely been designed and monitored by governmental bodies, allowing them to assess progress and to design and implement policies for human progress. Emerging technologies offer civil society and members of the general public opportunities to participate more actively in measuring a variety of indicators independently, without being solely dependent on the public sector. Broader partnership arrangements that also involve the private sector are needed to gain access to valuable new data sources, such as aggregated call detail record (CDR) data collected by mobile network operators. CDR data has proven valuable in deepening our understanding of a cluster of issues at the heart of human progress, such as mobility and transportation, social integration/segregation, the spread of communicable diseases, financial and economic activity, migration, and more.

Developing “Enlightened” Indicators of Sustainable Human Progress

As a contribution to the field, CXI is recommending a number of pilot projects to help explore new “enlightened” approaches to assessing progress at the national, community, and individual scales, along with new approaches to educating policy makers about the potential and perils of these same technological opportunities. In this regard, our framing of “enlightened” refers to complementing or extending existing indicator frameworks and research methodologies by:

1. Incorporating an intergenerational perspective that considers the long-term sustainability of human progress
2. Acknowledging the diversity in wellbeing value functions across cultures, communities, and individuals, and proposing a more inclusive and participatory approach to governing the advancement of human progress
3. Unpacking the inequalities and patterns of segregation, which aggregate indices and average measures risk glossing over
4. Adopting a holistic measure of social progress that considers simultaneously individual, community, and societal levels of wellbeing and their interrelatedness
5. Going beyond the elimination of harms and the acquiring of basic goods to instead value people’s freedom to pursue the life they value, and their enjoyment of a sense of hope and confidence in a better future
6. Adopting and continuing to develop new methods for how new types of data are collected, as well as how existing data and indicators are interpreted to deepen our understanding of how social progress is promoted, sustained, and made more inclusive

Here’s what some CXI members had to say about this issue:



Martha Minow – *“While it’s helpful to move away from only utilizing GDP, we also now have a proliferation of different indicators. One use of AI could be to factor in what elements are being fed into each Indicator.”*

Daniel Fagella – *“We need to take the data in the world combined with the AI tools we have to get a deeper richness regarding “traditional” survey methods. This will help us discover how data science might help us better measure wellbeing. This is a possibility space in AI.”*



The need to move beyond standard economic indicators

Standards and indicator frameworks for human progress are important because the ability to monitor and diagnose people's living situations over time and across countries allows us to analyze the source of challenges and help drive policy formulation. It is important to measure such progress as objectively as possible, because poor measures may lead to loss of confidence in government. An example of this would be the fact that most Americans saw no increase in their standard of living in early days of recovery from the 2008 financial crisis, even though GDP was increasing. What we measure and how we measure it matters, because our goals are often defined and evaluated by these indicators.

CXI recognizes the need to move beyond standard indicators prioritizing metrics solely focused on productivity, growth, or fiscal matters in isolation and acknowledges that there are a series of challenges inherent to measuring human progress.

Here's what some CXI members had to say about this issue:



Kate Raworth – *“The twentieth century was dictated by money. Countries were set up against each other as competitors, competing in the pursuit of endless growth. The great leap forward we’ll make this century is to define progress as moving towards balance and health versus growth alone. Growth drives a lot of human thought, but systems that move beyond growth thrive. We need to examine the institutional designs that lock in a dependency on endless economic growth, and ask if and how AI could help to overcome some of these structural dependencies.”*

Eileen Lach – *“There is a pressing need to address the economic imperative regarding AI. The challenge is how we can change the paradigm equity value from individual shareholder value to societal wellbeing.”*

Hruy Tsegaye – *“From an African perspective, in my country of Ethiopia we have been under a tyrant for twenty-eight years. In all that time the country was experiencing a faster GDP growth, and the government was measuring Ethiopians via this ‘remarkable’ measure. But the truth is the people were not happy. Right now there’s political mayhem. Violence everywhere. Now we’re having reform, the government is talking about our value system, and other indicators beyond GDP. What is the value of an individual in Ethiopia? Is it because they have wealth? The government is changing their attitudes. There’s something subjective that can’t be quantified, but it’s not the same old GDP measures.”*

Sophia Adams Bhatti – *“As an ex-civil servant and policy maker in the UK, the view towards GDP depends on which arm of the government you’re sitting on. Increasingly my colleagues and I are saying we need to consider more deeply what public value looks like beyond GDP. For instance, one could argue that a more broad distribution of wealth is a better condition of life for wellbeing. Likewise, access to education and access to justice provide value-oriented parameters. If all these conditions are met in the positive, you’re more likely to have a great state of wellbeing.”*



Developing “Enlightened” Indicators of Sustainable Human Progress

ISSUE TOPIC

1

The following items reflect key issues discussed by CXI members:

Human progress cannot adequately be captured in a momentary snapshot, or a single measure. Enlightened indicators therefore ought to capture the temporal dimension of human progress, while reflecting its inherent multidimensionality.

Human progress cannot adequately be captured in a momentary snapshot, as proposed by, for example, annual Gross Domestic Product (GDP). GDP measures mainly market transactions, while ignoring social costs, environmental impacts, and income inequality. At a general level, GDP does not distinguish between welfare-enhancing activity and welfare-reducing activity.³ GDP furthermore leaves out many activities that enhance welfare but do not involve monetary transactions, such as the caring economy. “Enlightened” indicators must take into account the sustainability of humanity’s progress—not just the prosperity of our current generation, but also that of generations to come. This calls for expanding our measurement framework beyond GDP.

National wealth accounting makes an attempt at capturing the important temporal and intergenerational dimension of humanity’s progress. It does so by taking into consideration the state of a country’s comprehensive wealth, including produced, natural, human, financial, and social capital, and how it evolves over time. Importantly, some countries are experiencing steady GDP growth, while simultaneously depleting the wealth foundation on which it rests.⁴ Comprehensive wealth thus constitutes one lens on future wellbeing.

[Natural capital accounting](#) (NCA), the [Social Progress Index](#) (SPI) as well as the [Social Wealth Economic Indicators](#) (SWEI) similarly go beyond merely measuring solely economic output to also take stock of the various inputs that underpin human progress. One such key input is how much a society cares for its population (particularly children) and the environment.⁵ The fields of neuroscience and psychology present mounting evidence that what children experience and observe in their early years, especially the quality of care they receive, has a profound effect on how their brains develop and their quality of life as adults.⁶

“

Riane Eisler – *“Enlightened” indicators will thus need to capture the substantial human, environmental, and financial return from caring for people and nature—and the enormous costs of not doing so. Most current Indicators just give us a snapshot of what is, versus the potential outputs. This means they also don’t tell us what inputs are needed. This is why a core element of the Center for Partnership Studies’ Social Wealth Economic Indicators are Human Capacity Indicators. These are critical, as they measure human development, which is very much correlated with how we treat our environment. Also critical is the second core element of Social Wealth Economic Indicators: Care Investment Indicators, which show what kinds of inputs are needed for better outcomes, providing realistic guidelines for policy makers.*”

”

³ Kubiszewski et al. (2013)

⁴ In Canada, for example, real GDP per capita increased at an average annual rate of 1.3 percent from 2009 to 2015. Meanwhile, the country’s largest and most important asset—its human capital—did not grow in real per capita terms from 1980 to 2015, and its market natural assets (minerals, fossil fuels, timber, agricultural land, and built-up land) declined in real per capita terms by 17 percent from 1980 to 2015 as a result of physical depletion. Overall, Canada saw its GDP grow more than five times faster than its comprehensive wealth between 1980 and 2015.

⁵ There is an extensive literature on what comprises care work and how crucial it is to the economic wellbeing of societies (see, for example, Antonopoulos and Hirway, 2010; Eisler, 2012; Esquivel, 2011; Folbre, 2006; Landefeld et al., 2009).

⁶ The ongoing Adverse Childhood Experiences (ACE) Study is an important source of measures of adverse childhood experiences and their impact on quality of life. The study found that health and longevity (two major indicators of quality of life) are directly affected by what people experience and observe in childhood (Vincent et al., 1995). Specifically, the study found that persons who had experienced adverse childhood experiences experienced greater risks for alcoholism, drug abuse, depression, and suicide attempts; along with greater chances of smoking, poor self-rated health, and sexually transmitted disease; and overall higher rates of physical inactivity and severe obesity (Felitti et al., 1998).

Progress is inherently subjective, because it reflects values, and there is fundamental diversity for these. Inputs, latent variables, and outputs can all be reflected in values. Enlightened indicators acknowledge the socio-spatial diversity across and within countries.

“The choice of relevant functionings and capabilities for any quality of life measure is a value judgment, rather than a technical exercise.”

— Stiglitz Sen Fitoussi Commission (2009)

Humanity’s progress cannot be assessed by measures that reflect the values of a single culture. Societies across the world are complex and heterogeneous, and the combination of factors that contribute to wellbeing and their relative weight varies across people in different places, with different cultures and ideas ⁷ as well as geographic⁸ and socioeconomic⁹ realities.



Jim Dratwa – *“These choices regarding the future cannot be made in some remote company boardrooms or policy makers’ offices. What we need is a sustained joint effort to ensure that these socio-technical arrangements are developed for the wellbeing of humanity and the planet. In fact we need a wide-ranging deliberation on where it is we want to go. Do not ever leave it to a small group, no matter how expert or wise, to define for the others the ‘common good.’”*

Beeban Kidron – *“Indicators do not have to be static, but must be multifaceted, so that human values are not imposed from one perspective, one geopolitical stance, or one user-group—but reflect the changing or negotiated values of individuals or communities.”*

Ali Shah – *“It’s important to recognize that wellbeing is very likely to vary across cultures, while at the same time being clear on what are global common measures. How can we provide a framework that works for my extended family in Kashmir, as well as for me in the UK? And how can the framework offer a baseline to see how we are globally being dealt with?”*



⁷ Alesina et al. (2004)

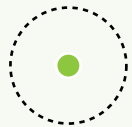
⁸ Cicerchia (1996), Jokela et al. (2015),

⁹ Land (1996)

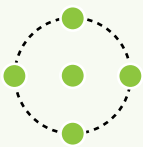
Developing “Enlightened” Indicators of Sustainable Human Progress

Aggregation across people, time, and space is necessary, because we need to summarize progress, but averages (and changes in averages) are inherently misleading. Enlightened indicators recognize that averages and correlations often miss the essential truth. They acknowledge the need to measure human progress at different levels (individual, community, society) and the importance of developing tools for better understanding the relationship between each of these levels.

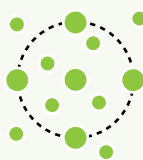
It makes sense to consider and measure wellbeing at different levels, including at the societal, community, and individual levels. While progress has been made in improving methods of measurement, we need better tools for understanding the relationship between wellbeing at each of these three levels. In the health sector the social-ecological model has helped researchers and practitioners better understand these relationships and [design interventions](#). On the one hand, it's impossible to talk about individual wellbeing without a measure of community wellbeing. On the other, researchers often rely on aggregate measures of individual wellbeing to measure community wellbeing. The complexity of this relationship can be illustrated by the fact that residential location is thought to influence people's wellbeing, but different individuals may value residential areas differently.^{10, 11}



Individual level: Subjective measures of wellbeing have made important contributions to help us acknowledge the diversity in value functions, while also enabling scrutiny of various society-level parameters proposed as contributing to quality of life. Technological advancements including the development of sensors has helped advance our understanding of psychological and behavioral aspects of wellbeing.



Community level: Similarly, the field of social ecology has helped make advances toward a better understanding of how and why community health shapes individual wellbeing. Cities like [Winnipeg](#) in Canada, [Sydney](#) in Australia, and Santa Monica in the United States have taken the next step to incorporate community wellbeing indicators as a central driver of their city planning frameworks. Measuring human progress at the community level aligns with theories of ecological sociology as well as ecological psychology, by capturing the relational and environmental aspects of progress. New data sources, including the ability to analyze patterns of communication and mobility based on aggregate phone records—also known as call detail records (CDRs), or in some cases high-frequency x-Detail Records (xDR)¹²—have enabled us to better understand core aspects of community level wellbeing, including financial wellbeing, health, crime, social cohesion, and socioeconomic status.¹³ These developments also prompted [Pentland's expansion](#) of aforementioned frameworks to apply in the digital age with the notion of sustainable digital ecology. It is of course critical that these new data sources be leveraged in a [privacy-conscientious way](#).



Societal level: Global indices made up of aggregate measures at a societal level allow us to make cross-country comparisons, and innovation in computing technology has introduced new opportunities to more reliably understand complex wellbeing datasets. But while it is common to summarize data using averages, and to summarize relationships between variables with correlations, this practice can easily miss the essential truth. As a simple illustration, here are sixteen datasets in which X and Y all exhibit a linear correlation of 0.5, that might be considered significant ($r = 0.50$):

¹⁰ [Jokela et al. \(2015\)](#)

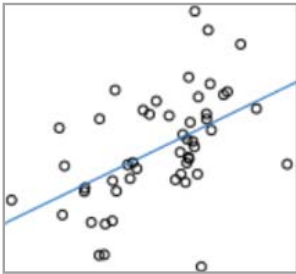
¹¹ Barker and Wright (1955)

¹² This represents a record that a call was made, including a timestamp, geographic location, and to whom the call was directed, but no information on the content of the call itself.

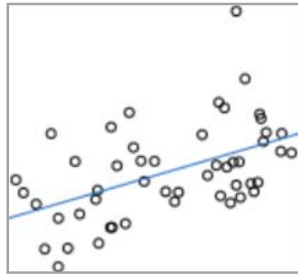
¹³ Pentland (2015b)

All correlations: $r(50) = 0.5$

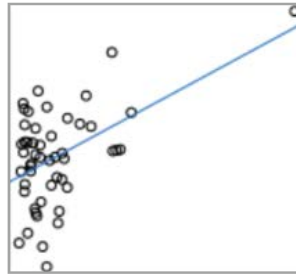
(1) Normal x, normal residuals



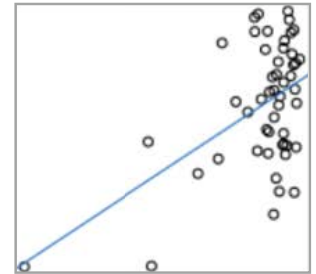
(2) Uniform x, normal residuals



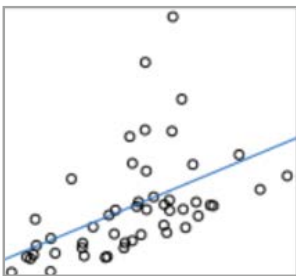
(3) +-Skewed x, normal residuals



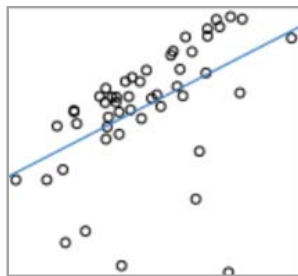
(4) +-Skewed x, normal residuals



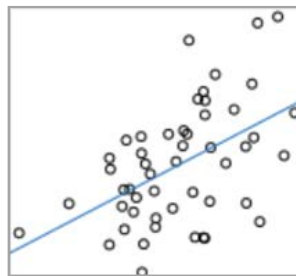
(5) Normal x, +- skewed residuals



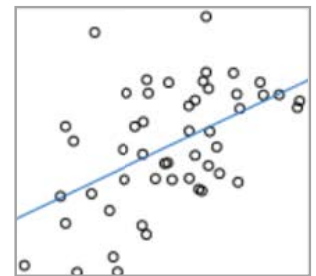
(6) Normal x, --skewed residuals



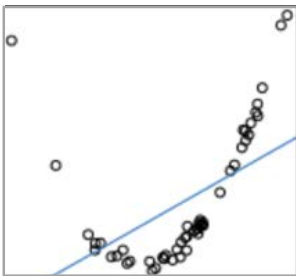
(7) Increasing Spread



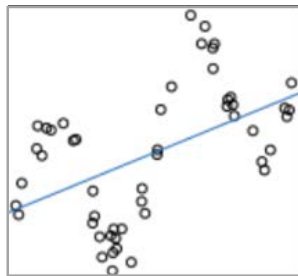
(8) Decreasing Spread



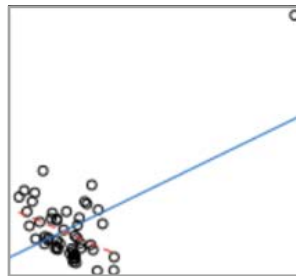
(9) Quadratic trend



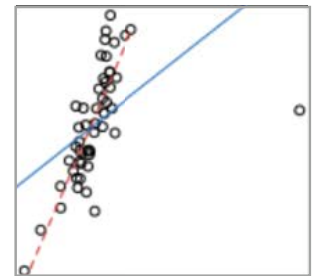
(6) Sinusoid relationship



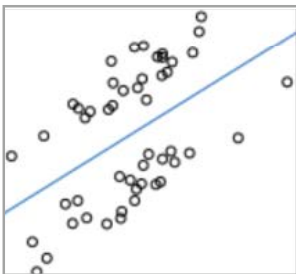
(11) A single positive outlier



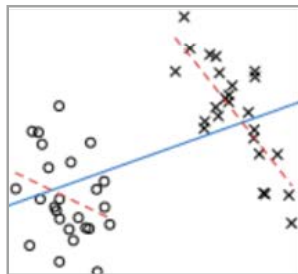
(12) A single negative outlier



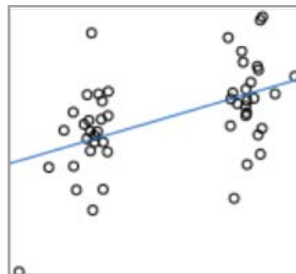
(13) Bimodal residuals



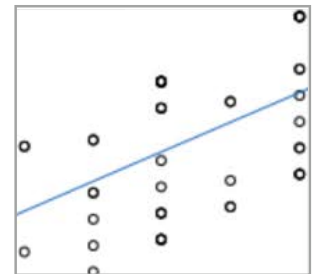
(14) Two groups



(15) Sampling at the extremes



(16) coarse data



In each case, the real data departs wildly from the trend line. Aggregation and summarization is necessary, but we need a more accurate approach than averages and correlations.

Developing “Enlightened” Indicators of Sustainable Human Progress

Such aggregate indices also rest on the assumption that there is widespread agreement in a given community about what factors are most desirable and thus risk glossing over the differential weighting of factors affecting wellbeing, across nations, communities and individuals. Aggregates and averages also run the risk of glossing over differences that have a direct and adverse impact on human progress:



Income inequality: Studies show that income inequality is associated with lower levels of happiness for citizens. Some of the central mechanisms that explain the link between income [inequality and subjective wellbeing](#) include anxiety from status competition, mistrust, and hopes and fears about the future.



Gender inequality: A study by the Center for Partnership Studies in 1995 found that the status of women can be an even more powerful predictor of general quality of life than GDP ¹⁴. The study found that a gender equity variable—prevalence of contraception—had a stronger relation to quality of life than GDP on five out of ten measures, including such basic indicators as infant mortality and life expectancy. Similarly, in five out of nine other instances, gender equity variables such as availability of contraception, female/male secondary enrollment, and social equality correlated more highly with overall literacy than GDP. The World Economic Forum’s Gender Gap Reports also confirm the correlation between the status of women and national standings in Global Competitiveness as well as quality of life, as shown by nations such as Sweden, Finland, and Norway, which have the lowest gender gaps in the world and rate high in measures of quality of life, happiness, and economic success.



Polarization, segregation, and social fractionalization: Research points to the adverse impact of social segregation along racial, ethno-linguistic, and religious lines on social progress. This highlights the importance of good and equitable governance in the context of diversity. For example, policies that promote social integration and inclusion have proven beneficial for human progress. By using data from the 2018 UK Community Life Survey, Appau et al find that social integration is associated with higher levels of subjective wellbeing.¹⁵ Specifically, an increase in respondents’ perceived strength of belonging to their immediate neighborhood (and country) is associated with an increase in subjective wellbeing.¹⁶ This effect is found to go via social networks and trust—both of which are found to be negatively influenced by ethnolinguistic fractionalization. This research is yet another example of how aggregate population-based factors, such as ethnic composition, interact with subjective dimensions of mental health and hence wellbeing,¹⁷ including through how regular interactions with one’s neighbors and perceptions of belonging and trust impact individuals’ quality of life.¹⁸

¹⁴ Eisler, R et al. (1995)

¹⁵ Appau et al. (2018)

¹⁶ Consistent with the construal-level theory of psychological distance, the researchers find that belonging to one’s immediate neighborhood influences wellbeing more strongly than belonging to a wider community such as one’s country.

¹⁷ Barnes-Mauthe et al. (2013), Dinesen & Sonderskov (2015), Sturgis et al. (2014)

¹⁸ This is consistent with the evolutionary psychology literature which notes the importance of social interactions for mental health.

Hruy Tsegaye – *“From a community perspective, an individual’s condition should be considered when thinking about indicators. The wellbeing of an individual is not alienated from the overall condition of the society one lives within. Most cultures in Africa treat the individual in a community-focused way because of Africa’s strong communal life and shared values.”*

Beeban Kidron – *“As it stands we articulate growth as an unfettered benefit, but if that growth is at the cost of someone(s) else, then that price must be accounted for in the cost-benefit equation.”*

Developing “Enlightened” Indicators of Sustainable Human Progress

ISSUE TOPIC



Human progress goes beyond the elimination of bads or the attainment of basic goods, whereas enlightened indicators acknowledge the importance of continued progress, people’s freedom to pursue the life they value, and a sense of hope and confidence in a better future.

In the public health sector, focus is shifting to encapsulate not only the elimination of physical and mental health diseases, but toward an emphasis on health resilience. Similarly, wellbeing science has moved from a “basic needs” approach, focused on eliminating ills or disabling conditions such as poverty, hunger, and armed violence, to also measuring positive foundations of wellbeing or so-called “wellbeing achievements,” including access to education, healthcare, and other social services.

Most wellbeing indicator frameworks, however, still fail to incorporate measures of enabling conditions for future opportunities and the freedom to pursue these, or agency. At the community and societal levels, this includes the universal protection of rights and freedoms as well as potential achievements, in the form of equal opportunity, social mobility and empowerment, such as through participatory governance. In short, it’s a measure of people’s scope for influencing decisions that affect their lives. At the subjective level, this includes personal outlook such as people’s sense of hope, optimism, and sense of confidence in a better future for themselves, their family, and their country. Studies [have shown](#) that optimism positively affects physical and mental wellbeing. The effect occurs via a series of goal-directed thoughts and motivations, such as setting up valued and attainable goals, planning pathways, and maintaining self-confidence and mastery, which in turn help individuals pursue their goals.¹⁹

Summary

In summary, in order to promote our understanding and ability to advance human progress at the individual, community, and societal levels, CXI encourages the extension of existing indicator and measurement frameworks for human development, progress, and happiness to incorporate intergenerational and intercultural dimensions of wellbeing. We must avoid the reductionism inherent in averages and aggregates, while deepening our understanding of how individual, community, and societal level measures of wellbeing relate. In order to do this, CXI hereby recommends further research into how emerging technologies such as probabilistic programming and augmented and virtual reality can help (a) deepen our understanding of existing indicators as well as their interrelatedness, and (b) generate complementary data.

“

Beeban Kidron – *“The mitigation of harm is not adequate. The human right to wellbeing is a minimum. Human ambition for flourishing should be the goal. It is clear that that ambition is not designed into the system.”*


Tenzin Priyadarshi – *“We need better defining statements around health and wellbeing. We’ve done so much on defining illnesses and disease that even visualizing what optimum health and wellbeing looks like is a struggle. In traditional Buddhist or contemplative frameworks people are trained not just to remove toxic factors, but to increase virtuous states.”*

Beeban Kidron – *“If we summarize our collective commitments (SDGs, human rights, and children’s rights) and had an indicator against each of these—how would that affect the ranking of governments and corporations in relation to the technology they purvey?”*

Konstantinos Karachalios – *“Any given society must explicitly set and exercise its ‘collective commitments’ at an individual and collective level in order to achieve eudaimonia (wellbeing); otherwise implicit, and often not desired ‘commitments’ will prevail. As Aristoteles puts it in his Ethica Nicomachea (Book 2):*

“Again, of all the things that come to us by nature we first acquire the potentiality and later exhibit the activity (this is plain in the case of the senses; for it was not by often seeing or often hearing that we got these senses, but on the contrary we had them before we used them, and did not come to have them by using them); but the virtues we get by first exercising them, as also happens in the case of the arts as well. For the things we have to learn before we can do them, we learn by doing them, e.g., we become builders by building and lyre players by playing the lyre; so too we become just by doing just acts, temperate by doing temperate acts, brave by doing brave acts.”

”

The background is a dark blue field filled with abstract, glowing elements. Numerous white, jagged lines resembling lightning bolts or neural connections crisscross the space. Interspersed among these lines are various colored circles and spheres in shades of red, orange, yellow, and cyan, some appearing as bright, out-of-focus bokeh lights. The overall effect is one of dynamic energy and complex, interconnected systems.

New opportunities from emerging data sources, web interfaces, and modeling and inference technology may allow us to more objectively assess human progress while resisting reductionism.

CXI in Action –

“Enlightened” Techniques

The Council proposes a two part research agenda to enable the development of more “enlightened” techniques to enhance existing indicators, at the individual, community, and national scales.

1

Building new AI tools that help policymakers understand how “enlightened” and “traditional” indicators relate.

Even if no new data is collected, existing multivariate data could be put to better use, to create more realistic pictures of wellbeing and development at the community and national scales. Doing so requires educating policymakers in the potential and perils of modern data science techniques. For example, there are a number of widely used frameworks for measuring human progress, such as the Sustainable Development Goals (SDGs), the OECD Better Life Index, and the World Values Survey. Collectively, these frameworks offer hundreds of dimensions along which countries can be compared. Fundamental questions include: where do these frameworks agree? Where do they disagree? What patterns of dependency exist between variables in these datasets? And how should indicators be adjusted to develop a more meaningful, comprehensive set?

Getting answers to these questions requires bringing together expertise in governance with expertise in quantitative analysis and data science. Although it has historically been difficult to do this, recent technological advances, especially in probabilistic modeling and inference,²⁰ have yielded spreadsheet-based software that can solve data analysis problems in seconds that would otherwise require hours of statistical programming.²¹ There is now the potential for policymakers to pose empirical questions themselves, and get quantitative answers, without needing to wait days or weeks for economist colleagues to translate and implement their questions. There is also the potential for improved accuracy and rigor in comparing frameworks for assessing and understanding wellbeing at the national scale.

One possible project would be to gather policymakers across the UN system, possibly within the frameworks of the SDGs and the World Happiness Council, and carry out collaborative workshops in order to inform policy making. The purpose of such workshops would be to analyze and compare wellbeing frameworks and develop suggestions for new tools and research methodologies that can help us capture relationships between behavioral data and subjective measures of wellbeing on the one hand, and between subjective, community, and societal-level indicators on the other. It may also be fruitful to consider similar exercises within nations with large existing commitments to national statistics offices, such as the United Kingdom and United States, as well as countries already at the forefront of applied wellbeing science, such as Denmark and the United Arab Emirates.

²⁰ Saad et al. (2019); Ghrahramani (2015)

²¹ Saad and Mansinghka (2016); Saad and Mansinghka (2017); Saad et al. (2017)



Another such project would be to gather municipal officials with local civil society groups in an effort to better understand the relationships between individual, community, and societal levels of wellbeing. Here, A/IS assisted data science could help facilitate a participatory process of better understanding how local realities of wellbeing might in important ways challenge our preconceived notions of what drives wellbeing by enabling us to search for communities where unexpected relationships exist between broadly accepted drivers of wellbeing and their outcomes. One could imagine doing so in cities committed to open data and participatory governance, such as New York City, as well as cities that have already started the work to define and measure wellbeing at different levels, such as Santa Monica and Winnipeg.

A third project would be to explore possible probabilistic relationships between a nation's Human Capacity Development (assessed via Human Capacity Indicators) and its investment in caring for its people and for nature (assessed via Care Investment Indicators), informed by existing research on Social Wealth Economic Indicators more generally. Unlike GDP, which consists of one easily accessible measure, the current iteration of Social Wealth Economic Indicators consists of multiple measures in each category. The Index would provide policy makers and the public with succinct, realistic information that takes into account the evidence from neuroscience and psychology that what children experience and observe in their early years, especially the quality of care they receive, has a profound effect on their quality of life as adults—and even on how their brains develop—and that social support for caregiving is vital for a more equitable and sustainable society and economy, especially in our post-industrial age when economists tell us that the most important capital is [“high-quality human capital.”](#)

CXI in Action –

“Enlightened” Techniques

2

Developing and testing automated assessments of individual mental health, psychological development, and empathy.

Is it possible to build more accurate, empirically grounded assessments of mental health than what's possible based on conventional subjective survey methods?

Data collection will require going beyond traditional surveys, to include other data collection modalities such as (i) [wearable sensor technologies](#) for detecting physical properties that can reveal a person's mental state, including facial expressions, heart rate variability (HRV), eye movement, and electrodermal activity;²² (ii) social media data to sense mental health and infer physical health measures such as heart disease mortality;²³ and (iii) cell phone use data to map social interactions and other dimensions of community health.

Analysis of this data can greatly benefit from the development and utilization of new or updated approaches to probabilistic modeling and inference. It will be important to distinguish between assessments aimed at surfacing opportunities for growth, and assessments aimed at reduction of symptoms. The objective of growth and that of immediate symptom reduction are often conflicting; the process of psycho-spiritual development can be painful and disruptive, producing short-term reductions in apparent wellbeing. In addition to developing new automated assessments, it will be necessary to compare them to subjective clinical assessments by mental health experts, to understand when and how the new assessments can be safely relied upon and where they can be inaccurate.

Immersive games and AR/VR technologies can also offer the ability to measure and influence subjective wellbeing interactively. A related project would seek to: (i) Assess the effect on wellbeing of explicit disclosure and agency-aware exchange of data for subjects or users of immersive reality environments; (ii) Create a working methodology to analyze longitudinal wellbeing and holistic flourishing for users of immersive reality, as some humans may eventually spend more time in immersive reality than concrete reality; (iii) Test this working methodology in order to generate data that could inform existing “Beyond GDP” indicators to prepare policy makers for future governance in immersive reality; and (iv) Test altruism interventions that show success in concrete reality to demonstrate the viability of communal wellbeing in immersive environments.

Both of these research directions (1) and (2) require confronting the intrinsic uncertainty in assessments of wellbeing, development, and progress, because (a) progress involves inferences about the future, and (b) progress requires inferences about psychological, not just material, attributes of people, communities, and nations, and we only observe proxies for these. Emerging technology for probabilistic modeling and inference offers a possible set of opportunities for addressing these challenges. For example, [hierarchical statistical models](#) are being used to describe complex ecological processes. Similar models may be suitable for the study of social processes. The benefits of such models include (i) the ability to incorporate variability in parameters that otherwise might be unrealistically treated as fixed; (ii) enabling the incorporation of multiple layers of uncertainty (process and observation),²³ which in turn allows us to (iii) model a range of possible futures as a basis for complex scenario planning in support of future flourishing and progress at the individual, community, and societal levels.

²² Cameron (2018)

²³ Eichstaedt et al. (2015), Hao et al. (2014)

²⁴ Ponciano et al. (2009)

Participant Design – Your Turn

Developing “Enlightened” Indicators of Sustainable Human Progress

Please click [this link >>](#) to go to our survey featuring all the questions for all three sections of our paper. We have provided full instructions in the survey where you can either list your name and title to be associated with your responses or remain anonymous at your discretion.

All responses (unless you tell us otherwise) will be published in a follow-up to this paper, where we’ll feature responses as a primary tool for guiding our rewrites. You may answer as many or as few of the questions below from any section you choose.



Academics and technologists

- What are your thoughts on the uses of probabilistic computing to help in the collection and analysis of economic indicator data?



Engineers, data scientists and programmers

- How might these “general” indicators of value be incorporated into technological systems?
- How can they be transparent to and trusted by the user?



Policy Makers

- What is your view on the limitations and risks of GDP as a measurement?
- What indicators would you like to see being measured to denote a healthy and happy society?
- What are the obstacles to developing policy that looks at a broader set of indicators?



The general public

- What values would you like to see reflected as a measure of benefit for society?
- How would you most trust that your values were being applied fully: a fiduciary system, regulator, watermark, audit, self-regulation, law, technical audit, or other?

References for *Developing Enlightened Indicators of Sustainable Human Progress*

[Alesina, A; Di Tellab, R; MacCulloch, R. "Inequality and happiness: are Europeans and Americans different?" *Journal of Public Economics* 88 \(2004\): 2009–2042.](#)

Antonopoulos, R and Hirway, I (eds.). *Unpaid Work and the Economy: Gender, Time Use and Poverty in Developing Countries* (2010).

[Appau, S; Churchill, SA; Farrell, L. *Social integration and subjective wellbeing*, in *Applied Economics* \(2018\).](#)

Barker, R. G. and Wright, H. F. *Midwest and its Children: The Psychological Ecology of an American Town*. (New York: Harper and Row, 1955).

[Barnes-Mauthe, M; Arita, S; Allen SD; Gray SA; Leung, P. "The Influence of Ethnic Diversity on Social Network Structure in a Common-Pool Resource System: Implications for Collaborative Management." *Ecology and Society*, Vol. 18 \(2013\), no. 1, article 23.](#)

[Bellamy, R., Chilvers, J. and Vaughn, N. "Deliberative Mapping of Options for Tackling Climate Change." *Public Understanding of Science* 25 \(2016\) no. 3: 269-286.](#)

[Buttrick NR et al. "Inequality and Wellbeing." *Current Opinion in Psychology* 18 \(2017\): 15-20.](#)

[Conversano, C; Rotondo, A; Lensi, E; Vista, OD; Arpone, F; Reda, MA. "Optimism and Its Impact on Mental and Physical Wellbeing." *Clinical Practice and Epidemiology in Mental Health* 6 \(2010\):25-29.](#)

[City of Sydney. *Community Wellbeing Indicators: Understanding our Changing Communities* \(2016\)](#)

[de Montjoye, Y.-A. et al. "On the privacy-conscientious use of mobile phone data." in *Scientific Data* \(2018\) no. 5.](#)

[Decancq, K; Fleurbaey, M; Schokkaert, E. "Happiness, Equivalent Incomes and Respect for Individual Preferences." *Economica* \(2015\).](#)

[Dinesen, PT and Sonderskov, KM. "Ethnic Diversity and Social Trust: Evidence from the Micro-Context." *American Sociological Review* 80 \(2015\), no. 3: 550-573.](#)

[Dolan, P; Peasgood, T; White, M. "Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective wellbeing." *Journal of Economic Psychology* 29 \(2008\), no. 1:94-122.](#)

[Eger, R. J., and Maridal, J. H. "A statistical meta-analysis of the wellbeing literature." *International Journal of Wellbeing* 5 \(2015\), no. 2: 45-74.](#)

Eisler, R et al. *Women, Men, and the Global Quality of Life*. Pacific Grove, CA: Center for Partnership Studies (1995).

[Felitti VJ, et al. "Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults: The Adverse Childhood Experiences \(ACE\) Study" \(1998\).](#)

[Folbre, N. "Measuring Care: Gender, Empowerment, and the Care Economy." *Journal of Human Development* 7 \(2006\), no. 2.](#)

[Ghosh, I. et al. Social Wealth Economic Indicators. Pacific Grove, CA: Center for Partnership Studies \(2014\).](#)

[Ghosh, I. Social Wealth Economic Indicators for a Caring Economy. Interdisciplinary Journal of Partnership Studies 1 \(2015\), no.1. <https://doi.org/10.24926/ijps.v1i1.90>.](#)

[Jokela, M; Bleidorn, W; Lamb, ME; Gosling, SD; Rentfrow, PJ. "Geographically varying associations between personality and life satisfaction in the London metropolitan area." PNAS 112 \(2015\), no. 3: 725–730.](#)

[Kubiszewski, I; Costanza, R; Franco, C; Lawn, P; Talberth, J; Jackson, T; Aylmer, C \(2013\). "Beyond GDP: Measuring and achieving global genuine progress, in Ecological Economics, Vol. 93, pp. 57-68.](#)

[OECD. Guidelines on measuring subjective wellbeing. OECD Publishing \(2013\).](#)

[Peg. Our City, A Peg Report on Sustainability: Linking Winnipeg's Wellbeing to the United Nations Sustainable Development Goals \(2018\).](#)

[Pentland, S. The Social Physics of Wellbeing, Part 1 \(video\) \(2015a\).](#)

[Pentland, S. The Social Physics of Wellbeing, Part 2 \(video\) \(2015b\).](#)

[Ponciano, JM; Taper, ML; Dennis, B; Lele, SR \(2009\). "Hierarchical models in ecology: confidence intervals, hypothesis testing, and model selection using data cloning", in Ecology, Vol. 90, Issue 2, pp. 356-362.](#)

[Saad, F and Mansinghka, V. "A Probabilistic Programming Approach To Probabilistic Data Analysis." Advances in Neural Information Processing Systems 29 \(2016\): 2011–2019. Curran Associates, Inc.](#)

[Saad, F and Mansinghka, V. "Detecting Dependencies in Sparse, Multivariate Databases Using Probabilistic Programming and Non-parametric Bayes." Proceedings of the 20th International Conference on Artificial Intelligence and Statistics. Proceedings of Machine Learning Research 54 \(2017\): 632–641. PMLR.](#)

[Saad, F; Casarsa, L; and Mansinghka, V. "Probabilistic Search for Structured Data via Probabilistic Programming and Nonparametric Bayes." arXiv preprint, arXiv:1704.01087 \(2017\).](#)

[Streeten P; Burki SJ; UI Haq M; Hicks N; Stewart F. First things first: meeting basic human needs in the developing countries. \(New York: Oxford University Press, 1981\).](#)

[Sturgis, P; Brunton-Smith, I; Jackson, J; and Kuha, J. "Ethnic diversity, segregation and the social cohesion of neighbourhoods in London." Ethnic and Racial Studies 37 \(2014\), no 8: 1286-1309.](#)

[Sun, RCF and Shek, DTL. "Beliefs in the Future as a Positive Youth Development Construct: A Conceptual Review." The Scientific World Journal. 4 \(2012\).](#)

[United Nations. Tier Classification for Global SDG Indicators \(2018\).](#)

[Vanhove, J. What data patterns can lie behind a correlation coefficient?](#)

[Vincent J. Felitti, et al. "Relationship of Childhood Abuse and Household Dysfunction to Many of the Leading Causes of Death in Adults: The Adverse Childhood Experiences \(ACE\) Study." American Journal of Preventive Medicine 14 \(1998\): 245–258.](#)

