THE 2021 CURIOSITY REPORT

PERSPECTIVES ON INNOVATION

CORGAN

HUGO

"At the end of the day, it doesn't matter how much hard data we have in our hands, how many brain scans we've monitored on our screens, or how many different ways we have segmented our markets. **If we don't have perspective on the human behavior involved, our insights have no power."**

CHRISTIAN MADSBJERG, ***SENSEMAKING: THE POWER OF HUMANITIES IN THE AGE OF THE ALGORITHM***

THE CURIOSITY REPORT

Contents

"Forget about the difference between generations, currently mere months can bring a revolution."

– Peter Diamandis, *The Future is Faster Than You Think*, published January 2020

Letter from the Editor

Ever heard the phrase, "the only constant is change"? If the year 2020 met any of our expectations, it was that. In a year where the future was constantly unknown, and kept changing, it became harder to imagine and plan for. But then again, the future is always unknown… it's just a matter of perspective.

In the course of a year, across multiple industries, science fiction became science fact. In mere months we went from identifying an unknown virus to creating a reusable at-home test kits for that virus — launching an emerging preventative healthcare product market that will evolve over the next decade. We became experts at Zoom and rediscovered the extreme value we place on our personal and professional relationships. Across industries, we created and adopted a variety of emerging technologies, that ultimately exposed gaps in equity and access across our communities — creating a new market for emerging entrepreneurial businesses focused on democratizing access for the benefit of everyone.

Globally, we faced the unknown, challenged norms, and evolved our perspectives. We watched carbon emissions plummet while the world stood still — and collectively understood the direct impact our actions have on the environment. We changed our stance on mental health, launched the Unhackable Internet, and watched together as we came one step closer to normalizing space travel. But most importantly, we witnessed the largest social revolution in history, as we protested together — in 4,446 cities across the world — to end systemic racism.

Hindsight is 2020 — but we are not focusing on it. Instead, we can use the fuel from last year's dumpster fire to help us ignite our passion for pioneering into terra incognita. In this edition of the Curiosity Report, we look forward together as observers outside of ourselves — collecting multiple perspectives that together reimagine the future that we really need…. a better one.

Throughout this report, we examine how evolving user behaviors and emerging technologies are shaping each other. We poke the bear and embrace changes that sit outside of our comfort zone. We elevate data-driven design research around everyday human experiences. We explore ways to distribute and support quality education across socioeconomic divides. We investigate the overlapping needs of our urban workforce and inner-urban communities. We renew our focus on the environment and hope to democratize space travel for all — so that we may each take a step back (or up) and view the world from a different perspective.

It's true. The world is changing. And we can change it together.

HUGO

“Because,” it said, “it’s good to have the ability to see things differently.”

WHAT DO YOU DO WITH AN IDEA?
BY KOBI YAMADA

Perspectives on Innovation

It’s the difference between looking down at a microscope versus out into the cosmos through a telescope. We experience it when we look outside our own vantage point and imagine a moment in someone else’s shoes. We also use it when we draw three-dimensional objects on paper.

Add this to your reading list.
What Do You Do With an Idea?

Perspective is all around us. In many ways, it is responsible for some of the greatest leaps in our understanding of reality. It’s the common brainchild of achievements in science, mathematics, and the arts. But most importantly, new perspective breeds innovation because it challenges the traditional mindset, “But we’ve always done things this way...”

The strangest way to see the world is from someone else’s point of view. Perspective keeps things interesting. It encourages us to think about things differently. It’s a word that has challenged all of us at one point or another. But, no matter what, we can always use more of it.

We realize that even the information being presented throughout this report has bias and as such, we are committed to becoming more aware of it and challenging ourselves to see past it. We believe that bias is best confronted with the help of others who share their perspectives and experiences that are different from ours. We are committed to learning and revisiting these topics any chance we get. This report is a living marker of where we are in our journey. We hope you will learn (and teach!) alongside us.

So, what are you waiting for? Let’s get out there and explore some different perspectives.

Chiesa di Sant'Ignazio di Loyola (The Church of St. Ignatius of Loyola) by Andrea Pozzo (c. 1685). Through this painting he creates an optical illusion effect that gives an impression of infinite space.[4]

Perspective: Technically Speaking...

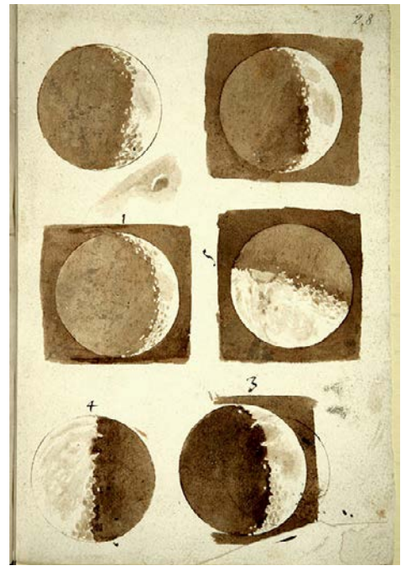
Perspective weaves together our understanding of both art and science. It's a technique that adds depth and volume to a flat plane. It makes objects on paper appear to look like they do in the physical world.

It's a term that is "deeply entwined with the word's literal meaning and its history."[1] Our ability to communicate perspective through drawing and painting has evolved over centuries. Ancient civilizations made rudimentary attempts to create the illusion of depth.

But perspective, as an artistic technique, is fundamentally rooted in mathematics. In 300 BC, *Euclid's Elements* outlined the foundation for geometry. This breakthrough in science "shaped art through the development of perspective — a technique originally called *geometric figuring*, which invited architecture and the figurative arts into the three-dimensional world for the first time."[1]

Advancements in perspective further developed through the study of art, philosophy, mathematics, physics, and astronomy and continued to evolve throughout the Renaissance, Scientific Revolution and into the Age of Enlightenment.

But these advancements in technique didn't just enhance the way we put pen to paper. **When Copernicus proposed the earth orbited around the sun, he suggested that the universe (quite literally) did not revolve around us.** His research would change the way we perceive ourselves and the world we inhabit.



After he observed the moon through a telescope in the autumn of 1609, Galileo produced six watercolors in its various phases "from life." They represent the first realistic depiction of the Moon in history, suggesting it is as solid and rugged as the Earth (rather than a heavenly body as was originally thought).[2]

Renaissance Perspective

"Around the 1300's, the flat, childish depictions of kings and saints begin to change. Their faces start to curve, ever so slightly, into what looks like a third dimension. Noses begin to have shading and depth. The Christ child begins to look like he's being held by his mother, not sitting flush with her. The portraits are still flat and unnatural, but not nearly as primitive as the portraiture that came before them. **Then come the 1400's, and suddenly portraits become *people*. They pop off the canvas in variations of darkness and light; their faces detailed and proportioned.**

The real reason that three-dimensional art was seldom seen before the 14th century was that artists didn't want to portray life in three dimensions. **In the medieval period artists lost the *desire* to make lifelike images. The job of art was not to reproduce the real world, but instead to show another world.** Unshackled from the mundane task of realism, it entered a more expressive realm.

Western Civilization after the fall of the Roman Empire was miserable, riddled with plague and hunger and oppression. People of the Dark Ages were simply waiting out their time on this mucky rock called Earth until they could be called to Heaven. And it was the surreal unknown of Heaven that most strongly influenced their work.

Gradually, artists lost the knowledge required to render realistic imagery. Bit by bit, [artistic] training stopped including things like perspectival composition or the modeling of 3D forms through the modulation of light and shadow. To regain that, one would have to retrain oneself. That retraining was sparked by the Renaissance. Renaissance means rebirth, a finding value in the old ways. The ancient world was re-examined and revived; one facet being the desire to paint realistically through perspective."

– HOW DID HUMANS LEARN TO PAINT IN THREE DIMENSIONS? BY THERESE O'NEILL [3]

The 20th Century Marked a New Chapter in Perspective.

Technology had finally caught up with our curiosities, enabling things previously considered impossible.

The Wright brothers lifted us into airflight, introducing a modernized experience of aerial perspective. Scientists discovered DNA and subatomic particles, transporting us into the some of the smallest corners of the universe. We successfully landed a human being on the moon, inspiring a vision for future interstellar travel that's now being pioneered by the likes of Blue Origin, Virgin Galactic, and SpaceX.

Today, technology continues to evolve our understanding of perspective. What was once communicated through pen and paper, is now more commonly represented through our screens; and our reliance and understanding of perspective as a tool will continues to evolve.

Powers of Ten by Charles and Ray Eames

The 1977 film *Powers of Ten* by designers Charles and Ray Eames is a masterpiece in perspective that "did for our understanding of scale and orders of magnitude what Edwin Abbott Abbott's Victorian novella Flatland did for our understanding of dimensions." [1]

Inspired by the 1957 book by Kees Boeke, *Cosmic View: The Universe in Forty Jumps*, the Eames decided to use it as the foundation for a film that would examine the relative size of things and the significance of adding a zero to any number.[5] This film was made only months after the launch of the Voyager mission, "ablaze with the thrill of cosmic curiosity — a time when humanity's prosthetic eye first left our corner of the Solar System and set out for its farthest reaches, in order to view our cosmic neighborhood from a perspective other than the one allotted us by gravity." [1]

Powers of Ten ends its perspectival extension at 1024 meters (the limit of our vision in 1977). In the decades since, "our Earth-tethered instruments, our space telescopes, our data modeling have all extended beyond this horizon." [1]

As architects and designers, we approach our projects from various perspectives. We design our airports, for example, to be viewed from the aircraft window (aerial perspective), while at the same time maximizing every inch of a restroom layout so that a traveler's luggage can sit next to them comfortably in the stall (human perspective). We investigate sight lines, explore viewing angles, and strategically manipulate perspective to intuitively guide users in the right direction (Love Field, anyone?) When we consider the technical aspects of "perspective" and its application to our industry, it's very easy to draw parallels to our design process… or is it?

Continue

Coppell Arts Center, Corgan Project

What Does this Mean for Architecture?

A single viewpoint can only do so much to express how we truly want end-users to experience the spaces we design — which is why extended realities have already become fundamental tools in our design process. In real time, we can experience our building from multiple vantage points — enabling us to physically gauge the detail, scale, and complexity of the spaces that we are creating virtually. However, our perspective of the built environment does not rest on our visual understanding alone — it is a multi-sensory experience.

Our noses have incredible influence on the way our brain defines space. Not only can scents stimulate our emotions, alter our perceived body temperature, and bring brilliance and depth to materials — they can subconsciously change the way our brain visually registers space by triggering our limbic system to redefine the height, width, and depth of any given room. In the **2020 Curiosity Report**, we explored Olfactory Architecture™, exploring how our sense of smell works in tandem with our internal navigation and sense of spatial awareness. And when we ignore scent, we are skipping over one of the most powerful ways we experience the world.

> "Photography is alright if you don't mind looking at the world from the point of view of a paralyzed cyclops — for a split second. But that's not what it's like to live in the world, or to convey the experience of living in the world."
>
> **DAVID HOCKNEY, ENGLISH PAINTER**[1]

FeelReal has created an aroma-focused multi-sensory attachment compatible with a variety of VR devices, bringing scent to Virtual Reality (VR) headsets.[2]

Just like our sense of smell, auditory architecture doesn't just change the way we *perceive* space — it can chemically change the visual *perspective* we experience. When what we hear supports what we see, it enhances our ability to create mental maps, categorize spatial zones, or navigate with agility.[3] Our visual and auditory systems frequently work together to identify and locate objects, determine distance, and define vanishing points — all components that build visual perspective, and are central to our development of spatial awareness.

In fact, our subconscious auditory distance perception instantaneously deciphers between our extrapersonal space and peripersonal space — the physical structure of which can alter our mood, emotions, and behavior towards our environment.[4] For example, neurological studies show that loftier ceilings dissipate sound in such a way that shifts the brain's activity from language centers to emotional centers, unlocking abstract thought.[5] This may be why we feel creatively motivated in an open office environment and feel more productive tackling heads down tasks at home.

While both our olfactory and auditory sensory receptors trigger our spatial awareness from deep within our subconscious, researchers in Sussex are giving sound shape through visual perspective. Via acoustic levitation, they are using sound particles to create visuals suspended in midair. Called a multimodal acoustic trap display (MATD)[6], the floating images are rich with color and depth. It can facilitate conversations between a 3-D projection of a virtual caller who can turn their head to follow the receiver around the room — visible from any perspective or location.[6] And by emitting patterns of sound waves in ultrasonic range, a sensation pushes back, as if the image is physically there.[6] All with zero help from screens, goggles, or haptic gloves.

As the technology develops, it's likely that the projection can not only be "felt," but manipulated — enabling a hybrid physical/virtual prototyping, without the need for a mouse, keyboard or computer screen.

> "We created a 3D display that we can see and we can touch… using ultrasound, [we] can create visual, tactile and audio content at the same time."
>
> **RYUJI HIRAYAMA, A RESEARCH FELLOW AT THE UNIVERSITY OF SUSSEX IN ENGLAND**[6]

Seamless interaction between physical and digital worlds is challenging architects and designers alike to change our perspective from digital versus physical space to *hybrid* space. In hybrid spaces, our digital world and physical elements are intrinsically interwoven, creating a new way to move value between the virtual and real world.[7] This nascent industry can be seen in "smart objects" — blockchain-enabled digital objects that provide the same authenticity and scarcity as physical objects.

Imagine you are at a car showroom and you see a virtual display of a car you would like to purchase. Simply point your phone and click to buy. Suddenly, the virtual car is no longer visible, but is instead a smart object on your phone. But you didn't just get a digital copy of the car — you got the real car. When you arrive home, the car has been delivered to your house. You use the smart object as a digital key to open the door and voila! — your secure purchase is confirmed.

Smart objects don't just bridge the gap between worlds, they gamify the world[7], changing how we design for and interact with our environments. Smart objects are only part of a larger effort to create persistent hybrid experiences — with the ability to toggle seamlessly between virtual and physical worlds, at all times, in all places. To successfully create this hybrid space, our devices — whether they be augmented reality (AR) glasses or contact lenses, VR headsets, mobile phones, or MATDs — must precisely understand the architecture of the surrounding world. This means the ability to scan the physical world with immediacy and accuracy from multiple perspectives at once — with zero latency — will be required by any and all devices within the next 5 years.[8] Combine that with digitized scent and soundscapes, and our perspective on reality is completely hybridized.

In today's post-digital era, we should no longer be questioning, "are we architects or are we software developers?" but instead, saying proudly "yes, and…" Cross-industry collaboration is paramount in the age of convergence.

Our perspective on hybridity isn't the only thing that is about to change — our perception of time and space is transforming as well. Consider for a second, what you believe to be "local" in your personal life. Maybe it's the Thai food restaurant down the street; maybe it's your parents' house that is a 45-minute drive, but still in the metroplex; maybe it's the "local" food you buy at the grocery store that was produced only 100 miles away. What we often consider "local" varies based on time and distance — and we are entering a transportation revolution. In 2020, we saw the first human trials of the Hyperloop, with passengers moving at the speed of 1,000km/hr; we witnessed major auto companies like GM, Audi, and a host of others make significant strides in their autonomous fleet production; we watched as SpaceX "normalized" space travel; and we saw Boom partner with Japan Airlines, offering 4-hour supersonic flights between Tokyo and Seattle — a major upgrade from the current 11 hours. Before the end of the next decade, the transportation revolution will significantly alter our perspective on what we consider "local" — impacting where we choose to live and work, the size of the "local" dating pool, the demographics of the "local" school district… the list goes on.[7] If this pace of acceleration continues, "off to Europe for lunch" could become a reality in the next decade.[7] With a bit of perspective, the way in which our means of travel can stretch the boundaries is limitless.

Perspective: Figuratively Speaking…

When you have a tricky problem that you can't seem to solve, what do you do? Research shows time and time again that when we **look outside ourselves** — when we explore new perspectives and ways of problem solving — we open the door to innovation.

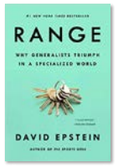
This seemed to work for the founders of *Innocentive*, an open-source innovation platform that originally began as an in-house incubator for pharmaceutical company, Eli Lilly.[1] At the time, their scientists were continuously stumped by a number of specific problems that they couldn't overcome with their own brain power or expertise. So in the spring of 2011, their vice president of research asked for permission to publish the problems that stumped them on a website open to the public.

Within months, a patent lawyer submitted a molecular synthesis solution. The individual wrote, "I was thinking of tear gas when I came up with the solution." But tear gas didn't have anything to do with the problem; they "saw parallels to the chemical structure of a molecule" that Eli Lilly needed.[2]

The world is full of examples like this. Karim Lakhani, Codirector of the Laboratory for Innovation Science at Harvard, conducted a series of studies on the platform *Innocentive*. He had problem solvers rate problems on how relevant they were to their own field of specialization, and found that "the further the problem was from the solver's expertise, the more likely they were to solve it." [1]

Human beings are notorious for taking the path of least resistance. Organizations and individuals tend to approach problem solving with primarily a *local search* — using specialists from a single domain and trying solutions that have worked before.[2]

But these blindfolds can shut out alternative perspectives, and they stifle our approach to problem solving.



Add this to your reading list.

Range: Why Generalists Triumph in a Specialized World

The Einstellung Effect: The tendency of problem solvers to employ only familiar methods even when better ones are available.

Principle of Least Effort: The tendency for people to choose the easiest path if there are several options for accomplishing the same task.

Examples of Bias

Confirmation Bias: The tendency to pay more attention to, favor, and/or interpret information in a way that confirms existing viewpoints and beliefs, often ignoring evidence to the contrary.

Recency Bias: The tendency to weigh recent events as more important than past or future events because they are easier to remember, even if the recent events are less significant.

Peak-end Rule: The tendency to remember and judge a past experience according to how it made one feel during emotional peaks, both positive and negative, as well as how it made them feel at the end, rather than evaluating the average experience overall.

In-group Bias: The tendency to assign positive attributes to groups that one is a member of.

Blind Spot Bias: The failure to recognize one's own biases, and the tendency to recognize biases in other people more easily.

Self-serving Bias: The tendency to assign positive characteristics and outcomes to our own behavior while attributing negative characteristics and outcomes to outside forces.

Availability Bias: The tendency to believe that the information we can recall most easily has greater importance or is more likely to predict a future outcome than information that is harder for us to remember.

Hindsight Bias (The "I Knew-It-All-Along" Effect): The tendency to believe that past events were more predictable than they actually were.

Anchoring Bias: The tendency to put too much weight or influence on the first piece of information offered in a situation.

Optimism Bias: The tendency to overestimate the likelihood of *positive* outcomes and underestimate the likelihood of negative outcomes.

Pessimism Bias: The tendency to overestimate the likelihood of *negative* outcomes and underestimate the likelihood of positive outcomes.

Stereotype Bias: The tendency to expect that an individual or members of a group will have certain qualities based on preconceived notions about that person or group rather than judging them based on real facts presented and/or meeting them in real life.

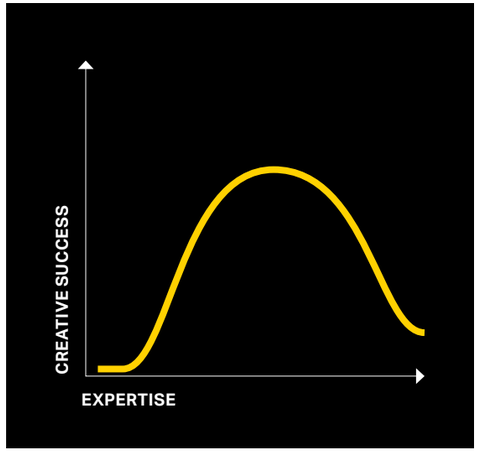
The Halo Effect: The tendency to oversimplify, deciding that if one aspect of a product, system, company, or person is extraordinary, then all of its other aspects must also be.

False-consensus Effect: The tendency to overestimate how many other people think, behave, and share beliefs like we do.

Normalcy Bias: The tendency to believe that things will continue as they normally do, causing one to underestimate the likelihood of a catastrophe and thus be underprepared and unable to plan for one.

Acquiescence Bias (The "Agreement Bias"): The tendency to agree or select a positive response more frequently than to disagree or select a negative response, often seen in survey research.

Go Ahead — Burst Your Bubble



Expertise (and the formal education that often accompanies it) looks like an inverted "U". That is, formal expertise first increases the probability of attaining creative success, but after a certain point it actually lowers the odds. [3]

The reason why perspective can be so hard to come by really boils down to bias. The human brain is skilled at playing tricks on us. The more specialized we become — the more set in our ways of thinking — the more vulnerable we are to hidden blind spots and misconceptions.

The term specialization doesn't just refer to our professions either. It's in the books we read, the experiences we have, the news we consume, our political affiliations — specialization refers to the general concept of narrowing in.

When you narrow in, you are combining concepts within your own purview and then generating ideas that evolve along that same direction.[4]

The best chance we have to shed our own bias is at the intersection of outside perspective and diverse specialties. When we open ourselves up, we not only increase the odds of stumbling upon new ideas, we also increase our own ability to develop solutions that meet the needs of a more diverse audience.

We are problem solvers, designing architecture for the benefit of future generations — but do we really? fMRI studies show that when we plan for our future selves, something weird happens: our medial pre-frontal cortex — the goal-oriented part of our brain — shuts down. Why? **Unconsciously, we see our future selves as strangers, and our brains are trained to believe that the person who would benefit from today's decisions is not the same person making that decision.** We have a hard time naturally empathizing with our future (stranger) selves. And when we think about actual strangers, that part of our brain deactivates.[1] These built-in features of our neurobiology make us blind to what's around the bend.[1] So how can we empathize with strangers for a better future when it's hard to empathize with our future selves? It's all about perspective.

Continue

What Does this Mean for Architecture?

Is snow-clearing sexist? In Karlskoga, Sweden, that is exactly what researchers decided to find out. The way it had always been done — clear major roads first, then local streets, followed by sidewalks and bicycle paths — was logical. That is, until they looked at it specifically from the female perspective.

In Karlskoga, women walk, cycle, push strollers, and travel to work by public transport at a much higher rate than men, who travel almost exclusively by car. The male travel pattern is simple: a twice daily commute in and out of town.[2] Women on the other hand complete several errands on their way to and from work — like taking the kids to school, picking up groceries, caregiving for an elderly relative, or dropping off the dry-cleaning, to name a few. This means that municipal snow removal has different consequences for men and women, especially when you consider that three times more pedestrians are injured in Karlskoga due to icy sidewalks than to icy roads – and 69% of those accidents are women.[2] Annually, this not only results in healthcare costs to taxpayers, but also a 400 percent decrease in business productivity.[2] So by prioritizing drivers (male travel pattern) over pedestrians (female travel pattern) the unintentional consequence was gender inequality.

After this data was gathered, the city realized that three inches of snow is harder to get through on foot than by car and therefore began clearing the sidewalks first — at no extra cost for the municipality. The result? Injuries dropped 50%, saving taxpayers an estimated 35.1 million SEK (around $4.2 million USD).[3] Additionally, car accidents significantly decreased, since later snow removal meant increasing caution while driving.[2]

The snow-clearing schedule wasn't designed to be male-biased — it was simply a gap in perspective. The men who created the clearing schedule are not at fault — they designed around the travel needs they knew best. However, by not considering a different perspective, they spent decades wasting millions of tax-payer kronor, putting pedestrians at higher risk of injury, and excluding the needs of half of their population.[2] What other hidden bias exists in urban design?

THERE IS AN ALGORITHM FOR THAT.

Hannah Rozenberg, a 2020 grad from the Royal College of Art, has created an algorithm that questions gender bias in architectural design. Why? Architects and designers are not consciously bias — but believe it or not, gender is built into the technology our industry uses every day.[4] Building Information Modeling (BIM) uses comprehensive software to both standardize and share data across collaborators — architects, engineers, and construction alike — each generating their own data from their own perspective[5], and creating unintentional data gaps that cross a variety of inclusive design spectrums.

These data gaps aren't intentional. As our use of different software increases, and we begin using data-driven design as part of a more efficient practice, we end up taking on converging project timelines — limiting our ability to seek out every alternative solution. Instead, we rely on precedents, heuristics, data, and design standards that have developed over the last few decades. According to Tversky and Kahneman, researchers in human behavior anomalies, relying on precedent data over multiple generations can lead to designers wrongly anticipating a user's environmental behavior, which in some cases can lead to exclusive instead of inclusive design.[6] It is important that the perspective of the end-user is included throughout the design process, and that we seek to evolve industry precedents — because when "business as usual" remains unquestioned, bias can easily go unnoticed. As data continues to play a larger role in design, interrogating it and correcting it will enable us to design spaces that work better for all.[4]

Data gaps don't just exist in precedents — they can sometimes be found in the very software we use to design. Take virtual reality (VR) headsets for example. Human eyes have two basic cues to determine depth: "motion parallax," how big or small an object seems depending on your distance from it — and "shape-form-shading," the way the shading of a point changes as you move.[7] In the real world, both cues work together to create depth.[8] However, most VR headsets prioritize motion parallax, and neglect shape-form-shading, simply because the built-in retina trackers struggle to simulate the persistent flickering of the retina that registers perceived shading of elements. As you may have guessed, men are significantly more likely to rely on motion parallax for depth perception, while women rely on shape-form-shading.[7] Additionally, headsets tend to default to the average male interpupillary

distance, which is larger than a female's.[9] For these reasons, not only do women tend to experience VR-induced motion sickness at significantly higher rates than men, but because the female and male brains are wired differently, it can actually deter women from registering specific object locations, resulting in disorientation. And because human retinas have more sex hormones than anywhere else in the body (with one exception), these effects are even worse for the **transsexual population**.

These effects are important to understand, as VR becomes more central to healthcare caregiving for patients with dementia. Our retinas are the source of macular degeneration — an eye disease that occurs in two out of three women versus one out of three men.[10] Dementia patients themselves are two times more likely to be women.[11]

In contemporary commercially available VR systems, 40 to 70 percent of motion sickness occurs after only 15 minutes. In some applications, nearly 100% of users get sick.[9]

Understanding our design process from multiple perspectives means that we can begin to uncover unintentional bias built into both our digital and physical worlds — and we can change it. For more than two decades, researchers at Stanford have been exploring VR's immersive capabilities to produce lasting behavioral change. Through first-person experiences that illustrate racism, sexism, homelessness, and other forms of discrimination, VR can produce lasting changes in users: creating a significant shift in empathy and understanding.[1] "People in the majority and minority often see two different realities based on what they do and do not notice. For example, white people might only hear a racist remark, while people of color might register subtler actions", writes Jenny Odell, in her book *How to Do Nothing: Resisting the Attention Economy*.[12] These subtle eye movements and microexpressions provide valuable insight into a user's response their built environment[13] and can be captured in a way that helps us build a better database into our BIM modeling, putting us on the path to removing bias in architecture.[13]

"To seek content is already to acknowledge that you don't have the whole story... Context is what appears when you hold your attention open for long enough; the longer you hold it, the more context appears."[12]

From the hardware that informs our design decisions, to the software that enables us to design urban spaces, and everything in between, it is imperative that we consider multiple perspectives in order to best support the needs of the end user. And sometimes, that may mean architecture is not the solution to the problem. This was the case in 2016, when WaterAid funded the design and construction of latrines in northern Bangladesh villages, as a way to end the practice of open defecation and reestablish access to clean water. The project was executed exactly as planned. However, an evaluation conducted months later revealed that the villagers, who believed these foreign structures were more nicely built than their own homes, had disassembled the latrines, pillaging the materials for their own use.[14] The architects missed the first step: understanding the user behavior. Why would they use such a nice building for something they typically associated with occurring outside? Until the villagers themselves understood how their behavior was affecting their health, the architectural solution was useless. We must see the situation from the user's perspective in order to solve the right problem.[14]

01

MOLECULAR PERSPECTIVES

There are the rushing waves
mountains of molecules,
each stupidly minding its own business
trillions apart
yet forming white surf in unison.

RICHARD FEYNMAN, THEORETICAL PHYSICIST AND NOBEL PRIZE WINNER

What to expect

How can we use our understanding of the smallest perspectives on earth to enhance the way we design?

Imagine if we approached design from the smallest perspectives on earth. From molecules and neurons, to binary codes and waves of light — these objects, given their size, may feel invisible, but ultimately have a significant role to play throughout the design process.

Morphing Matter: A Molecular Perspective

LAUREN JABLONSKI

What would it look like if your building changed shape to keep you comfortable in the sun? How would it feel if the waiting room furniture in your local hospital morphed to reduce the pressure on your injured leg? Would you be excited if you made it to school on time to see the floral welcome wall bloom in school colors before class? If these questions seem like a glance into a distant future, think again.

Researchers are already exploring how to use "morphing matter" to improve the quality of life and space through soft robotics, fashion, human tissue replacement, electrical engineering, food packaging, and architecture that can morph to meet user needs.

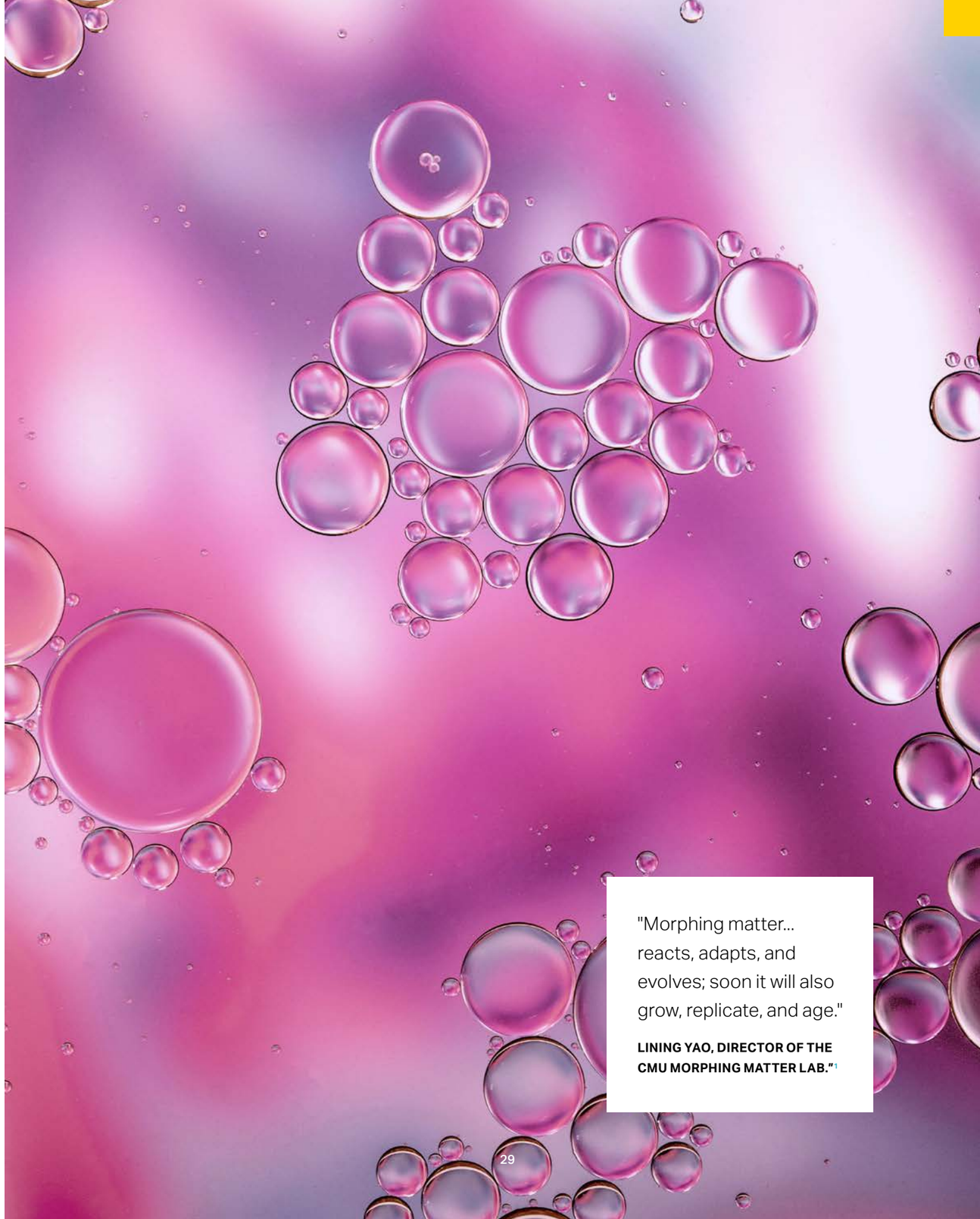
Director of the Morphing Matter Lab at Carnegie Mellon University, Dr. Lining Yao explains morphing matter on Medium.com as a fluid material that "travels across the boundary of the physical and the digital. For people often designing with physical medium, morphing matter adds a flavor of programmability and responsiveness; for those designing with its digital medium, it adds tangibility and sensational experiences." She also emphasizes that morphing matter "adds spatial and temporal dimensionality. It reacts, adapts, and evolves; soon it will also grow, replicate, and age." [1]

Morphing matter innovations transform materials through electrical conduction, robotic programming, bacterial actuation, heat transference, and liquid crystal phase transition (just to name a few). We can view the future of material design from a zoomed in molecular perspective that showcases how matter can transform scientifically, while also fostering dialogue about the future use of technology for physical space, such as self-healing buildings that transform overnight. [2]

To offer concrete examples, we have curated a list of mini-case studies below from leading researchers and engineers across the country.

Artificial Muscle and Tissue Technology

Researchers at Carnegie Mellon University and the University of Texas at Dallas have created an intelligent composite that is furthering the field of soft robotics. Using rubber-like liquid crystal elastomers along with a combination of liquid metal microparticles, this innovation displays human tissue-like functionality including "sensing, electronic connectivity, and shape-morphing." [3]



"Morphing matter... reacts, adapts, and evolves; soon it will also grow, replicate, and age."

LINING YAO, DIRECTOR OF THE CMU MORPHING MATTER LAB."[1]

In an interview with *Phys.org*, research author and Associate Professor Carmel Majidi shared that "just like a human recoils when touching something hot or sharp, the material senses, processes, and responds to its environment without any external hardware. Because it has neural-like electrical pathways, it is one step closer to artificial nervous tissue." [4]

This sparkly, stretchy material is exciting because it conducts heat and electricity and continues to operate even when punctured, just like a torn muscle. The authors hope this design will have future applications in human tissue and muscle replacement, along with a myriad of soft robotic employments.

Scan this QR code to see morphing matter in action

Un-Broken Heart

A new smart polymer has been created by researchers at the Islam Research Group, the Morphing Matter Lab at Carnegie Mellon University, and the Kawahara Lab at the University of Tokyo known as "Self-healing UI." This robotic putty mimics the self-healing properties seen many places in nature including starfish and reptile tails.[5]

> "It's like a computer that you can slice in half, then just stick back together again."
>
> **MARK WILSON, *FASTCOMPANY.COM* ON SELF-HEALING UI."[2]**

The research authors describe their polymer as "a soft-bodied interface that can intrinsically self-heal damages without external stimuli or glue."[5] Initially formed into a heart, when the polymer is "broken" and completely separated, the heart halves are able to come back together and reform while continuously conducting electricity throughout the process.

In another demonstration of this technology, the authors created a programmed piano keyboard that played music even when pulled apart into four unique pieces.[2]

This morphing matter could be used for needs as simple as separating a single bench into multiple extra chairs, or as complex as smart walls that self-erase overnight.

Scan this QR code to watch the heart heal itself at minute 1:39

Bacterially Actuated Blossoms

Researchers at MIT have designed responsive artificial flowers that bloom and change with the addition of bacterial actuation (cause of movement or operation) via Bacillus Subtilis natto cells. Using humidity, touch, and computation, this version of morphing matter is both whimsical and beautiful. It is easy to imagine this technology being used as a new form of simulated biophilic interior design along with many other artistic possibilities.[6]

The research authors created a biofilm from the natto cells; once applied, the biofilm allows the blossoms to expand, contract, and change color in reaction to touch, heat, and humidity sensors.

This same biofilm has been used to automatically open and close air vents in athletic clothing according to the athlete's body sweat and movement. [7] If this transformation can be manifested on a human-sized fabric level, it seems plausible to also imagine using it on a macro-architectural level through patios with automatic sun-shades or walls that vent to produce airflow when indoor humidity gets too high.

Scan this QR code to watch the blossoms (at minute 11:07) and athletic wear (at minute 6:44)

So, What Does This All Mean for Physical Space?

The applications of morphing matter technology appear endless across sectors like education, healthcare, aviation, interior design, and data centers just to scratch the surface. With soft robotics and material engineering innovations that can transform a user's experience according to their physical comfort and temperature needs, a more beautiful, comfortable, and intelligently designed world awaits us.

As we consider what life on the Moon will look like, architects and designers need to examine the role that *lunar regolith* — a collection of particles of dust, soil, broken rock, and other materials found on the Moon — will play in the construction of lunar infrastructure.[1] Scientists believe lunar regolith can be transformed into bricks, which could then store daytime solar energy so that electricity can be produced at night; this would be vital for any humans living and working on the Moon.[2]

The Most Important Solid Substance

JORDAN GILL

I build up castles. I tear down mountains. I make some men blind yet help others to see. What am I?

Sand. It is the most important solid material on earth. How is such a mundane, ubiquitous item so important to modern civilization yet overlooked so easily? Look around you. With certainty, sand has been used to make most everything in sight. If sand is not directly in the final make-up of an item, it surely was used in fabrication process. **Concrete, glass, filtration systems, metal fabrication, masonry, computer chips, roofing, snow control, ceramics, chemicals, the list is endless, and without sand, there is nothing.**

But the catch is, we are running out of it.

Why Talk About Sand?

Sand is nearly everywhere, but not all sand is usable. The Sahara Desert is approximately 3,320,000 square miles of waste in terms of sand production. Desert sands have been worn down from centuries

of wind exposure, essentially rounding each grain. In contrast, beach sands consist of broken-down aggregates and shells which create a composition that is more jagged and thus better for production. It is like trying to build with round stones (desert sand) vs. bricks (beach/water sand).[3]

There are hundreds of miles of exposed beaches in the world, but sand mining is invasive and damaging to the environment. The coastal and riverbank mines that have easy access to production sand are diminishing their resources due to the pace of demand. This is requiring the mining industry to find alternate way to harvest the mineral.

Like the oil and gas industry, the deeper and more equipment needed, the higher the price per barrel. Sand is similar.

Mining companies are having to engineer new equipment to extract ocean floor sand or deep river sand to meet global demand. Whether it is scooped via a front-end loader bucket or vacuumed up from the depths, this process destroys the environment from which it came. Some river mines in Vietnam have destroyed local fishing industries and even caused the riverbank to collapse. **Many countries have now implemented regulation on where and how sand is mined to control the environmental impacts. France, the Netherlands, the United Kingdom, Germany, and Switzerland have banned river sand mining completely.**

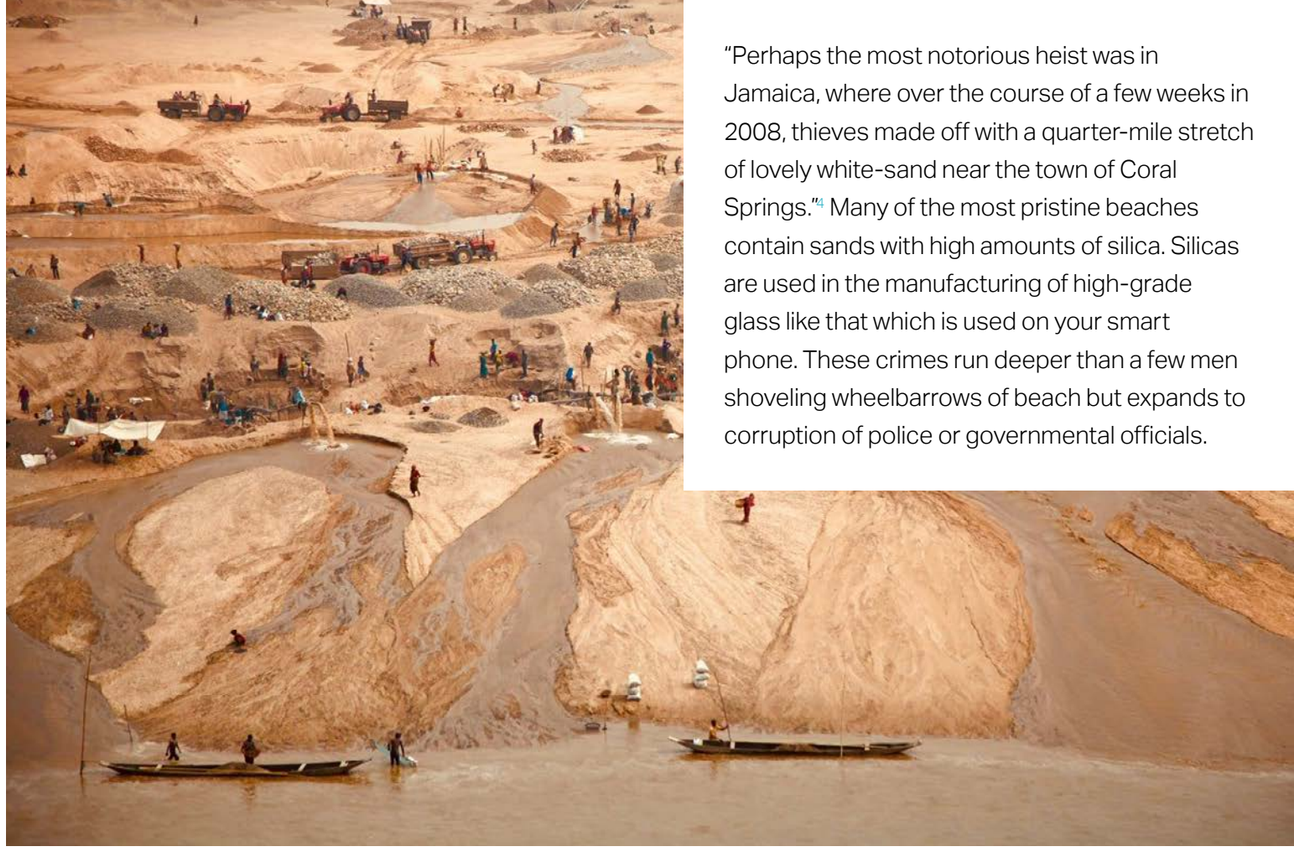
With regulation, however, comes rebellion. This commodity has become so critical to the economy, it has sparked organized crime in many parts of the world. In Vince Beiser's book *The World in a Grain*, he recalls firsthand experience of coming face-to-face with illegal sand mining. Many of these sand syndicates steal the resource and punish anyone who stands in their way. "In an Indian farming village of Raipur Khadar, southeast of New Delhi, a farmer was gunned down while sleeping, because for years he had been campaigning to shut down a local gang. This gang's main means of funding, robbing the village of its sand."[4] In China, Saudi Arabia, Africa, South America, the Caribbean, India, and more people are being captured, terrorized, and murdered to control the sand trade.

The Origin Story

Some scholars believe the ancient Egyptians used a form of concrete in the building of pyramids, though most disagree. The Egyptians almost certainly did use sand, though, to help their bronze saws cut through stone for their monuments, likely including the pyramids.[5] Sand, in fact, has been used for construction since at least 7000 BCE, by the ancient peoples who mixed it with mud to make crude bricks. But by far the most enthusiastic and technically sophisticated users of concrete in ancient world were the Romans.[4]

The Romans found that forming and molding this material could allow for multiple uses. Buildings, roads, aqueducts, baths, this concrete provided a means to construct lasting establishments that could stand the stress of time. "Rome's Pantheon, built nearly 2,000 years ago, is roofed with a spectacular concrete dome — still the biggest concrete structure without reinforcing steel in the world." [4]

Though the ancient Romans were considered masters of concrete, the technology faded with the fall of the empire. It is not known why this material did not continue use, but it was not for another thousand years before the material made its modern-day comeback. Ernest L. Ransome, an Englishman, arrived in San Francisco in the late 1800's where he was exposed to an American inventor, Thaddeus Hyatt who embedded iron bars in concrete-laid sidewalks.



"Perhaps the most notorious heist was in Jamaica, where over the course of a few weeks in 2008, thieves made off with a quarter-mile stretch of lovely white-sand near the town of Coral Springs."[4] Many of the most pristine beaches contain sands with high amounts of silica. Silicas are used in the manufacturing of high-grade glass like that which is used on your smart phone. These crimes run deeper than a few men shoveling wheelbarrows of beach but expands to corruption of police or governmental officials.

Ransome began experimenting with this technology which lead to the patent of this system along with his first large commercial reinforced concrete structure. Though selling this new technology to the construction industry was a challenge, it was not until 1906's San Francisco earthquake where his ideas showed their versatility. His warehouse held up so well against the earthquake and resulting fires, they turned the facility into a shelter for the homeless.[6]

In the following years, concrete began to boom. "From 1902 to 1909, according to the U.S. Geological Survey, the United States' production of construction sand and gravel had grown more than a hundred-fold from 452,000 metric tons to 50 million tons." [4]

Sand Today

Domestically, the U.S. Geological Survey (USGS) and the U.S. Department of Commerce produce an annual report, Mineral Commodity Summaries (MCS). This report summarizes information on events, trends, and issues for each mineral commodity (more than 90 individual minerals and materials in total). This report shares sand (and gravel) in two district categories: construction and industrial. Combined, in 2020, sand and gravel production allotted for approximately $15 billion with mines in all 50 states.

The scope of concrete use is growing exponentially. It is said that the amount of concrete used in a year is over eight times the size of New York City.[7]

In some cases, we are building entire cities without the supply of inhabitants. Ghost cities have appeared in China, Qatar, Italy, India, Turkmenistan, to name a few, where millions of tons of sand band together without purpose. A Washington post article states that China used more cement (a sand product) in three years than the U.S. did in the entire 20th century: 6.6 gigatons (1 gigaton is roughly 1 billion metric tons). [8]

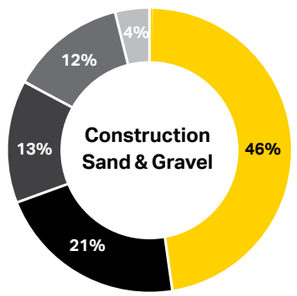
> It is said that the amount of concrete used in a year is over eight times the size of New York City. [7]

Famously known, the Palm Islands in Dubai were created by dredging sand from the adjacent sea and shooting it strategically into a palm-shape to create elite neighborhoods. The World Islands are the next in Dubai's development, where stakeholders can claim a continent or country as their own. A similar sand manipulation technique was done at China's Spratly Islands to expand a military base.

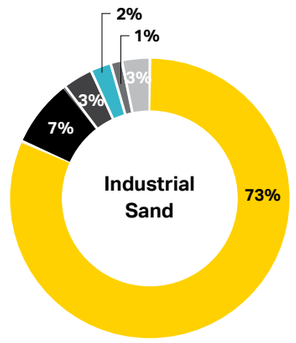
Where do we go from here?

Sand will remain obtainable, but the mining techniques to harvest this resource are becoming more aggressive and consistently destructive. The increase in demand is ever growing but for what purpose and at what cost?

Like all natural resources, the awareness of nature's reaction to human intervention is essential. It is imperative for designers, artists, creators, scholars, engineers, contractors, developers, and owners to discover supplemental ways to react to demand. We, humanity, must rethink what we honestly "need" to survive and thrive. We must want less and live smarter. Bruce Mau states, "don't design for the human, design for life." What better way to understand perspective than to take inventory of the world around you and realize how significant this finite material is to each of us.

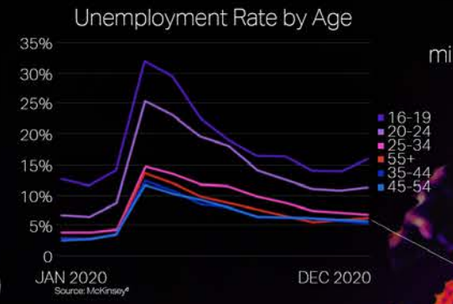


- Concrete aggregates
- Road base and coverings and road stabilization
- Construction fill
- Asphaltic concrete aggregates and other bituminous mixtures
- Concrete products, filtration, golf course maintenance, plaster and gunite sands, railroad ballast, road stabilization, roofing granules, and snow and ice control



- Hydraulic-fracturing sand and well-packing and cementing sand
- Glassmaking sand and other whole-grain silica
- Foundry sand
- Ceramics and whole-grain fillers
- Recreational sand
- Abrasives, chemicals, fillers, filtration sand, metallurgical flux, roofing granules, silica gravel, and traction sand

Dueling Perspectives



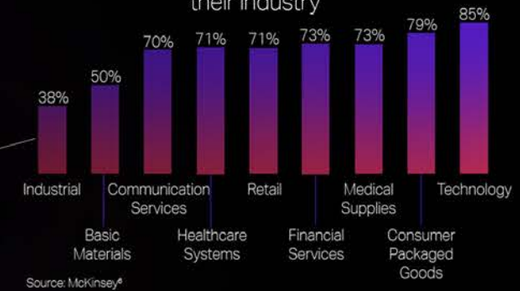
9.8
million jobs lost[2]

90%
of executives believe that the COVID-19 crisis will fundamentally change the way they do business over the next 5 years[6]

The first A.I. model to detect asymptomatic COVID-19 infections through cell-phone recorded coughs is created[8]

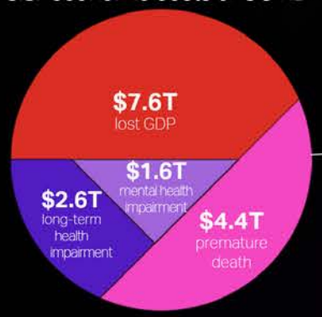
78%
of CEOs believe remote collaboration is here to stay for the long-term, and 80% expecting employees to work remotely part-time post-pandemic[7]

Executives expect the COVID-19 crisis to be one of the biggest opportunities for growth in their industry



71-100
million people are being pushed into extreme poverty[1]

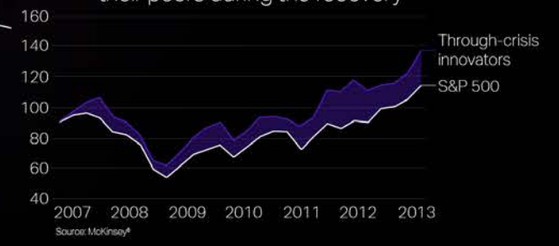
U.S. economic costs of COVID-19[5]



49
pandemic-related retail bankruptcies[3]

#1
San Francisco is the most innovative city in the world during the coronavirus pandemic[9]

History suggests that companies who invest in innovation during times of crisis outperform their peers during the recovery



The cost of mental health impairment could be as high as

$1.6T
People ages 18-34 are the most affected, doubling the rate of people over 50 years old[4]

8 Million
U.S. students learning remotely through hybrid education at the start of the 2020 school year[10]

DISRUPTER

The COVID-19 pandemic has in many ways disrupted our lives. In the U.S. alone, it has robbed us of thousands of our loved ones, our coworkers, and our dear friends. And in its wake, it has fundamentally changed and challenged every aspect of our lives.

Its ripple effects will be felt for generations as we make major shifts from office culture to remote work, move from digital-first to digital-only retail, and opt to visit our doctors from the comfort of our homes. It's true — the way we live, work, learn, or even how we "run errands" may never be the same.

ACCELERATOR

We can take comfort in knowing that COVID-19 did not cause these revolutionary shifts — it accelerated them. Across industries, we have seen the creation and adoption of emerging technologies, increasing opportunities for innovation — while at the same time exposing gaps in access across our communities — creating an emerging entrepreneurial market focused on democratizing technologies for the benefit of *everyone*. The scale, complexity, and urgency of today's challenges will demand new perspectives to guide us toward a better future.

From *The Future is Faster Than You Think*, by Peter Diamandis and Steven Kotler

Why Does Longevity Matter?

"[Our initial] thirty-year lifespan... held constant from the Paleolithic Age to the front end of the Revolution. During the twentieth century, marvels such as antibiotics, sanitation, and clean water extended our average age to forty-eight years by 1950, then to seventy-two years by 2014. [Since then, our ability to recognize and treat the two largest killers — cardiac disease and cancer — has us living routinely into our eighties. And when we tackle neurodegenerative disease, research shows we can expect average lifespan to reach and perhaps exceed 100 years]. [1]

[These] days, Ray Kurzweil and longevity expert Aubrey de Grey have begun talking about "longevity escape velocity", or the idea that soon, science will be able to extend our lives by a year for every year we live... This helps explain the increasing investments being made into anti-aging technologies, with Google's Calico [being] perhaps the most visible example...[and] as we've seen with every other accelerating technology, it isn't long before the benefits become demonetized and democratized. And this means that possibly you, and definitely your children, will have the potential to tack decades onto your lives, simply because, as time passes, all of us will intercept a gaggle of anti-aging technologies along the way." [1]

Anti-aging drugs passed human trials for first time on February 13, 2019.[2]

While this may seem like a future that is lightyears away — it isn't. Studies conducted by Kurzweil and de Grey project put longevity escape velocity somewhere between 12 and 30 years away. Add to that a recent study by Samumed, a company blazing the trail in medical research and development for tissue-level regeneration, where they successfully created new, younger cartilage in patients with osteoarthritis — bringing us a few steps closer to curing arthritis, which affects 350 million people worldwide.

"'The molecule stays [there] for about six months,' explains Samumed CEO Osman Kibar, 'during which it [stimulates] stem cells to grow new cartilage. And that new cartilage is that of a teenager... An injection of the same molecule into the spine of rats whose invertebral disc has been destroyed regenerates a whole new disc.'" [1]

But I still ask, why does longevity matter? "Longer lives means more time spent at our productive best which means more innovation" [1], writes Diamandis and Kotler. Not only will longer lives enable us to innovate, it will necessitate innovation. With more years in our lives, we will travel more, live even more densely, need more food, work for even more years, and finally be forced to reverse our impact on climate change — or start over on another planet. This molecular discovery will change our world — are you ready?

Add this to your reading list.

The Future Is Faster Than You Think

HOW CONVERGING TECHNOLOGIES ARE TRANSFORMING BUSINESS, INDUSTRIES, AND OUR LIVES

02

DIMENSIONAL PERSPECTIVES

“Today, your cell phone has more computer power than all of NASA back in 1969, when it placed two astronauts on the Moon. Video games, which consume enormous amounts of computer power to simulate 3D situations, use more computer power than mainframe computers of the previous decade. The Sony PlayStation of today, which costs $300, has the power of a military supercomputer of 1997, which cost millions of dollars.”

MICHIO KAKU, *PHYSICS OF THE FUTURE: HOW SCIENCE WILL SHAPE HUMAN DESTINY AND OUR DAILY LIVES BY THE YEAR 2100*

What to expect

As we design for the 21st century, how might our understanding of multiple dimensions change the way we perceive the world around us?

The world is made of different dimensions — length, width, depth and, some might even say, time. Dimension is how we explain the ability to move through physical space. It's how we perceive certain aspects of reality. And these dimensions exist in relationship to one another. The emergence of digital and interactive design poses some interesting questions for architects.

Cyclegan and Convolutional Neural Networks

BRADLEY BOWMAN

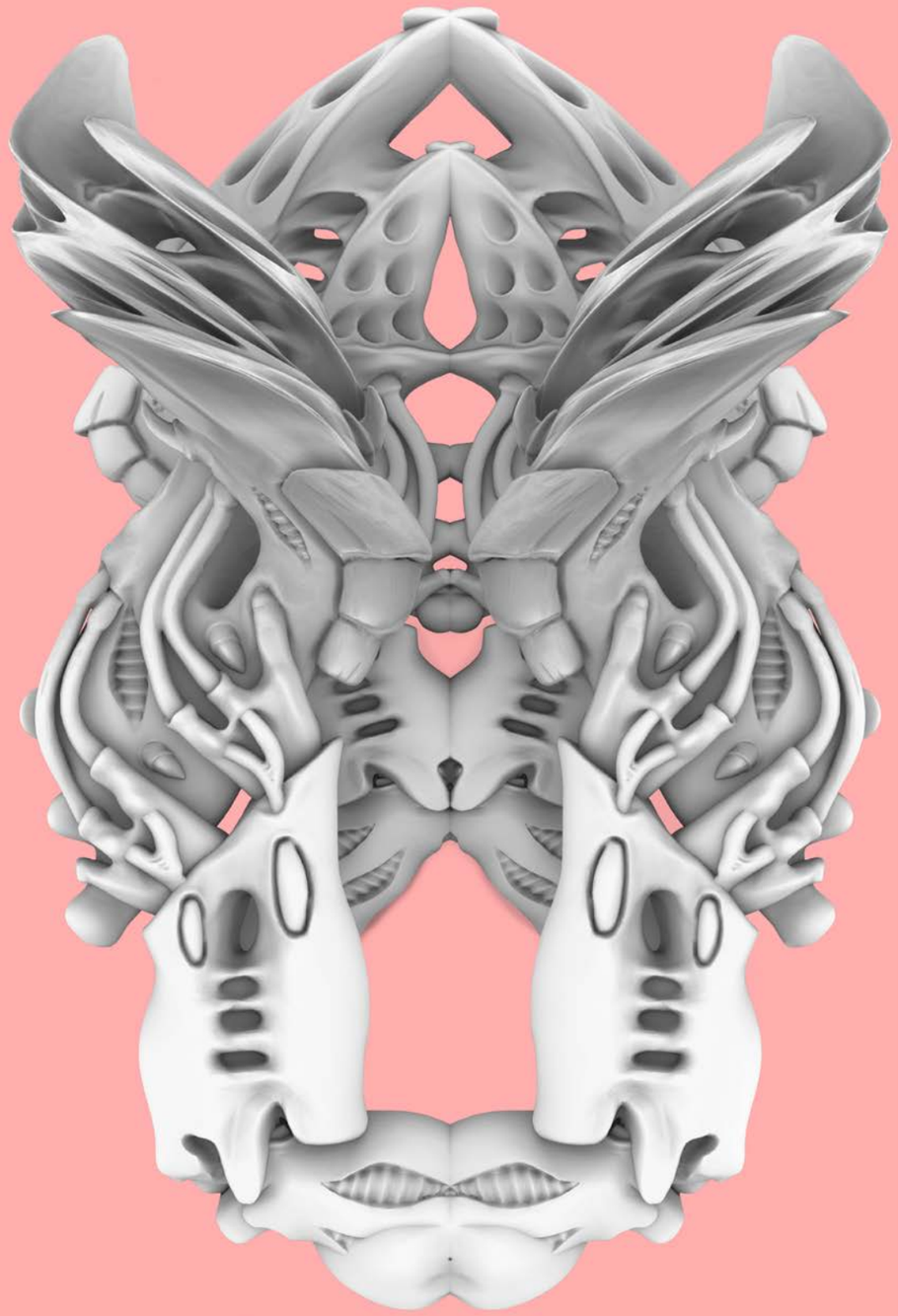
In the past decade, and most notably the past few years, Artificial Intelligence (A.I.) has seen a revolutionary transformation. No longer is AI viewed as an elusive technology reserved for Silicon Valley companies, like Microsoft or Apple — each with a team of programmers and an array of servers.

What once required an incredibly advanced degree in Computer Science has now been democratized through the use of free resources (like OpenAI and DeepMind) and free software (like Tensorflow, Torch and IBM Watson), coupled with free and relatively cheap platforms (like Periscope, Google A.I. and AWS), all of which have made A.I. extremely accessible and easy to use for artists, designers, craftsmen, and architects. Today, each of these design communities are facing a paradigm shift — and those taking advantage of relatively new A.I.-enhanced design tools are reaping the benefits.

AI is often lauded for its administrative and production benefits that leverage machine intelligence to tackle repetitive and monotonous tasks that begrudgingly steal designers' away from their true passion: artistic expression. However, much of the software we use today leverage low level AI, integrated within software commands, as a drafting companion to tag doors, automate dimension strings and compile photogrammetry scans quickly, efficiently, and without a second thought. In this case, AI is just that — a companion tool that reacts to our command. But AI has many roles to play. It can be an influential partner in the design process, leading us towards more impactful and thought-provoking solutions.

How can Artificial Intelligence be injected into a designer's workflow to augment the creative process and add accuracy and value?

A few weeks ago, I was given the assignment to create a finish schedule for a project. I was given two reference projects we completed in the past and was told to use them as a basis-of-design. I started looking for room names — Restroom; Conference Room; Open Office; etc. etc. Next, I looked at what finishes were called out in each instance. I started to notice similarities between the two reference projects. If both projects used the same finish in a restroom, I was confident that given the same client and the same project type that 90 percent of the time, the same finish would be used in this project. My intent then, was to get a finish schedule completed and work through it with a colleague to determine if I was right or wrong.



AI in the Medical Industry

To understand why architecture is on the edge of a massive paradigm shift it is important to understand how other industries are redefining procedures and methodologies through the implementation of A.I. The medical industry with a market share of 17.7 percent of the United States GPD has been the breeding ground of remarkable A.I. research and development. Patients with specific strains of cancer will see a 91 percent survival rate, when detected in the early stages, and in stark contrast, only 11 percent if detected too late. Sufficient growth in cancerous tumors can occur between medical examinations once cancer metastases, and the difference between discovering cancer at the first checkup or the second checkup 6 months down the road can be life or death.

With the American Cancer Society reporting that 1 in 5 Americans will die from cancer in their lifetime, quick, accurate, and efficient identification is the single most important factor in saving patients' lives. Today, researchers in South Korea are implementing Convolutional Neural Networks (CNN) in breast cancer scans, which is a form of AI designed to learn convolutional parameters (hidden layers) from a set of available data. When given a set of data, CNNs can identify similarities between specific data points, making it ideal in tasks of classification, segmentation, and object detection — it is the same technique that uses your reCaptcha "pick each image with a stop sign" confirmation data to train driverless cars, or the system that Facebook uses asking "is this you?" after your mom forgets to tag you in an embarrassing photo.

The researchers at South Korea use CNN to compare the effectiveness of A.I. detection of breast cancer in tissue samples to a radiologist's ability to detect of breast cancer. Using a dataset comprised of over 200,000 annotated breast scan images — half of which were healthy while the other half contain tumors — researchers trained an A.I. model to identify features that deem a patient to be healthy or to have cancer. Once trained, 320 cases were examined by 14 radiologists as well as the A.I. Model. The A.I. model outperformed the radiologists with a 94 percent success rate, compared to the radiologist 81 percent success rate.[2] Out of the 320 cases, half of which having breast cancer, 60 patients would have been sent home with a false test result, compared to only 20 people when A.I. was solely used to identify tumors.

In a similar study researchers concluded that a two-step process, utilizing AI and human intelligence could correctly identify breast cancer with an effectiveness of 99.5 percent. Simply by having an AI classifier run through scans, classifying scans as True Positive (cancerous), False Positive, False Negative and True Negative (not cancerous). False Positive and False Negative determinations, scans where the AI acknowledged it was uncertain, were given to pathologist who examined the data and offered their professional input in identifying cancerous scans. The results clearly show that integrating deep learning-based approaches into the workflow of a pathologist will drive improvements in the accuracy and clinical value of pathological diagnosis. [3]

A task that requires designers to look at multiple reference projects to identify similarities between one another could be accomplished with machine learning. This is exactly what *UpCode AI* is investing their research in.[1] When given a room name, *UpCode AI* Is developing a model that can predict and assign those names an occupancy class. As more and more designers use the tool, the data set grows, increasing the accuracy of predicted output. At the rate that the AI is learning this design workflow, it will not be long until an output can generate predicted room finishes the moment a room name is entered.

Designers can use similar image mapping approaches used in the healthcare industry and apply the same methodologies for architectural designs. Take, for example, the following image, which was generated utilizing a similar GAN architecture. The source code derives from CycleGAN[4] , the building block for many artistic uses of A.I. This study is an example of *Neural Style Transfer*, a process that manufactures a generated "fake" image by combining the content of one image with the style of another image based on a model trained to mimic the style of an entire collection of data.

The result of the study shown was generated using a training set comprised of images that detail architectural ornamentation and biomechanics. The architecture examines the many layers that make up an image (like RBG values, black/white values, edges, etc.) and finds similarities between the two datasets. Once the model has learned from the two training datasets, the test image gets fed into the model generates outputs that are tested by a discriminator. The process is repeated until desired images are generated, and no distinction between real and fake can be determined. Another GAN architecture was used to upscale the resolution of the output image.[5] The result is images produced from the perspective of the machine.

AI presents a pivotal shift in the role we can play as designers.

During the renaissance, cathedral designers looked at neighboring cities for inspiration, as they sought to build taller and more ornamental churches. Today, designers seek inspiration from websites and social media platforms like Instagram and Pinterest. Tomorrow, as A.I. creeps its way into the architectural design process, the designer can delegate the initial process of concept development to algorithmic models. In the A.I. model seen above, the designer is no longer producing the

artwork; the designer becomes a curator. Just as a curator in a museum controls what visitors sees and, more importantly, what they do not see, the designer manages what the AI model learns and the perspectives from which the A.I. algorithm trains.

By introducing AI into the architect's workflow, fewer mundane tasks will need to be completed by the architects themselves, making way for more creative outputs. This, like many things, is not a black and white field. There's a middle ground somewhere: Designers probably should not drop everything they are doing and #LearnToCode. Architects are not Coders. Architects did not dedicate their lives to writing a foreign language.

On the other hand, rejecting AI as a design tool can limit creative progress and expansion of output. Architects have knowledge and expertise that can embrace A.I. as a partnership, not a replacement, to enhance their architectural perspective.

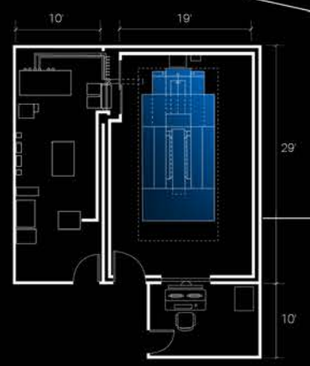
Dueling Perspectives

$2 million
average cost of machine[1]

$1.5 million
average installation cost[1]

$2,000
average cost per scan[1]

30 mins
average scan time[1]



13 ft
average length[1]

12%
MRI scans are terminated due to patient movement[3]

35%
cancellation rate due to long wait, no transportation, anxiety, and high costs[2]

42%
people are afraid of MRI scanners[3]

HOSPITAL

MRI is used by clinicians to diagnose medical problems by spotting abnormalities that could indicate anything from a torn meniscus to muscular dystrophy. It is the best imaging equipment to look at soft tissue, without any known harmful effects to the person. But the procedure increases patients' stress and anxiety, takes a long time, and comes at a high price to cover the expense of the machine, the chemicals, medical staff, and administrative costs. Because of this, the sometimes life-saving procedure is inaccessible to large swaths of the population.

67%
of emergency room visits would be avoidable through the use of preventative virtual consultations, saving healthcare authorities
$32 billion[6]

$1,000
average cost of machine[1]

$0
average installation cost[1]

$2,000
average cost per scan[1]

3 mins
average scan time[1]

1 million x
resolution[4]

Wearables will combine with telehealth services, creating better preventative health measures by
2025[7]

Pre-pandemic, patient adoption of telemedicine in 2020 was up
33%[6]

3/4
of the world will have access to medical imaging they curently lack[5]

4 in
average length[1]

HOME

However, the miniturization of hardware, along with computer vision and A.I. will allow diagnostic imaging to become mobile. Researchers are hard at work developing diagnostic solutions that measure the same quantitative parameters as the full MRI - from the comfort of your own home.

Portable and wearable MRIs are being developed for earlier and less expensive detection of blood clots, internal bleeding, and a host of neuro-logical disorders[8]. Democratizing this access can significantly increase life expectancy, and will change the way we design healthcare facilities.

Tyranny of the Screen: How the Screen has Taken Over our Spaces

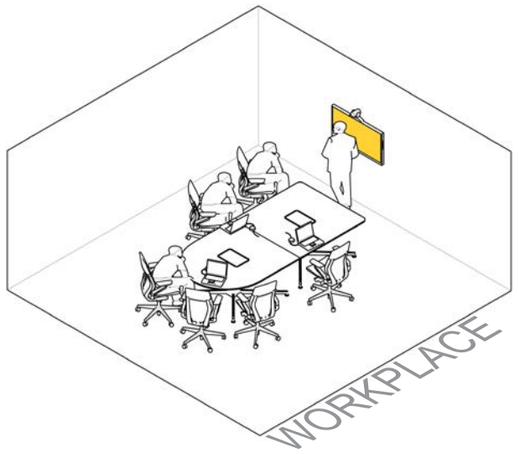
SAMANTHA FLORES, TANIA WHITE, SAM DODD, AND UNMESH KELKAR

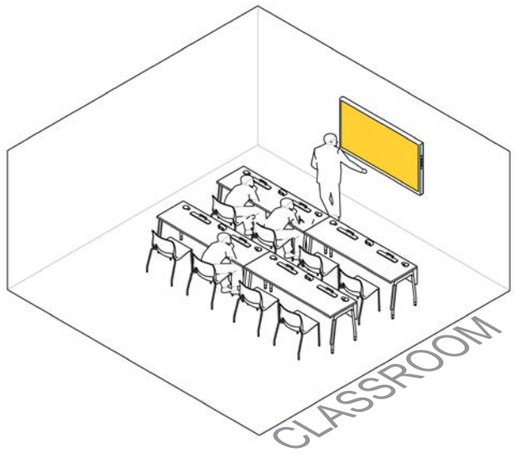
Storytelling and information sharing began around a campfire — a circular formation that subtly engages people, enabling each to communicate at the same gaze, read behavioral cues, and maximize collaborative dialogue. However, centuries of advancements in technologies have fundamentally interrupted natural conversational behaviors, changing the way we design our spaces to foster collaboration, conversation, and the ways we share ideas.

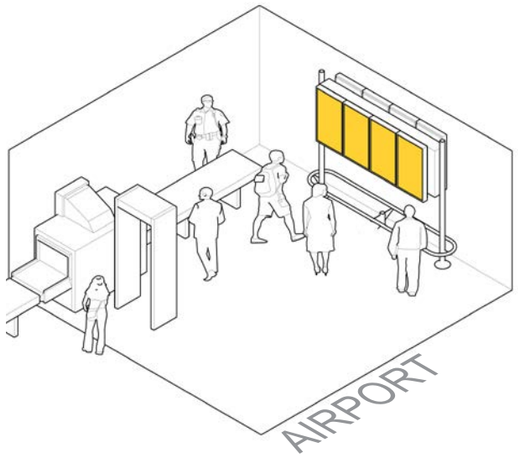
Take for instance books, newspapers and magazines — each were a means of communication enabled to by the technology of the printing press, however reading circles still fostered natural human conversation. The radio, however, offered a new level of intimacy and immediacy – and just as it began bringing nightly news into our living rooms, our furniture and spatial layouts slowly started listening, too.

For centuries, we have enabled technology to dictate the layout of our spaces. The typical conference room is a prime example of how spaces support the technology before the behavior — with remote callers struggling to engage those in the room, as they are typically relegated to a monitor on one wall outside of the "conversation circle," placed above table eye-level, and usually engaged only as an afterthought. Unfortunately this interaction often does more than suppress good ideas from making their way to the table, but can also create bias against remote callers, simply because they are not physically present.

In today's hybrid world, it's our responsibility as designers to foster the behavior first — creating successful collaboration and communication that technology supports, not dictates.



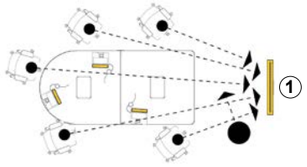


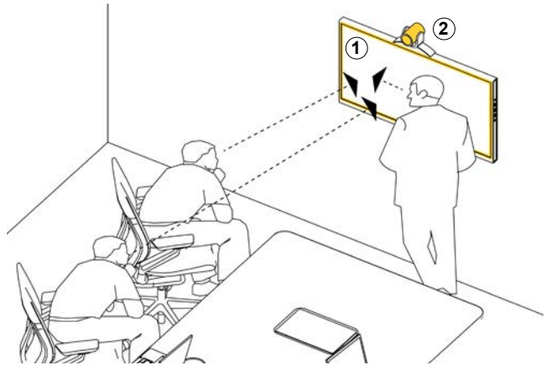


Screens have an inherent limitation: place. Because of this, we are forced to receive our entertainment, communication, or information from a fixed location on a designated wall or surface, impeding the natural flow of collaborative conversation. Circular settings act as a subtle cue for engagement, inclusion, and create the innate reaction of behavioral mirroring. It's a naturally supportive space.

By contrast, arranging collaborators in rows initiates independence, self-centeredness, and naturally suppresses the initial reaction to engage in collaboration – instead, people feel more apt to "one-up" others' contributions.

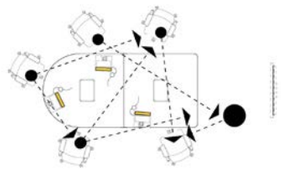
As designers, we carry the load of choreographing spaces that drive conversation, learning, collaboration, and even transactions between people. Our designs have a direct impact on perceived importance of information (are you virtual or in-person?), as well as hierarchy of information (are you able to see the information from the last row?). Although technology may be the problem, it can also be the solution.



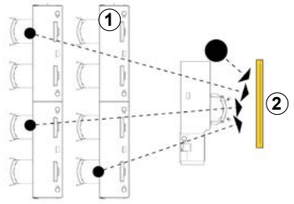


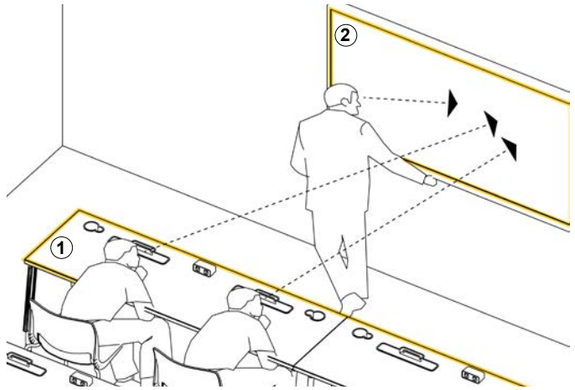
CONFERENCE ROOM

1 - Fixed TV Screen, **2** - Unilateral Camera Angle



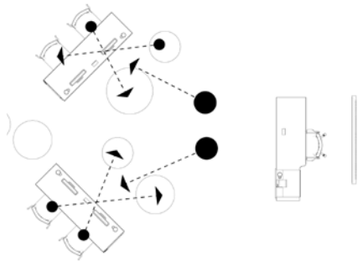
Conversational Behavior



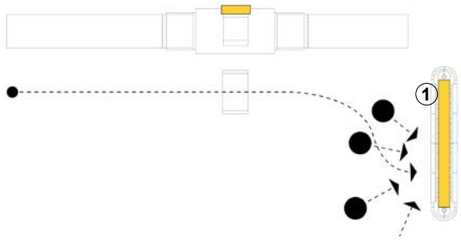


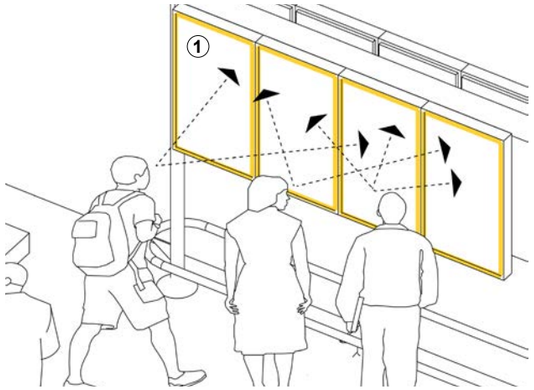
CLASSROOM

1 - Linear desk seating, **2** - Fixed Smart Board



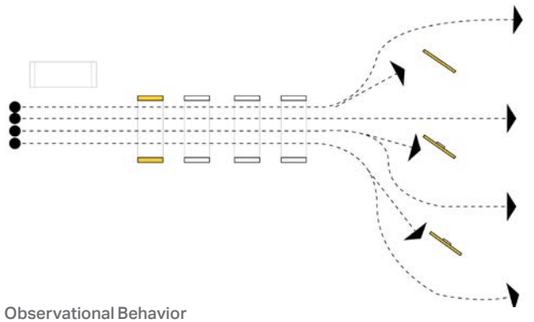
Learning Behavior





AIRPORT

1 - Single fixed screen causing congestion



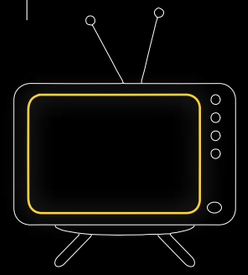
Observational Behavior

NEWSPAPER | 1605

The first official newspaper was printed and distributed in Strasbourg, France. Newspapers soon appeared across Europe, solidifying the contribution of the printing press to the growth of literacy, education, and the far-reaching availability of uniform information to ordinary people.[1]

TV | 1927

The first public long-distance television image was sent from Washington D.C. to New York. People hundreds of miles apart could see and hear each other as if they were face to face. Although momentous, commercial popularity of television took over a decade after this event.[3]



CELL PHONE | 1983

While first demonstrated a decade before, the first cell phone made it to the market costing the equivalent of $7,000 today.[5] However, the first cell phone with internet access didn't come out until 1996. They contained full QWERTY keyboards, had email capabilities, and you could even fax someone from it.[6]

MOBILE INTERACTIVE WHITEBOARD | 2001

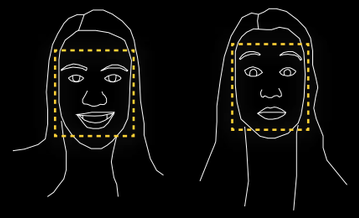
The first fully mobile interactive whiteboard used wireless technology to allow for free movement in the learning environment. In 2009, the same company released a system of remotes and mini-boards that allowed students to interact with the class board from their seats.[8]

AUGMENTED REALITY WORKFLOWS | 2013

Augmented Reality has transitioned from novelty to necessity, by becoming training manuals for new-hires, ensuring predictive building maintenance, and assisting bricklayers with difficult and otherwise time consuming parametric designs. AR is even assisting in surgery enabling surgeons to see a digital display of a patient's internal anatomy as they conduct the procedure.[11]

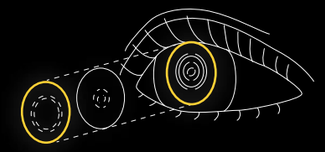
AFFECTIVE COMPUTING | 2016

Originally defined in 1995 as systems that recognize, interpret, process, and simulate human emotions, the recent maturation of affective computing software can identify a face, features, and classify facial expressions into emotional categories, all with a standard webcam[14]. Disney, for example, uses affective computing to read if the rider is bored or excited and changes the digital content of a ride accordingly to improve their experience.[15]



INVISIBLE COMPUTING | 2020

Augmented reality contact lenses contain built-in displays that seamlessly fuse digital information onto the world around its user by understanding their activities and needs. The lenses know not to distract when driving but provide timely information through eyes-up notifications and answers.[17]

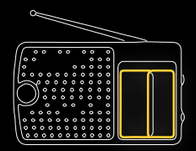


1900 | 1950 | 2000 | 2015 | 2020

Static | Mobile | Dematerialized | Immersive

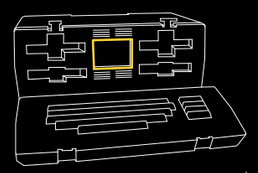
RADIO | 1920

The first commercial radio transmission broadcasted the presidential election results. For years, people could read politicians' words in newspapers, but radio made it possible to hear their voices. Suddenly the ability to engage and entertain was crucial to political candidacy.[2]



LAPTOP | 1981

The first portable computer was created in 1981 weighing 24 pounds with a five-inch screen. By 1988, laptops had evolved into the notebook style that we see today, weighing only 5 pounds, and rapidly grew in popularity.[4]



WEARABLE DEVICES | 2000

Internet-enabled devices became fashion accessories that inspired cutting edge technology of today. By embedding sensors within them, they can measure our pulse, movement, and temperature to deliver a holistic picture of our health. Today, a ring device allows this data to be gathered from a single finger, enhanced by AI, and visualized within an app.[7]

SOCIALLY INTELLIGENT ROBOTS | 2004

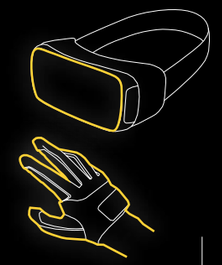
Social robots have been created in many forms. Multi-foot tall robot butlers can navigate terrain and live alongside their owners to accomplish tasks such as checking on a baby in a crib.[9] Others can communicate and collaborate with people by understanding and adapting to their emotions.[10]

HOLOGRAPHICS | 2015

The idea of holograms relied on optical illusions of two-dimensional image projection for centuries until the first 360-degree color hologram technology made it happen without. The process involved a series of high-powered, multicolor lasers diffracting to create a 3-inch floating image above a tabletop.[12]

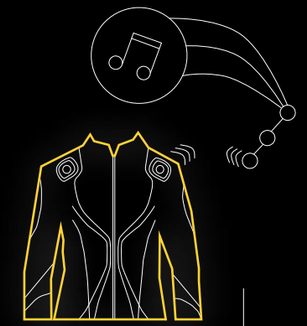
VIRTUAL REALITY | 2016

Immersive virtual experiences have technically been around for decades. The first head-mounted display was created in 1968, but it was so heavy it needed to be hung from the ceiling. Today, the screen is brought to life with lightweight audial-visual headsets, full immersion photorealistic graphics, audial experiences attuned to location, and haptic sensing.[12]



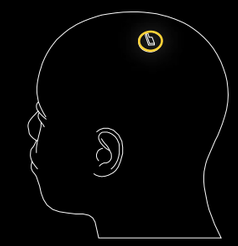
HAPTIC WEARABLE DEVICES | 2020

Haptic devices create touch-like sensations out of conductive pathways that can be embedded into the woven textiles of garments without the need for wires. As micro-electronic circuitry gets smaller, these devices are being used to simulate the feeling of music for deaf people and are paving the way for many more experiential opportunities.[16]



BRAIN-COMPUTER INTERFACES | 2021

Neural implants now on the market enable the user to control a computer or mobile device simply with the thoughts in their minds. This is made possible through micron-scale threads that are inserted into specific areas of the brain that control movement.[18]



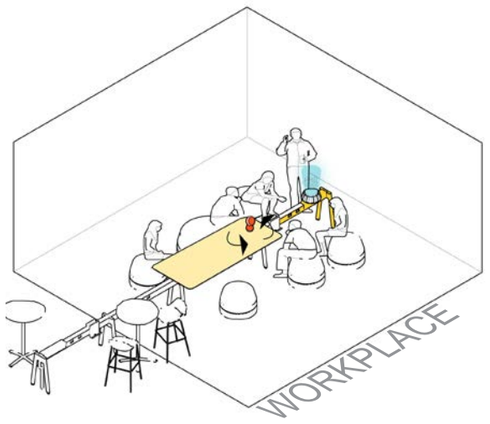
Mobilization

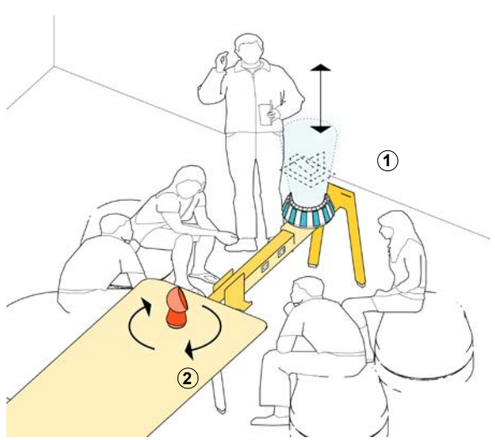
Mobilizing the screen is the first step to changing how, where, and when we can collaborate and engage with digital information — enabling us to move around, recreating natural conversational behavior. Whether via teleconferencing white boards, cobots, or holographic displays, our screens are certainly becoming more mobile, more versatile, and more engaging.

At the Consumer Electronics Show in January 2021, a whole host of mobilized screens were on display. From television screens that flip between vertical and horizontal format — to best showcase content we create via social media — to completely transparent and mobile OLED displays — the way we view content is both shaping and being shaped by our behaviors.

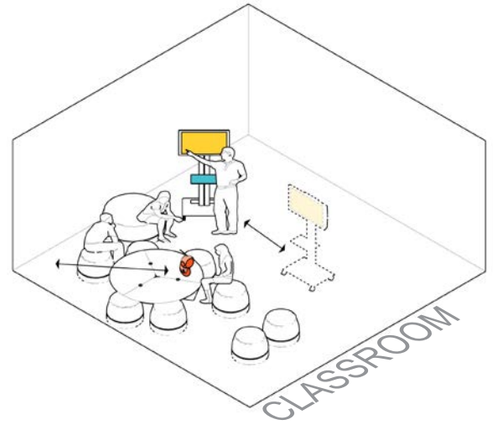
Companies like Missapplied Sciences in partnership with Delta are taking this one step further, changing the way we view personal information on public screens by adapting multi-view pixels to personalize content specific to each viewer, in their preferred language.[19]

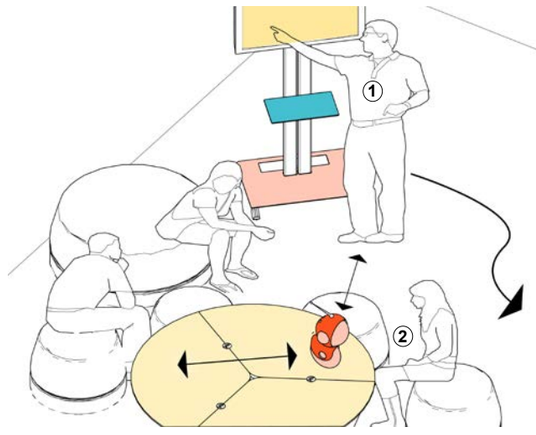
And while all of these solutions take mobilization one step further, that's not where it will end.



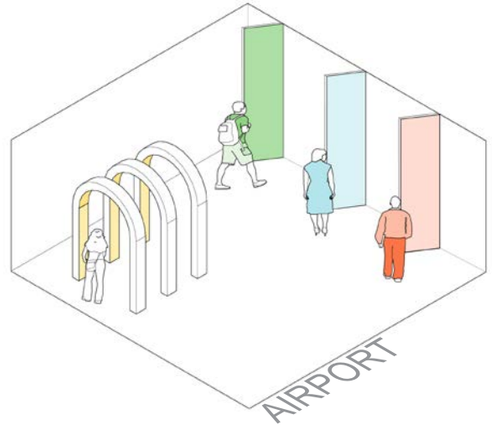


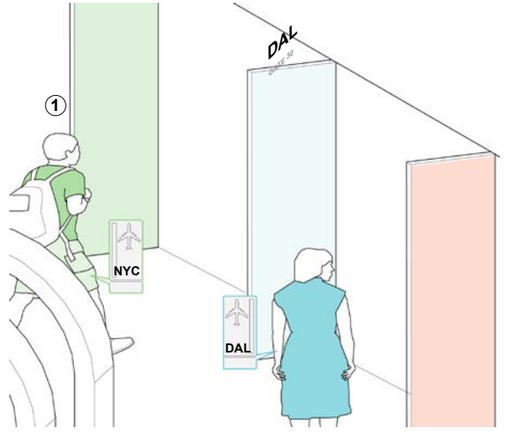
1 - Hologram Projection, 2 - Social Robot





1 - Movable Screen, 2 - Personal AI assistant





1 - Parallel Reality

Various companies are hard at work to completely **dematerialize** the screen.

Pioneers like Mojo Vision are bringing the screen directly to our eyes, using AR contact lenses to project content with no physical surface necessary, while researchers in Sussex have developed haptic holographics — light projections that you can "touch and feel" — that require no screen at all.[17] Add to that the power of affective computing, and you have an environment that is not only devoid of screens, but can sense your emotions, and adjust automatically to enhance your experience — coming to a Disney World theme park ride near you.

By de-tethering our physical environment from the tyranny of the screen, we can once again examine our spaces as places to support natural human behavior, enable collaboration and finally, let us design spaces with technology in mind, instead of around it.

Media Bias: Ground News

Developed by NASA engineer Harleen Kaur, Ground News is an app that hopes to make our news consumption more diverse while educating us about media bias. A recent study from the Pew Research Center found that "Democrats and Republicans live in nearly inverse news media environments." [1]

Ground News is built around the app's algorithm which "culls through nearly 50,000 news sources, determines viability on a number of factors like length of existence, citations in other publications, what they have published already, and social media presence." [1]

Kaur said the biggest challenge in creating an algorithm unlike Google's or the old Facebook trending news column is to "not follow the human instinct to crowdsource reliable news." [2] This crowd-sourced approach to news has a "fundamental flaw because we mistake volume of shares as veracity of news." [2]

Ground News developers acknowledge that "even algorithm writers are introducing their own bias." [2] With this in mind, the app doesn't just present a news story as is, but rather offers multiple points of view.

"In other words, expertise, for all its strengths, can also make it more difficult to break us out of established patterns of thought."

THE MEDICI EFFECT: WHAT ELEPHANTS AND EPIDEMICS CAN TEACH US ABOUT INNOVATION BY FRANS JOHANSSON

What if a City had an Operating System?

ELENA VASILOVSKA, TOM KRUGER, JT JACOBS, AND CAMERON LASSITER

"What strange phenomena we find in a great city, all we need do is stroll about with our eyes open. Life swarms with innocent monsters."
- Charles Baudelaire

The way our cities are designed and built is changing. When we consider the components of a city, we notice various "patterns and layers" that enable such a mechanism to function.[1] However, the most important layer for the 21st century will be the *communication layer* which manages the transfer of information.

This new era in urban life is more tech-enabled and requires faster time management, usage, and consumption, which would in turn, directly impact a city's ability to function. **Can you imagine if, like the software on your smart phone, a city had its own operating system?** A smart grid that functions simultaneously with our daily movement in a fraction of a millisecond. But the question remains, do we already share our existence with some sort of operating system, or is this new reality about to arrive?

"Just like a city shapes the lives of its inhabitants, software shapes the lives of its users."

THE CITY IS MY HOMESCREEN, DAN HILL[3]

In order for an intelligent city operating system to thrive, it must conside two things: new technologies (like edge computing) and rapid population growth. According to the United Nations' 2019 World population forecast, urban areas are projected to become the nucleus for future population growth and migration. The Agenda for Sustainable Development in 2030 report says, "By 2050, the world will be more than two-thirds urban (68 percent), roughly the reverse of the global rural-urban population distribution of the mid-twentieth century." [4]

Edge computing can be described as, "The cutting-edge computing paradigm characterized primarily by its geo-distributed operation, context-awareness, mobility support, and low latency. It migrates computing resources, such as computing power, data, and applications, from the remote cloud to the network edge, thus enabling numerous real-time smart city services." [5]

What is an operating system?

An operating system is the most important piece of software that runs on a computer. It manages the computer's memory and processes, as well as all of its software and hardware. It also allows you to communicate with the computer without knowing how to speak the computer's language. Without an operating system, a computer is useless. The three most common operating systems for personal computers are Microsoft Windows, macOS, and Linux. [2]

The projected growth of urban populations will require the need for better information tracking, processing, and storing. Mohnaty, Choppali, and Kougianos, state that the challenges mentioned above could be solved with an intelligently designed city operating system. They note that, "A smart city is a place where traditional networks and services are made more flexible, efficient, and sustainable with the use of information, digital and telecommunication technologies, to improve its operations for the benefit of its inhabitants, and for better use of resources while impacting the environment less." [6]

> "Cities have the capability of providing something for everybody, only because, and only when, they are created by everybody."
>
> **JANE JACOBS**

Managing the Smart City OS

A Smart City with an operating system could improve the city's collective intelligence as it connects the physical environment with various information-technologies, social interaction and business infrastructure.[7] However, it also introduces certain challenges, such as: how do we work in-network with all the various components while maintaining transparency and personal privacy?

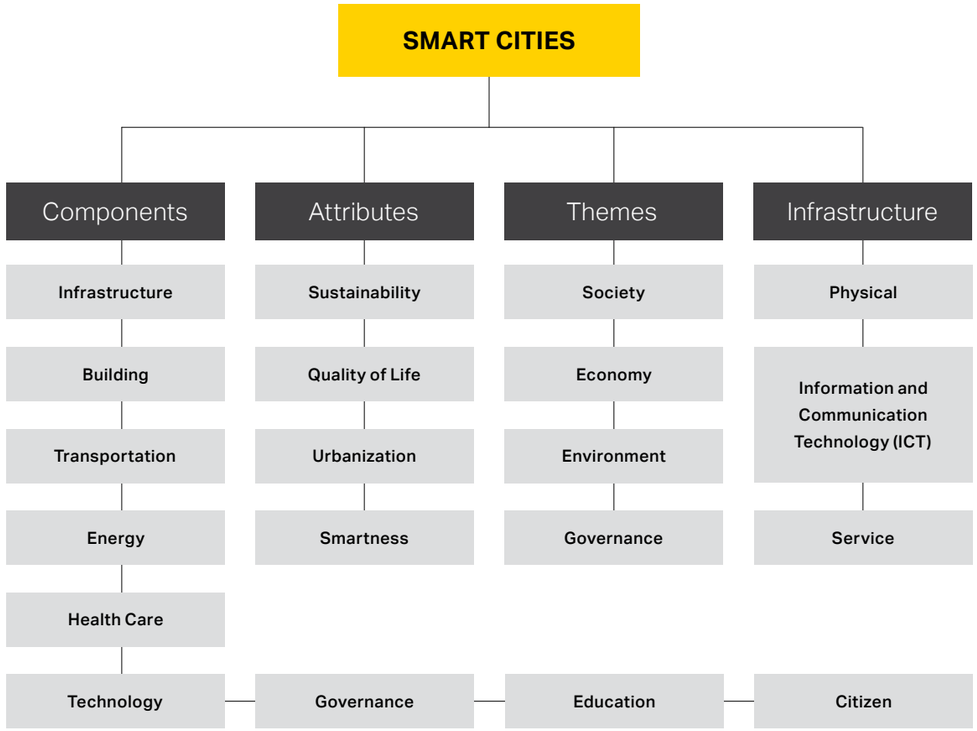
Smart Cities are meant to serve the occupants of the grid but they must be efficiently maintained and carefully monitored. A Smart City is a complex structure. There can be various smart systems acting at once (i.e. smart parking, smart waste management, smart transportation, etc.). These systems need to be linked together within a vertical smart service, otherwise they risk being siloed, truncated, and disjointed.

Data Security

Additionally, one of the most significant challenges of a Smart City operating system is data security and data transfer. The goal is simple: offer the best services in the quickest amount of time with a high level of security and ample storage. Many cities cooperate with big technology companies, like Google, Amazon and Microsoft, which have the capacity to operate with extensive amounts of data across various platforms. But when incorporating a Smart City system among multiple parties, the main question remains: who owns the data and is responsible for supporting community interest.

According to Khan et al., one way to mitigate risks associated with mass-scale computing and data storage is to implement high quality computing hardware with adequate storage capacities. Cloud computing, while it proves to be a robust digital technology that significantly improves the Quality of Experience (QoE), has several downsides when used in smart environments, such as: high latency, processing time inefficiency, non-context-aware behavior, and no mobility support.[5]

Edge computing, on the other hand, is a cutting-edge technology that provides flexibility, scalability, cost optimization, automation, low latency, and nobility support. Its biggest advantage is in its close proximity to micro data centers, enabling systems to rapidly process information with reduced latency. These microsystems within a city grid can serve as its operating system homebase, where speed, privacy, and security are leading priorities.



Source: Everything You Wanted to Know About Smart Cities-Mohanty et al.

What is a Smart City?

Smart Cities are not just where new technologies are born. They are the receptacles for technology; the target of its applications.[8] A Smart City uses different types of electronic methods and sensors to collect data and manage assets, and different resources and services efficiently across different systems like healthcare, education, governance and infrastructure. Smart city application can span a variety of different industries which requires harmonic and centralized communication across different systems.

Climate Change and Pollution Management

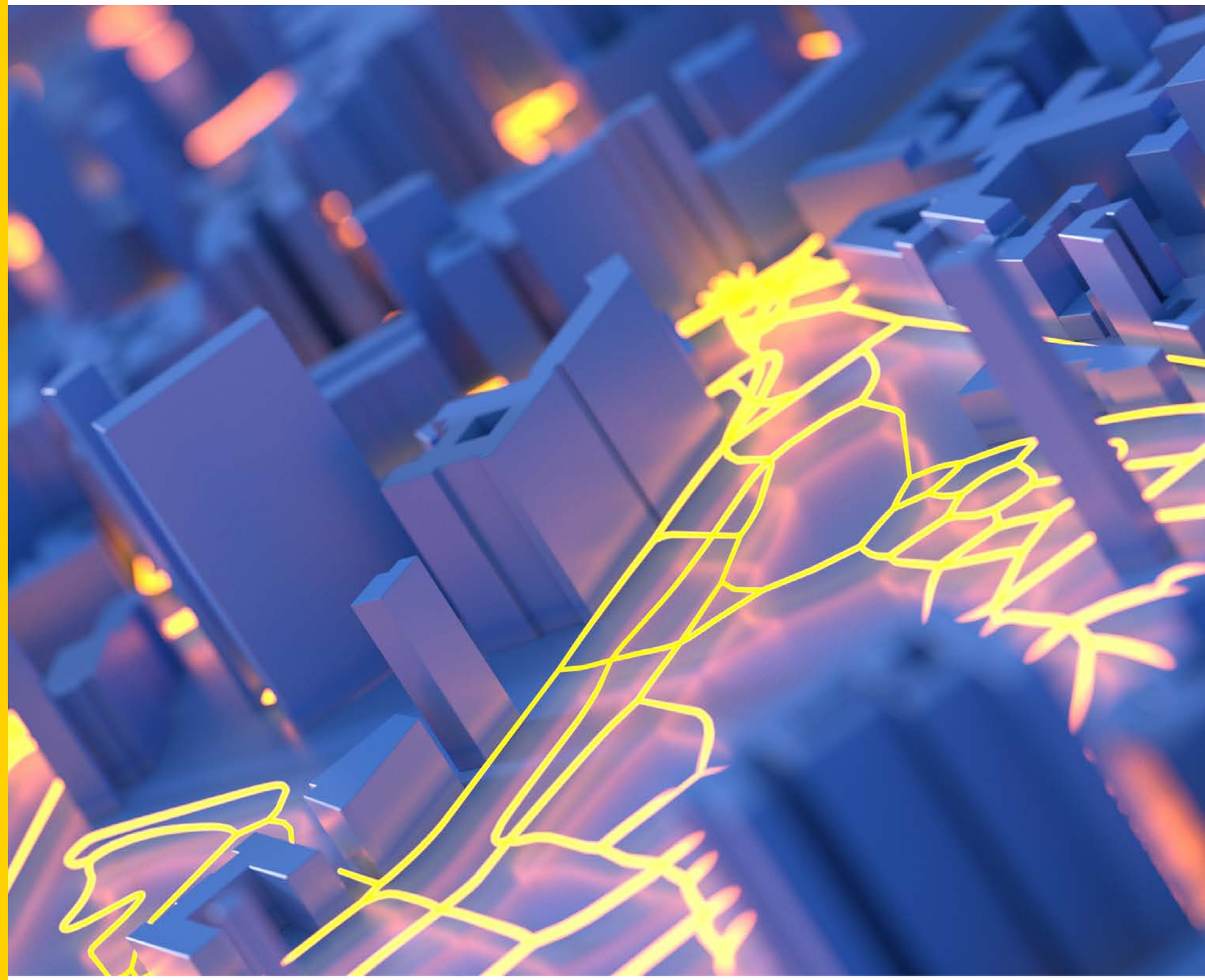
Cities are responsible for 70% of global greenhouse gas emissions, according to a new report from the United Nations Development Programme (UNDP). [9] Building climate-smart cities can involve a vast range of measures, depending on the location's needs — from flood defenses and drainage canals, to electrified transport, and the creation of green spaces for urban cooling. Edge technology in urban areas can also facilitate smart trash removal and waste management systems with trash bins that are equipped with sensors and notification systems.

Parking

Several pilot projects around the United States have incorporated a collection of cameras, sensors and IoT devices to identify open parking spaces. Smart parking solutions can also use predictive data analytics, payment information, crowdsourced information, cellular location data and other information to increase the accuracy of reporting. These integrated platforms require network infrastructure and connectivity that can transfer massive amounts of data in real-time. [10]

Emergency Services

Whether it's an ambulance, a fire truck or a police car, smart city services can help predict when and where the next emergency might occur. While these smart systems seem to provide an objective and scientific way to maximize limited police resources, they have a dark side: the information that guides their predictions is imbued with racial bias. This data indicates where police have observed and prosecuted crimes — information that reflects the disparate ways that police treat different communities. As a result, this predictive policing software overestimates crime in minority neighborhoods and underestimates crime in white neighborhoods. [11] As we develop Smart Cities, these systems must be closely examined to ensure they serve a wide range of communities.



The Digital Twin Smart City

Digital technologies, like the Internet of Things (IoT), edge computing, artificial intelligence (AI), and augmented and virtual reality (AR/VR), are the foundation for Smart City grids and their digital twin counterparts.[13] A Smart City's digital twin is a virtual copy of the city's urban grid, which in this case, includes a robust digital network that collects data via various monitoring technologies.[13]

An example of a digital twin grid is Singapore, which invested $73 million to simulate a live digital copy of the entire city, where citizens can run virtual scenarios before government policies take place. Another characteristic of this system is its ability to implement an Integrated Digital Delivery (IDD) plan where the engineering sector can collaborate and achieve higher standards of design and urban development. [14]

The Smart City and Time

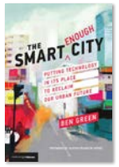
The element of time is one of the most important features to consider with a Smart City grid. The Open Mobility Foundation provides a compelling example that illustrates the importance of time as one of the driving layers in a smart city's digital grid and its correlation with other sublayers in the same system. [15]

Imagine yourself as an emergency vehicle driver who must respond on time to a car accident by traveling from the starting point to the accident scene; however, you have encountered several traffic delays on your way and you arrive one minute late.

But imagine, if instead, we had a virtual traffic simulation that ran on a virtual city grid. In this alternate scenario, sensors oversee the traffic in a matter of milliseconds, and, because of rapid data processing, the system reacts to the emergency vehicle and it arrives safely on time. This smart grid would also enable autonomous vehicles to adapt accordingly within a changing grid so that their physical twins can take appropriate action. [15]

The ultimate goal of a Smart City operating system is to create a robust mitigation mechanism that addresses municipal issues in a concise time frame and collects data that prevents controllable instances in the future. The application of such an approach is broad and complicated. Is this the beginning of the brave new world where we all can control our future in some sort at the pillars of smart algorithmic harmony, or the base for more controlled lives?

Only *time* will tell.



Add this to your reading list.

The Smart Enough City

PUTTING TECHNOLOGY IN ITS PLACE TO RECLAIM OUR URBAN FUTURE [12]

FIWARE

For a smart grid to function, it requires a solid technological foundation. FIWARE is an open-source platform that focuses on defining a universal set of standards for context data management, facilitating the development of smart solutions across different domains. The core component of this initiative is The Orion Context Broker. In 2018, FIWARE was chosen as the Connecting Europe Facility (CEF) Building Block by the European Commission. This system collects, manages, allocates, and provides access to the city's data from various city's layers, which outlines details of the smart city system. [16]

Bettair®

An exciting smart city solution powered by FIWARE is the Bettair® project. Bettair® is a matrix of layered autonomous devices across the city; each device is placed between nodes that range from 0.5km to 1km apart. Bettair® updates urban planners on air quality metrics in specific regions and makes recommendations on how to improve the outcome by mitigating the air pollution in advance. Moreover, Bettair® uses a low-cost air quality sensor matrix that is essential for spatial monitoring in complex environments. [17]

WiseTown

WiseTown, which stands for 'Web Information Streams Enhancer for your Town,' is a smart technology solution that collects information from different streams, detect the cause of the problem, and then solves the issue. WiseTown is a flexible platform that can be used for a variety of smart city solutions such as urban renewal, garbage collection, public safety, transportation, social services, and environmental issues. As part of its service offering, WiseTown also offers a "situation room," which provides real-time analysis and management of singular system occurrences.

A great example of WiseTown's application can be seen in Perugia, Italy, where the city uses a specific feature called Crowd Planning, where, with help from various sensors and data management, allows citizens and government to successfully communicate, adjust and adapt urban project proposals. [17]

Future of Education

SAMANTHA FLORES

The educational system as we know it today — classrooms with desks facing forward, the "sage on the stage" one-way instruction, bells heralding students to transition classes, the standardized testing and grading system — was created in the 18th century to teach children the necessary skills that would prepare them for a life working in the factories.

It's true — the "modern" education model has proven itself to be an idea from a bygone age. Over the past decade, emerging technologies have changed how, where, and when students can learn. Most recently, the coronavirus pandemic has accelerated the adoption of education technology — to which we are deeply indebted for enabling the continuing of education while also slowing the spread of COVID-19.

Technology is not a substitute for in-person learning. The sudden shift from traditional to remote learning has notably increased pressure and anxiety for students, teachers, their families, and communities — **forcing 1.6 billion learners across 190 countries out of traditional learning and causing 24 million children to be at further risk of dropping out completely.**[1] But even before the pandemic, our education priorities felt outdated — the "one-size-fits-all" education model does not work in the era of extreme personalization.

Scan this QR code to watch Sir Ken Robinson's "Changing Education Paradigm" TED Talk animation.

We are witnessing an inflexible education model that is being pushed beyond its limits. And COVID-19 has revealed the cracks. This pandemic is *accelerating* the need to innovate and evolve the learning experience so that all students can have the proper education and support systems they deserve, regardless of location, socio-economic status, age, and abilities. To change, we first must examine two extremely important factors of the education model: quantity and quality.

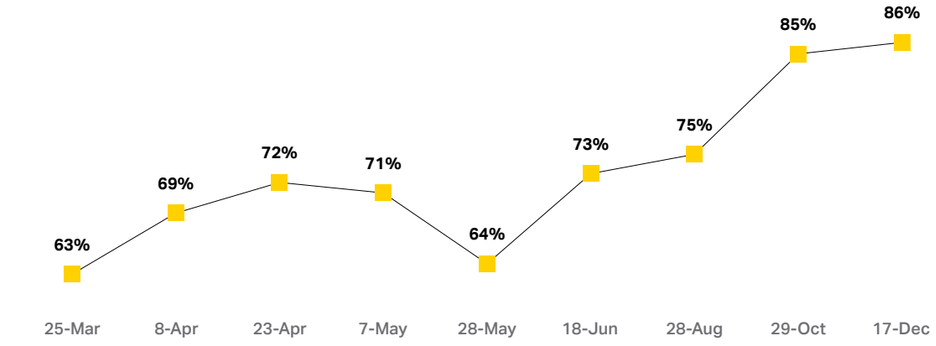
Quantity

UNESCO estimates that globally, 69 million teachers are needed to achieve universal education in 2030.[2] This means that in pre-pandemic America, we were short 1.6 million teachers,[3] and with the loss of more than 1 million jobs in 2020 between February and May due to the coronavirus pandemic,[4] that number rose to 2.7 million.[5] Additionally, enrollment in university courses to become educators has declined nationally by 33% in the past decade, and with some states such as Michigan, Oklahoma, and Illinois, declining by more than 50%.[4]

> 27% of educators still teaching are currently considering leaving the workforce.[4]

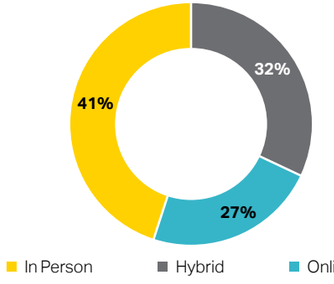
With fewer educators, class sizes — which serve as an important determinant of student success — will likely increase. Ideal class size ranges from 15-18 students total per one educator, and are shown to improve student achievement, graduation rates,

PERCENT OF TEACHERS WHO SAY TEACHER MORALE IS LOWER NOW THAN BEFORE THE PANDEMIC, MARCH – DECEMBER 2020

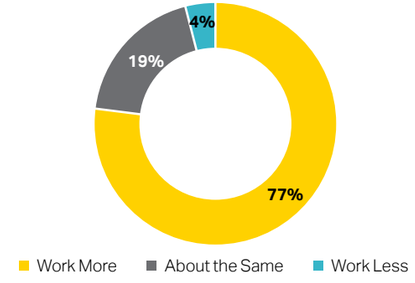


Source: EdWeek Research Center, 2020

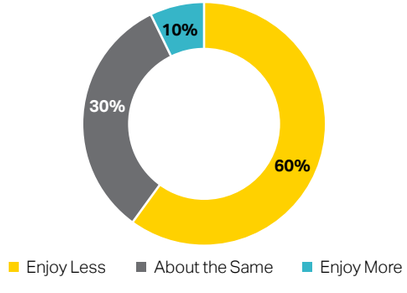
Educators' work environments in 2020–2021 school year



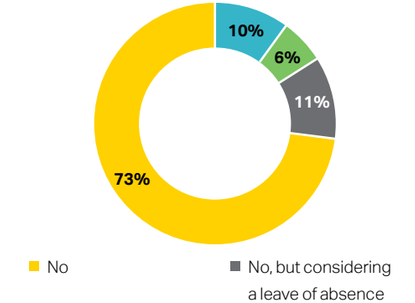
Educators' workload vs. a year ago



Educators' job satisfaction vs. a year ago



Educators' considering leaving profession due to COVID-19



and the development of non-cognitive skills.[7] With an average class size of 24 students in U.S. public schools and 18.8 students in U.S. private schools,[8] our educators continue to be stretched thin, unable to give students the personal attention they need to develop fundamental skills.

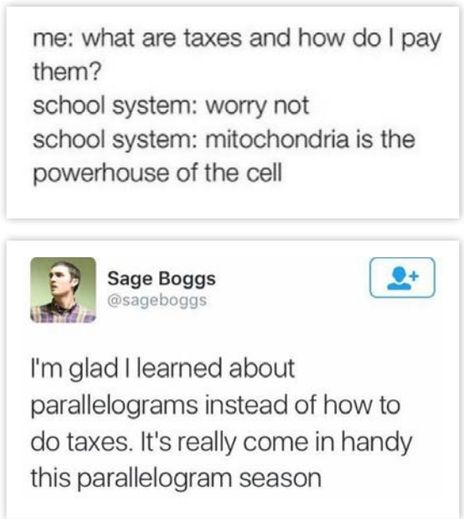
"If [teachers] are not getting recharged, they're not going to be able to teach properly. It's not just a question of looking out for the teachers and their well-being. It's a question of the quality of the education system." [6]

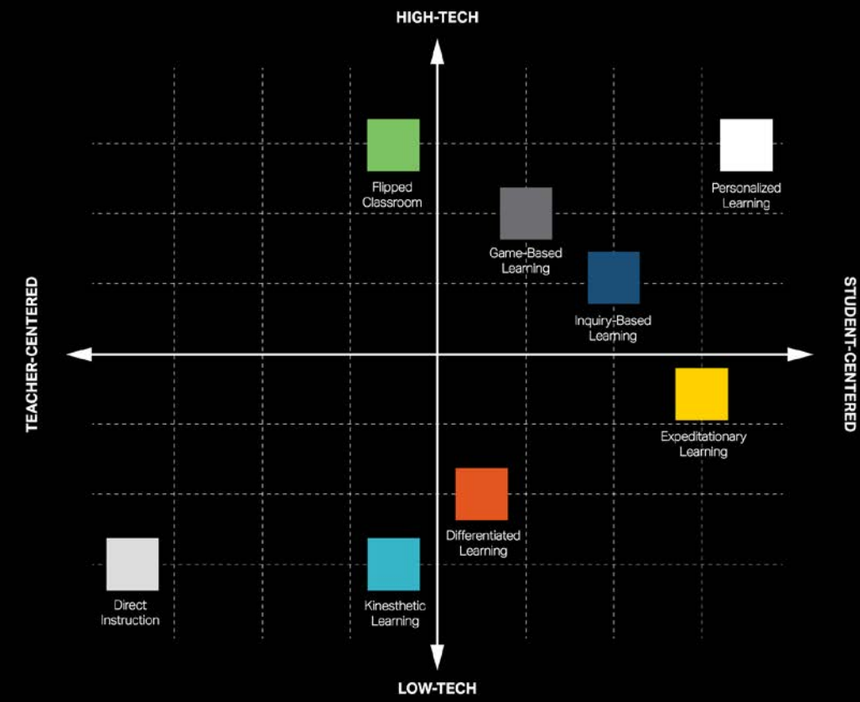
Quality

Overcrowded classrooms tend to divide students into two distinct groups: those who are failing and those who are bored. According to the U.S. Department of Education, 7,000 students drop out of high school every day — that's 1.2 million students a year.[9] 28% of those dropouts lack the confidence to retry a course after falling behind,[10] while 50% cite boredom as the reason they left the education system.[11]

Graduating school, however, may not be the best representation of how well we prepare our students for the real world. Forced to "teach the test," educators report teaching a very narrow bandwidth of skills to help students pass standardized exams — many of which have nothing to do with the needs of adult life.

The one-size-fits-all standardized approach neglects the fact that we are unique individuals who absorb content in a variety of ways — each with varied support systems and a diverse context for our experiences. There truly is no one standard approach to education that can maximize the learning experience for all.





The introduction of mobile technology in the classroom has renewed focus on student engagement. These evolving methods aim to help teachers in search of tools that will help ease, modernize, and tailor education to fit the learning styles of their students.

1. **Direct Instruction** Traditional teaching method that relies on the use of textbooks. Students learn by listening and watching precise instruction through lectures and teacher-led demonstrations during class, and complete personal assignments at home.

2. **Flipped Classrooms** At home, students watch pre-recorded lessons tailored to their level of learning and complete in-class assignments alongside their peers.

3. **Kinesthetic Learning** Rarely based in technology, this method values creativity and encourages hands-on learning that requires students to do, make, or create instead of being instructed.

4. **Differentiated Instruction** Low-tech method tailored to meet individual student's needs, considers how students access content, what types of activities they enjoy, and emphasizes the end-product.

5. **Inquiry-Based Learning** Teacher provides guidance and support for students throughout their investigatory, hands-on learning process, and encourages students to ask questions. Students develop their own education by asking the teacher high level questions and making research suggestions about the process rather than the content.

6. **Expeditionary Learning** A project-based learning style where students experience real-world problem solving in their communities, develop an understanding of the current issues, and work alongside teachers to find a solution they can actively implement.

7. **Personalized Learning** Students follow personalized learning plans that are specific to their interests and skills, enabling students to progress to work beyond their grade level as they master topics, and receive specific help on topics with which they struggle.

8. **Game-Based Learning** Encourages a mastery mindset rather than a focus on grades, and requires students to be problem solvers and use soft skills that they will need as adults by working on game-like quests to accomplish specific goals, earn badges and points, and develop valuable team-building communication skills with their peers.

How We Educate is Changing

What students learn and how performance is measured has become a crucial issue for schools and colleges, making traditional grade progression outdated.[14] Current systemic flaws allow students to progress with the rest of the class, even when they haven't fully understood a particular concept, or mastered course content.

Competency-based models, however, require a higher standard of learning. Using a blend of online and instructor-led learning, they more accurately reflect the diversity and individuality of the learning experience. This ultimately enables students to graduate with a full mastery of skills based on their chosen area of study, making their achievements more robust and attractive to future employers.[16]

This type of "leveling-up" challenges students to learn in sequences that are similar to videogames — advancing to the next level only after all tasks have been completed accurately — and is an incredibly powerful and motivational learning tool. Integrating artificial intelligence (A.I.) and gamifying the competency-based experience could lead to a more enjoyable, tailored learning experience that uses data to augment and inform educators as they develop customized curriculum from each students' unique performance metrics. Other benefits of gamification in education include:

- Improving the rate at which the brain processes and maintains information.[17]
- Increasing classroom engagement, productivity, and peer-to-peer interaction and instruction.
- Increasing accessibility and inclusion for differently-abled students.
- No longer limiting instruction to the hours spent in the classroom. Imagine — getting biology badges for learning the 40 different dolphin species, while on vacation swimming with them!

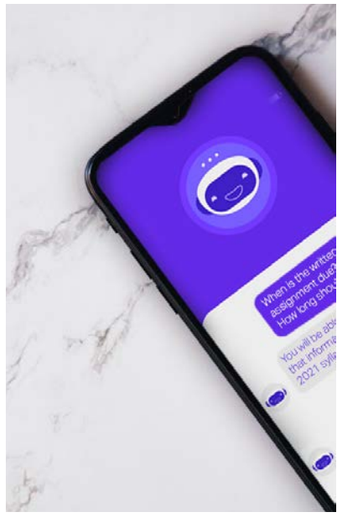
Leveling up as content is mastered creates a much more varied system, with multiple age-groups in one subject, better peer support systems, and a personalized portfolio of metrics to support students as they move into future careers. For this model to become commonplace, the current education system will need to evolve by:

- Removing standardized assessment structures and traditional grading systems
- Encouraging informal learning
- Hybrid in-person and online courses becoming commonplace
- Teacher certification requiring a more diverse education
- Enacting information transparency of performance metrics between parents, students, and teachers

A.I.-driven education models are still in their infancy but are showing incredible promise. Spending just 34 hours on *Duolingo*, for example, equates to an entire university semester of language education.[14] This is just the beginning — an early 2020 study shows that A.I. in education is expected to reach $6 billion by the year 2025.[14] This market will not just focus on performance metrics, but a variety of A.I.-enabled education tools.

Chatbots

Quickly becoming a fundamental tool in next generation education, chatbots are arming educators with new strategies for more engaged learning, whilst simultaneously reducing their workload by providing:



- **Spaced Interval Learning:** Chatbots use algorithms to predict when a student will start to forget what they've learned, setting time reminders for subject matter repetition to optimize memorization.[14]
- **Self-Paced Learning:** Chatbots can track student performance and adjust curriculum to better meet their individual needs.[14] They serve as a guide to help pace learning and manage assessment as students move from one lesson to the next.
- **Immediate Feedback:** Studies show that learners who receive feedback immediately see greater improvement than those who get delayed feedback.[14] Chatbots can respond promptly to questions both during and outside of normal office hours, using programmed answers to frequently asked questions relating to the course syllabus and providing responses with images and links to help guide students. Additionally, essays can be graded with 92% accuracy and returned in a faster time using an A.I., compared to human graders. [14]

Chatbots such as IBM's *Jill Watson* — built in 2016 by Dr. Ashok Goel at Georgia Tech in response to high attrition rates in their online-only courses — not only answers questions, but helps reduce instructor workload. Trained using data from the syllabus and the course's online chat forum, *Jill Watson* responds to technical questions, such as: "what are the requirements for ___?" Using *Jill Watson* has enabled Dr. Goel and his teaching assistants to prioritize their personal responses on the more nuanced, open-ended questions that were previously overshadowed by the shear amount of technical questions. The best part: most students have no idea that *Jill Watson* is an A.I.

"I haven't been able to tell that Jill Watson is an A.I. I think if you can't tell, it's pretty effective, and I think it's a good thing, because people can get help more rapidly."

DURI LONG, STUDENT AT GEORGIA TECH

Jill Watson has visibly improved the social connection between professors and the students, reducing the online course drop-out rate. As hybrid education increases, chatbots will soon be able to create the sense of community and belonging among the online cohort — helping them to connect and form buddy systems inherent to in-person classes.

Cobots

The use of cobots is becoming more common across both workplaces and educational institutions alike. Designed to work in collaboration with teachers — not replace them — cobots have already been integrated into many classrooms, delivering STEM concepts to students. Cobots have gained momentum for:

- **Remote Learning:** Cobots follow action and sound — spinning as much as 360 degrees — and have become increasingly popular in K-12 classrooms, enabling remote students to see more than a fixed shot of the classroom. Online students who use cobots report higher levels of satisfaction and engagement with the course curriculum, as a result of feeling more connected to both the instructor and in-person students.[18]

Robots can also teach in homeschooling settings or areas where human experts are short in supply. In 2019 for instance, South Korea began using *Robosem*, an English language teaching robot, to help students in areas where certified English teachers are rare.[19]

- **Positively Shape Group Dynamics:** Cobots can improve social interaction by encouraging collaboration among young children. Certain cobots mimic human behavior in collaborative conversation, and with a simple rotation and connecting gaze, can encourage shy participants to speak up more frequently.[20] Some cobots can even help mediate conflicts between two people, building on basic negotiation concepts to create resolution.
- **Teach Valuable Skills:** Created to teach children the fundamentals of robotics and programming, *Winky* is the first educational robot proven to improve children's cognitive performance in problem-solving, logic, memory, and concentration, among others. Children first learn to assemble *Winky*, then learn to program and customize their robot — skills that will come in handy as the career landscape introduces more highly customizable career paths in automation.
- **Create Inclusive Environments for Differently Abled Students:** Playing (and learning) with robots can offer special education and other benefits for students with disabilities, helping them to learn necessary social, emotional, and communication skills. Using robots like *Milo*, students with autism can practice these skills without the pressure of interacting with a real person.[19]

XR in Education

Augmented reality (AR) and virtual reality (VR) in the education market is expected to grow from $9.3 billion (2018) to $19.6 billion by 2023, making education the 4th largest sector to invest in VR worldwide.[21] Use of these tools can improve memory and create a deeper sense of empathy in students by:

- **Boosting Learning Potential:** When presented with complex concepts, theories, procedures, and subjects, there is a gap between understanding an idea from written explanations and experiencing something firsthand.[23] Students who learn by textbooks, and in-class lectures have a retention rate of 20% — only able to recall information one

week after it has been presented. By bringing abstract concepts — such as learning how to perform a triple bypass on a patient — to life with AR and VR, the gap closes and brings student retention rate up to 80%, giving them the ability to recall the lesson up to one year after it occurred.[23]

- **Contributing to Inclusivity:** Both AR and VR can help students with various disabilities blend more seamlessly into class activities.[24] Certain devices, like *VR Augmented Aid*, allow visually impaired students to manipulate contrasts, alter text sizes, or add audio commentary to coursework, while *Sign Aloud* gloves enable students to communicate in sign language with immediate translation into human speech[24] — an incredible way help hearing impaired students "speak" with others in collaborative conversations.
- Language translation can be a significant challenge to individual participation when material and assignments are misunderstood, which is why the majority of AR and VR tools offer robust translation tools. To take language learning a step further, AR technology, such as *Microsoft HoloLens*, is using AI to recreate the user's likeness — facial expressions, voice, speech patterns, and characteristics — to then adapt the avatar to the language of choice.[22] This can be extremely helpful for remote video learners in the future.
- **Creating Empathy:** It's easy to reimagine field trips using VR — everyone, including those who would otherwise be unable to attend, can now take a class trip to the Louvre in Paris, thanks to VR platforms like *Google Expeditions*. Google has even created easy-to-use tools for teachers to to generate new, imaginative virtual realities that fit the scope of their lessons.

Teaching with VR and accompanying extended reality tools enables students to fully experience the sounds, smells, and emotions as the subjects of the lesson would be. Rather than reading about the Australian Bush Fires, for example, students can experience the situation from a first-hand perspective, gaining a much deeper understanding of those affected.

When considering the challenges brought on by COVID-19, many educators see AI, AR+VR as the future of an education system that challenges, engages and includes them — and one that doesn't necessarily have to occur within the four walls of a classroom between 8:00 AM–3:00 PM bells. After centuries of classroom-based education, the learning experience is evolving at last.

> "Knowledge and learning are humanity's greatest renewable resources for responding to challenges and inventing alternatives. Yet, education does more than respond to a changing world. Education transforms the world."[25]

Dueling Perspectives

80-200 million
jobs in infrastructure will be in demand post-pandemic to overcome housing shortages, and use of robots will fill a portion of the need[1]

2.6
new jobs are created for every one that is automated[4]

75-375 million
people may need to switch occupational categories before **2030**[1]

8%-9%
of the **2030** labor demand will be in new types of occupations that have not existed before[1]

5%
of occupations consist of activities that can be fully automated[1]

gardeners, plumbers, and both child and elderly care providers will see less automation by

2030[1]

63%
of pre-pandemic restaurant traffic was already takeout, drive-through, or delivery. In 2020, it went up to **90%**[3]

Automation during the **2020** pandemic found that fewer than

30%
of a nurse's tasks can be automated[2]

The robotics market is expected to grow from **$76.6 billion in 2020** to

$176.8 billion
in 2025[6]

Work to be displaced by automation by **2030**[1]
(by adoption scenario)

Slowest	Midpoint	Fastest
0% (10 million)	**15%** (400 million)	**30%** (800 million)

67%
of companies have accelerated automation and A.I. since March 2020[8]

50%
of current work activities can be automated by adapting currently demonstrated technologies[1]

42%
of jobs lost during the pandemic will not return, due to automation[5]

80%
of restaurant jobs can be automated. **This is likely to drive widespread adoption of automation**[9]

Robo-masons lay

1000
bricks per hour[4]

Robots used in retail increased in Q1 2020 by **14%** and

24%
in Q2 2020[8]

HEAD CHEF

For centuries, jobs have been made obsolete by technology. Today, almost every occupation has a proportion of its activities that can be automated. When monotonous tasks are automated, employment in those occupations don't always decline, but instead require workers to perform new tasks[1] — which means spending more time on activities machines are less capable of, such as empathizing, managing people, applying creative expertise, and collaboration.[1] Mid-career retraining is imperative, as people may need to shift occupations and learn new skills in the years ahead.[1] A key factor propelling the market today is COVID-19 mitigation, increasing investments in this area.[7]

SOUS CHEF

Automation can facilitate contactless interactions at a time of social distancing and heightened awareness of hygiene, as well as cost pressures that are arising from the economic slowdown caused by COVID-19.[8] Another plus: robots don't get sick.[8] The service industry was adopting automation pre-pandemic to supplement low labor supply, and meet shifting customer needs, as off-premise dining, and on-demand services were already on the rise.[9] Additionally, history shows that, over time, labor markets adjust to changes in demand for workers from technological disruptions, especially as increased automation allows companies to create new jobs.[5]

03

HUMAN PERSPECTIVES

"Do you ever look at someone and wonder, what is going on inside their head?"

JOY, *INSIDE OUT* (PIXAR, 2015)

What to expect

If we take the time to seek out and better understand the experiences of others, how might we design spaces with more empathy and understanding?

Understanding human perspective can surface insights that lead to previously unimagined opportunities. Everyone has a unique set of experiences and contextual references that make them who they are. The method of studying human experience is equally focused on what is common and ordinary, as well as, what differentiates us as unique individuals.

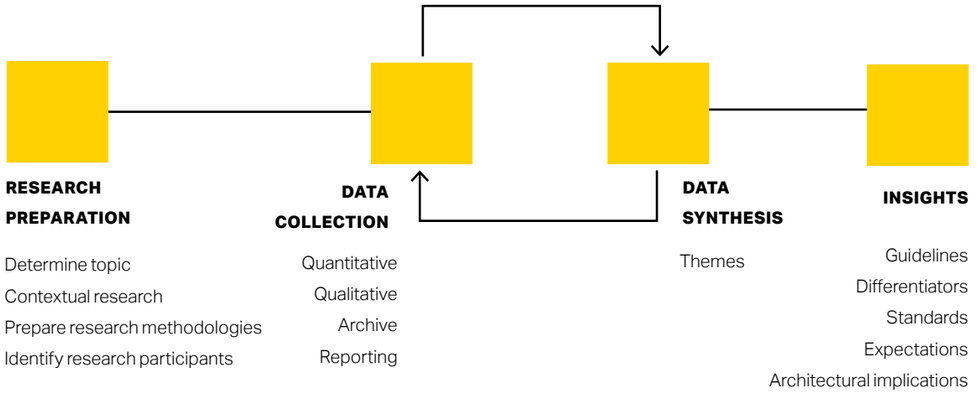
Work. Place. *Blurred.*

EMILY STRAIN, RAE'VAN PARSON, TANIA WHITE, LAUREN JABLONSKI, AND SAM DODD

In September 2020, Corgan's workplace strategists completed a qualitative research study to better understand the work from home (WFH) experience forced upon so many due to COVID-19 and how it compares to working from the office. Sometimes referred to as "thick data," qualitative research studies try to communicate what is meaningful in people's lives. It doesn't just capture facts, but the context of those facts, in order to gain a deeper understanding of people's needs. In this case, Corgan's research team set out to understand what it has been like to work remotely and how this situation could inform future office design.

Using design research methodologies, the team conducted a total of 50 in-depth interviews with workers across the United States. These workers were broken down into two main audiences — those who are working from home exclusively (Remote Workers) and those who are splitting their time between home and office (Hybrid Workers). The study also compared managerial perspectives with individual contributors across both Remote Worker and Hybrid Worker audiences.

During each interview session, participants were asked to discuss productivity related to certain tasks, attitudes towards work-life balance, engagement with co-workers, and their outlook towards career advancement opportunities within the context of their work environment. With almost 20 hours of recorded anecdotal data, Corgan's research team was able to identify insights and emerging opportunities which are documented throughout this article.



INSIGHT 01

Wake up, roll out, sign on

Throughout this research study, participants often reported waking up 10-15 minutes before their first morning meeting, only leaving enough time to brush their teeth and get dressed. While this may provide employees with more sleep and increased flexibility, it also begs the question: how might these remote work routines impact our performance and overall quality of life?

"I used to run in the mornings and have coffee before getting ready for work. Now I sleep in, work out in the evenings and wake up right before work."

REMOTE WORKER

INSIGHT 02

Working from home is like living in the office

When work and home activities take place in the same location, physical, temporal, and psychological boundaries between work and home can become extremely blurred. Throughout this research study, participants expressed difficulty establishing not only physical boundaries, but mental boundaries between home and office life as well.

"I didn't used to check my email after 5 PM, but now if an email comes in at 10 PM I'm more than likely to read it and respond since my work laptop is just 5 feet from my bed..."

REMOTE WORKER

INSIGHT 03

The optics of equity and visibility

As we examine the future of hybrid work, it is important to consider its long-term impact on career advancement and economic development opportunities. In an office setting, our physical presence often communicates a certain level of reliability and commitment to do work on-site. But what happens to your future job prospects and perceived trustworthiness when you conduct your work from behind a virtual screen?

"In the office, they see me work hard so they [my team members] work hard. But when I work from home, I don't see anything and they don't either."

HYBRID WORKER

INSIGHT 04

Innovation is a *place*

One of the structures that supports innovation is the expansion of knowledge through rapid information exchange. During our research interviews, participants expressed a certain level of difficulty when it came to conducting activities related to innovation, such as: pitching new ideas or projects, brainstorming, receiving constructive or rapid feedback, and generating a certain level of "symbiotic energy" amongst teammates.

"It's hard to quantify these random connections: a trip to the coffee shop, a chat around the water cooler where you share details about what you're doing and receive fresh perspective. These interactions can't be quantified."

HYBRID WORKER

INSIGHT 05

The office isn't just about productivity, it's about coming together

When we talk about remote work, we often hear about productivity. However, productivity isn't the only thing that makes us *successful*. There are an assortment of interpersonal relationships and cultural values that can inspire employees to connect with the greater mission and vision of an organization. They are also important for our social development. Throughout these research sessions, participants expressed how remote work platforms, like email and chat threads, make communication feel extremely "formal" which limits how they relate to one another and build working relationships.

PRODUCTIVITY ≠ QUALITY OF WORK

A majority of research participants classified their *productivity* and *quality of work* as two different factors. Their productivity was often related to speed or "time spent working," while quality of work was associated with the general caliber of work.

INSIGHT 06

Not all tasks are created equal

In addition to understanding what people are feeling when they work from home, we were also curious to find out how people are working from home. This includes things like the types of resources needed in order to work from home effectively and the types of tasks they preferred to complete from home versus in the office (and vice versa).

> "Anything that requires human interaction is hard to complete from home."
>
> **HYBRID WORKER**

Tasks People Prefer to Complete at Home	Tasks People Prefer to Complete at Office
High-intensity Focus Work (Individual Contributions)	Group Collaboration
Repetitive Tasks	Brainstorming and Generative Tasks
Email	Rapid Feedback and Communication
Reporting and Documentation	Launching a New Project
Existing Project Work	Larger Meetings (More than 5 People)
Smaller Meetings (Less than 5 People)	Anything that Requires Hands-on Equipment
Individual Phone Calls	Managing Confidential Content
	Onboarding and New Hire Training
	Fostering Relationships

INSIGHT 07

The seesaw of resources

Remote workers also said they enjoyed being able to “control their own environment” in their at-home workspace. This included things like temperature, lighting, and location within residence. However, a portion of these remote workers also said they were incurring their own resource costs at home — from upgraded internet, to higher-than-average utility bills, remote work requires a certain level of individual investment.

> "I've seen an increase in my utility bills. I'm using more A/C and technology for longer periods of time."
>
> **REMOTE WORKER**

Click here to read the full report

The Introverted Workplace

MEGAN HUBACHEK

Are you an introvert or an extrovert? This exchange is a casual attempt to better understand ourselves and the people around us but it is not necessarily a question that is easy to answer.

Introversion is one of the most misunderstood dimensions of personality. It is often associated with being thoughtful or introspective, but research shows that these perceptions of introversion are at best incorrect — and at worst harmful. [1]

Additionally, our modern society demonstrates a bias towards extroverted personality types by rewarding certain behaviors and attitudes related to putting ourselves "out there" and working enthusiastically in teams.

But what can we learn from the introverted perspective about designing office space?

Throughout 2020, introverts and extroverts alike were asked to work from the confines of their homes, both realizing certain comforts and benefits associated with introverted work environments. As we transition out of lockdown, how can we incorporate an introverted mindset to ensure the inclusion of different working styles at the office?

Background

The terms 'introvert' and 'extrovert' were first coined by psychologist Carl Jung in the early 1900's, but it was psychologist Hans Eysenck who further elaborated on them in the 1950's and '60's.[2]

Eysenck described extroverts and introverts by their "baseline of arousal — **introverts need a lot less stimulation to become satisfied, whereas extroverts need a little more excitement.**" Brain scans even provide the physical evidence to back this up, with introverts, on average, possessing thicker prefrontal cortices when compared to extroverts — suggesting that introverts are less impulsive than extroverts. [2]

From an evolutionary standpoint, both introverts and extroverts had their respective competitive advantages in hunter-gatherer days, with less impulsive introverts more likely to stay alive, and adventurous extroverts more likely to stumble upon a new source of food or water.[2]

Today, extraversion-introversion is one of the "Big Five" dimensions of personality, the other four being neuroticism, agreeableness, conscientiousness, and intellect/imagination. [1]

There's not just one way to be an introvert. Introversion is often poorly represented, failing to give us insight into how dynamic introverts really are. According to psychologist, Jonathan Cheek, there are four shades of introversion: social, thinking, anxious, and restrained. And most importantly, many introverts are a mix of all four types, rather than demonstrating one type over the others.[1]

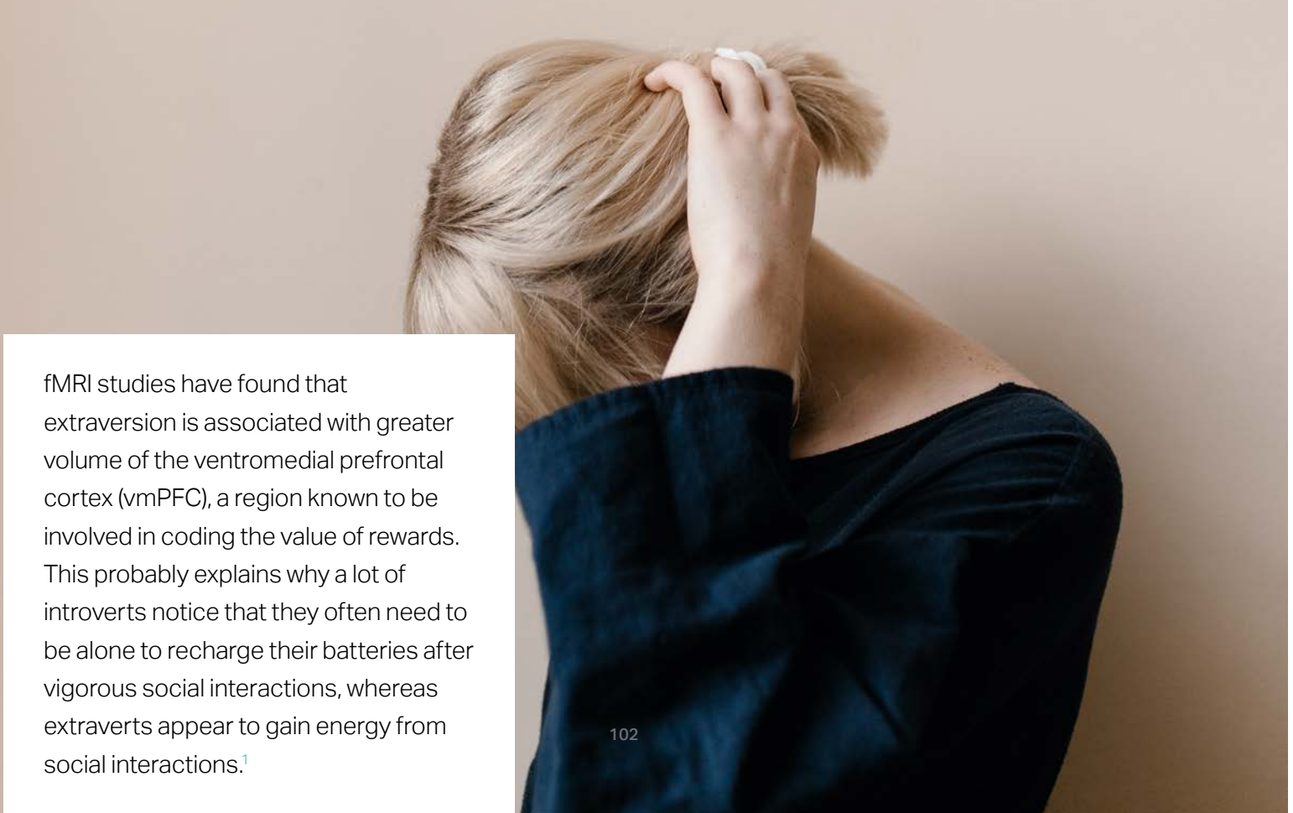
Introverts in the Workplace

The open office, while presenting many benefits for collaboration and the transference of knowledge, possesses additional challenges for introverts who can often feel overstimulated by their lack of privacy.

Introverts are notorious for their ability to adapt as they morph in extroverted settings; however, this behavior comes at a cost. Researchers have analyzed whether acting as an introvert or extrovert can have any effect on well-being. In a study that included 147 people, some of the participants behaved like extroverts for a week — but only the true extroverts among them gained in positive emotions. The introverts suffered when they pretended to be extroverts.[3]

Following this overstimulation and forced adaptation, introverts can become distracted and unfocused. In his article for *Atlantic Monthly* entitled *Caring for Your Introvert*, Jonathan Rauch suggests that introverts require "2 hours alone for every 1 hour of socializing."[4] This would mean an introvert sitting in an exposed open office while absorbing typical workplace noise for 8 hours a day would need 16 hours of solitude to regain their balance.

But what if we could flip this? What if introverts could reenergize during their 8-hour workday?



fMRI studies have found that extraversion is associated with greater volume of the ventromedial prefrontal cortex (vmPFC), a region known to be involved in coding the value of rewards. This probably explains why a lot of introverts notice that they often need to be alone to recharge their batteries after vigorous social interactions, whereas extraverts appear to gain energy from social interactions.[1]

Decades of research suggest that extroverts come out ahead in feelings of contentment and report higher levels of happiness. "There are benefits of introversion," says University of California, Riverside, psychologist Sonja Lyubomirsky. "However, research suggests that extroverts are happier."

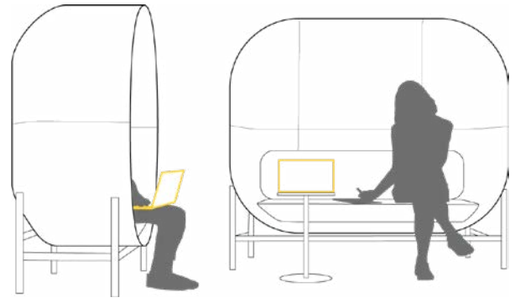
But this begs a bigger question — why would there be a correlation between happiness and extroversion? One hypothesis is that extroverted tendencies, such as being high-energy and outspoken, are highly valued in many societies. [5]

Adapting the Workplace for Introverted Personality Types

Susan Cain, author of *Quiet*, talks about the art of "restorative niches."[6] This phrase — restorative niche — elicits other words like "wrapped," "enveloped," and "tucked away." These words, incorporated into office space design, can help renew energy levels and provide more effective working environments for introverted individuals.

"I think there's the part of being an introvert where people want to be connected to a fabric of other people doing the same, but they just don't want to have to feel forced to interact with them. Which just means that they don't need to be isolated in their own rooms, but they don't need to completely engage all the time either."

MALE 30'S, MANAGER, NY
Self-identified introvert



Cain also cautions introverts against "acting out of character for too long without enough restorative niches." She says, "when you try to take on more than you can handle, you begin to lose interest in tasks that normally engage you."[6] Cain labels the effort to take control of and change emotions as "emotional labor" and says it can result in high levels of stress, burnout, and even cardiovascular disease.[6] The physical health impacts of our workplaces is something introverts know very well as they absorb it throughout the day.

Now, fast forward to March of 2020 and the beginning of an unforeseen shift in the world economy, combined with a fear of person-to-person interaction and the threat of a communicable disease. A subtle force lies within this shift as many introverts have adopted and embraced their home working environments as places of refuge and regeneration. As architects and designers, we have an obligation to respond and adapt, and that includes furthering our workplace designs to meet various types of working styles.

It's a challenge that requires deep reflection in order to develop creative and effective solutions. So, what if instead of approaching this from a collaborative (and albeit, extroverted) design charette, we tap into our pool of introverts?

Place them at the center of this design development where they are uniquely and organically gifted to solve it. Instead of repeating the age-old adage that introverts are "ineffective contributors",[2] ask them to lead the charge as we begin to answer some of these tough questions, and ultimately, design a new path forward that speaks to the heart of who we are as a workforce.

"It is definitely hard to concentrate [in the office]. I have to put my headphones in to listen to music just to drown out everybody else and luckily they let me do that."

FEMALE 30'S, ACCOUNTANT, TN
Self-identified introvert

introverts make up

30-50%

of the workforce[7]

The design principles for the introverted workforce developed by Cain and Steelcase are:[7]

- **Permission to be alone:** the freedom to focus and innovate without interruption from an otherwise highly stimulating workplace.
- **User control over environment:** the ability to control elements of the workspace.
- **Sensory balance:** the ability to control sensory stimulation, often in the form of calming, more intimate influences.
- **Psychological safety:** having the choice of places to be unseen and unable to see others.

What are You?

Take this quiz to find out where you lie on the spectrum.

These 20 items have been found to accurately capture major aspects of the introversion-extraversion spectrum.

Step 1. Rate each item from 1 ("doesn't apply to me at all") to 5 ("really applies to me"):

1. Make friends easily. __
2. Am hard to get to know. __
3. Keep others at a distance. __
4. Reveal little about myself. __
5. Warm up quickly to others. __
6. Rarely get caught up in the excitement. __
7. Am not a very enthusiastic person. __
8. Show my feelings when I'm happy. __
9. Have a lot of fun. __
10. Laugh a lot. __
11. Take charge. __
12. Have a strong personality. __
13. Lack the talent for influencing people. __
14. Know how to captivate people. __
15. Wait for others to lead the way. __
16. See myself as a good leader. __
17. Can talk others into doing things. __
18. Hold back my opinions. __
19. Am the first to act. _
20. Do not have an assertive personality. __

Step 2. Reverse code items #2, #3, #4, #6, #7, #13, #15, #18, and #20 (replace 5=1, 4=2, 3=3, 2=4, and 1=5).

Step 3. Now take the average of all the items.

Results:
If you averaged 3.0 or less, you are probably an **introvert**.
If you averaged between 3.1-3.8, you're probably an **ambivert**.
If you averaged 3.9 or higher, you're probably an **extravert**.

Source: *Will the real introvert please stand up?* by Scott Barry Kaufman, Scientific American

Dueling Perspectives

motion parallax

is used by men to determine perspective, due to thicker retinas[2]

Men employ the left hemisphere of the brain when problem-solving, enabling logic-driven solutions[13]

Males have a thinner parietal lobe, making it easier for them to visualize rotating 3D objects[13]

Females have a larger hippocampus and deeper limbic system than males, allowing them to feel a fuller range of emotions[13]

Women employ both hemispheres of the brain when problem-solving, enabling their ability to empathize[10]

shape-form-shading

is used by women to determine perspective, due to varying blood levels in retinas[2]

Sweden's paternity leave of **16 months** distributes childcare duties, and is directly linked to the increase in female employment to

80%[3]

Female business owners receive **50%** of investment their male counterparts get, but produce

2x more $[1]

80+ hrs
of work per week increases men's risk of developing depression and anxiety[8]

for every **5 hrs**
of extra work per week, the probability of promotion for men increases by **2.5%**[9]

55+ hrs
of work per week increases women's risk of developing depression and anxiety[1]

50+ hrs
of work per week decreases productivity regardless of gender[8]

10° ↑
rise in the typical office temperature would only reduce the cognitive performance of men by **3%**[12]

16,000
jobs **gained** in December 2020[4]

A **10%** increase in male labor force is associated with a decrease in median real wages by

3%[5] ↓

10° ↑
rise in the typical office temperature would boost the cognitive performance of women by **27%**[12]

156,000
jobs **lost** in December 2020[4]

154,000
of those were Black women[4]

A **10%** increase in female labor force is associated with an increase in median real wages by

8%[5] ↑

LEFT-BRAIN

Diversity between coworkers can influence social behaviors, work product, and can drive innovation. By 2025, 75% of the global workforce will be millennials,[6] who will also occupy the majority of leadership roles over the coming decade. While other generations tend to view diversity through the lenses of race, equality, and demographics, millennials have a more granular perspective on diversity — a melding of varying experiences, different backgrounds, individual perspectives, and better support systems between genders.[6] They are also significantly less likely to prefer working with male coworkers than any other generation.[11] Why? Because women lead with empathy.

WHOLE-BRAIN

Women in leadership tend to prioritize work-life balance and company culture, and take on roles that are less likely to soon be automated. Also, cognitive diversity can enhance team innovation by 20%, directly increasing profit.[7] But because women do 75% of unpaid work,[1] the pandemic significantly shut women out of the workforce, causing GDP growth to be estimated $1 trillion lower in 2030, than it would had unemployment been equally distributed.[14] Balancing unpaid work, addressing digital and financial inclusion, and addressing entrenched bias about women's roles in the workplace is extremely important for innovation, the economy, and society as a whole.

Microsoft's Inclusive Design Toolkit

TANIA WHITE AND LAUREN JABLONSKI

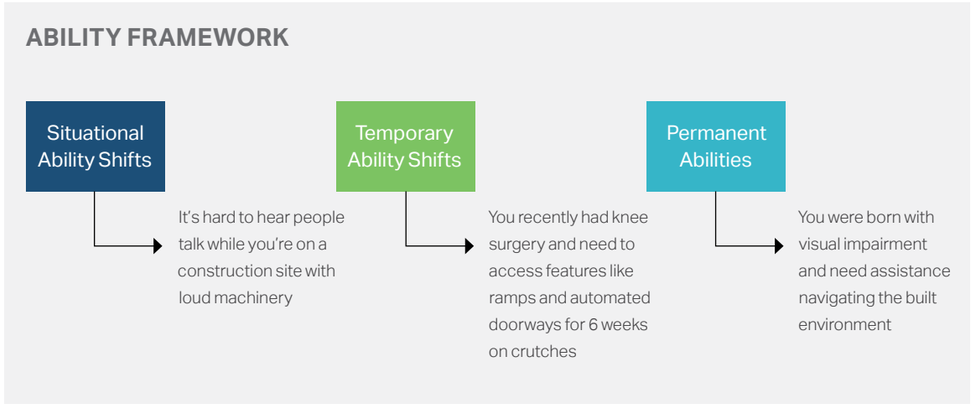
> "Inclusive Design is a methodology, born out of digital environments, that enables and draws on the full range of human diversity. Most importantly, this means including and learning from people with a range of perspectives."
>
> MICROSOFT.COM

Microsoft's Inclusive Design Toolkit was created to help designers of every kind "recognize exclusion." This toolkit is intended to help designers identify their personal biases and adjust their research, design, testing, and recruiting methods accordingly. These measures are outlined in a way to ensure that solutions are created that meet a wide range of user needs in terms of ability, gender identity, racial identity, ethnicity, sexual orientation, age, and class.

At Corgan, we believe in the power and importance of inclusive design in physical and digital space. We strive to be active participants in this dialogue so we may contribute positively to the field of design and make it a more inclusive place for everyone. To do so, it's important for us to recognize the negative impact that historically less inclusive design practices have had, while also learning more about the research methods and design practices that thought leaders are employing to combat exclusive design. There are many wonderful resources that we use to learn and grow in our practice, but we'd like to feature Microsoft's Inclusive Design Toolkit specifically.

As Microsoft notes, inclusive design means learning from a range of perspectives, and we're eager to do so. If you have a favorite resource you recommend or have any feedback for how we can better contribute to the design community, please share them with us at hugo@corgan.com. We'd love to hear your perspective.

The Persona Spectrum: An Ability Framework



Designing inclusively benefits all of society; as Microsoft points out, there is no one version of "normal" when it comes to the human experience.[1] Our unique life circumstances are always changing, along with the way we interact with the world. Throughout history, solutions meant for one specific human problem have expanded to meet the needs of others in different situations.

Kat Holmes, author of *Mismatch: How Inclusion Shapes Design* and former principal director of Inclusive Design at Microsoft, shared one such example in an interview with Knowledge@Wharton. She explained that the first typewriter was created in the 1800's for a blind countess so that she would be able to write private correspondence. Today people around the world benefit from the countess' unique need as they type on their computer keyboards.[2]

Similarly, screen reader technology, closed captioning, and many other innovations designed for a specific need have come to benefit people who were never the intended target market.[3]

While these innovations have proven useful on a mainstream level, it's important to note that it's not only isolating and exclusionary to design around one perspective; it can also be dangerous.

Microsoft's Principles of Inclusive Design[5]

Recognize Exclusion
Exclusion happens when we solve problems using our own biases

Learn from Diversity
Human beings are the real experts in adapting to diversity

Solve for One, Extend to Many
Focus on what's important to all humans

With the advent of artificial intelligence, machine learning, and other emerging technologies automating processes, traditionally marginalized communities are facing insidious consequences of exclusive design such as soap dispensers that do not recognize all skin tones, inaccurate facial recognition technology, and potentially deadly autonomous vehicle algorithms. With stakes as high as human safety, it's never been more important to identify biases and design against them through inclusive methods like those recommended in Microsoft's toolkit.[4]

Kat Holmes challenges every designer to begin by recognizing exclusion, asking themselves "Whose voice is missing from my process and the feedback that I am gathering? Who has the most to lose if I make changes to this solution?"[6] With these questions front of mind, all of us as designers can work to create safer, more useful, more accessible, and more inclusive experiences for everyone.

The Workplace We Want Now

CORY DEAR

In the spring of 2020, companies across the U.S. were faced with the uncertain future of the office-only work, and designers rushed online, eagerly weighing in on must-have safety measures for the new COVID-19 workplace. While at first, introducing temperature checks, hand sanitizer, bipolar ionization, fist-bumps and awkward 6-foot exchanges seemed likely to become the norm, a year into this pandemic has allowed us to examine the true value of both our corporate offices and our home offices.

Currently, a lively debate is ongoing across industries as to whether remote work is a viable permanent solution. For instance, Jack Dorsey, CEO of Twitter, believes his staff can work from home forever, while in contrast, Reed Hastings, CEO of Netflix, believes working from home is "pure negative."[1] Like similar conversations, we tend to paint a stark contrast between the office or the home, asserting one or the other as the ideal workplace. As architects, it's our responsibility to transition this debate from idealism and argument to action that strategically challenges the status quo. We can no longer ignore the fact that our office spaces are burdened with certain traditions that may no longer be relevant to the post-pandemic workforce. How can the office meet the new needs of both employees and employers alike?

Preferences have already surfaced between conducting work at-home or in-office. In Texas for instance, businesses across the state to open to 50% capacity in June, 2020.[2] However, offices were slow to fill, and by early September, Dallas reported 36% workplace capacity (14% shy of the 50% limit), with Austin and Houston lagging further behind at 29.9% and 23% respectively.[3] According to a recent study by Zippia.com, 63% of workers are more likely to want remote work permanently.[4] Corgan investigated these evolving worker sentiments in our recent publication, *Work. Place. Blurred.*, by conducting in-depth interviews with both hybrid and remote U.S. workers, with findings pointing towards a desire for a mix of hybrid and remote options. According to one respondent whose company sent out a flex survey to all employees: "12% said they want to be back in the office full-time, 67% want a flexible working schedule and the rest (21%) want work from home forever." But while employees prefer flexible work schedules, some employers are doubling down: for example, Amazon and Facebook have acquired 1.6 million square feet of new office space in New York City, a place hit hardest by the pandemic.

As the physical and psychological effects of the COVID-19 pandemic subside, workers will return to the office with remote working memories, and the **office must compete with and ultimately offer a preferred alternative to the home atmosphere.** The solution is not binary — and therefore architects must provide a durable strategy for the future workplace that meets the personal needs of those who work there.

The first challenge: we have a history with the office, and must change our thinking. Laden with metrics, tradition, and rules of thumb, workplace design has wandered into formulaic territory, where spreadsheets and proformas throw the first punches. This approach, connected to commodity-based thinking, when left unchecked, yields universal, standardized, and generic built solutions. Can we truly thrive in such an environment, when one space feels just like the one which came before? As we are learning, the most delightful aspects of the home is its ability to be variable, infinitely customizable, unique, and personal.

Our second challenge is that designers, employers, and employees have come to understand the office as a place apart from the home, an environment that counterbalances home life, which obviously carries with it the expectation that workspaces *should* feel different.

Lastly, quantitative, and qualitative examples of the differences between the home and the office abound, but which changes need to be met to provide the best impact? In *Work. Place. Blurred.*, five preferences consistently emerged: alternative postures, food and fitness, focus, user control, and outdoor connections. Enabling our future designs to better respond to these insights may begin to nudge our workspaces towards a more comfortable reality.

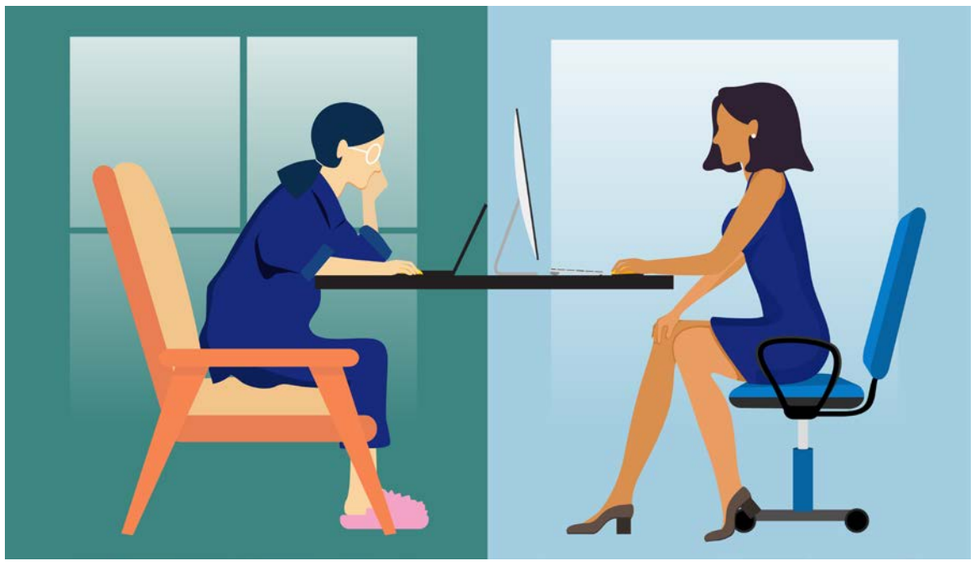
Alternative Postures

Years ago, we recognized the important need to vary body position throughout the day, resulting in a slew of sit-stand desks and adjustable furniture. Employees working from home, however, likely discovered an even wider variety of productive working postures.

> " I really enjoy working from home and being close to family, my dog, and the home-like comfortable furniture that supports variety of postures."
>
> **HYBRID WORKER, MINNESOTA**

At home, it's possible to answer emails from the couch, kick up your feet for deep thought, or listen to a webinar while making lunch. The variety is endless. And while the spectrum of options in office furniture has come a long way since the advent of the cubicle, how many would choose to hang out for a significant amount of time in an office chair? The reality is that the workplace furniture, dominated by products that are durable, stiff, and uncomfortable, has a purpose: to keep you upright while you work at your own desk.

The personal desk is often assumed to be the primary place where work and productivity happen and remains the metric for planning most office spaces – but each company culture is unique, and some are more collaborative than others. Given this opportunity to rethink the comfort and value of our workplace, its our responsibility to design better processes for meeting, collaborating, and conducting business that is not centered around an office full of people sitting in their own confined spaces staring at their own computer screens. Our workspaces can now shed some of the traditions



of the past work culture to make way for better collaborative opportunities.

Comfortable furniture alone, however, will likely not be enough. We let our guards down and become relaxed on our couches at home, because they are always readily accessible and, at home, there is no guilt associated with getting cozy to do work. Like it or not, there is a real stigma in the workplace around relaxed posture — unprofessional, bored, and unengaged. Even when actively engaging in meaningful work, studies show that comfortable or relaxed posture in the workplace can equate to the perception of laziness and poor production. Even worse, people who seek comfort during the workday will likely have to search out a location far from their desk — triggering another bout of guilt as people often equate being accessible and available at your desk to being open for opportunity and career advancement. Knowing this, areas in the office that support relaxation and a variety of postures should be close to the individual's personal workstation, ideally just steps away. Also, their design should include boundaries and buffers, giving the employee a sense of enclosure and protection.

Food + Fitness

Over the course of 2020, we baked bread together, shopped at our favorite restaurants to stock our pantry shelves, and prepared chef inspired cuisine from at-home cooking kits. Some of us found healthier eating routines – eating six small meals a day is easier when you are not at your desk — and others enjoyed cooking comfort food lunch with the family.

> "I really enjoy making lunch whenever I am hungry versus having to prepare food or leave early to miss the lunch rush."
>
> **HYBRID WORKER, NEW MEXICO**

Our perspective around when we eat, what food we prepare, and how we choose to consume it has changed. Likewise, eCommerce grocery shopping skyrocketed – and is now expected to be adopted by 55% of U.S. consumers by the end of 2024. Over the last year, we have rediscovered the value we place on our personal health and well-being, and our access to quality food is a big contributor. Gone are the days where we will settle for the half eaten leftovers we were able to grab on our way out the door – workplace lunches can now be an experience. Inspired by the at-home delivery kits, progressive employers are looking to supply employees with kits to prepare healthy lunch options alongside their colleagues, promoting team building, health, and contributing to an overall healthier culture. This means that more robust kitchenettes and prep stations will likely start to make an appearance in the future workplace.

The breakroom as a social space is about to get more exciting – and it will also not be the only "social" break people will want to take during the workday, either. Personal fitness apps saw a 67% increase in global installs[9] at the height of the pandemic last March, Peleton sales increased 100% — increasing from $910 million in 2019 to a whopping $1.8 billion at the end of 2020[10] — and the Hydrow rowing machine was listed on Time's "Best Inventions of 2020".[11]

> "I like to exercise for 30 minutes a day and its really hard if I have to wake up early before work. But now I can exercise at lunch."
>
> **REMOTE WORKER, CALIFORNIA**

People don't see this just as an opportunity to get a good workout in during the day — this is an opportunity to connect socially with friends, family members, cycle groups or crew. And while corporate gyms have been rising in popularity over the years, individualized workout rooms that cater to these more personal workout routines would not only be easier to incorporate, but would also invite opportunities that are more in-line with personal health trends that will continue to grow in the coming years.

> "Amenities [like a gym or kitchen] could sway my decision... Incentivizes me to be in the office more than working from home. No amenities? I would choose to work from home."
>
> **HYBRID WORKER, CALIFORNIA**

Focus

The open office is a cacophony of sound and activity, where web meeting reactions, casual chatter, and intense project discussions fill the air. Over the last decade, this environment has been widely regarded as an instigator for impromptu social collisions that boost creativity, innovation, and culture. In fact, neurological studies show that the dissipation of sound provided by loftier ceilings (often found in the workplace) can shift the brain's activity from language centers to emotional areas, fostering more abstract thought.[12] This may be why we feel motivated to take on creative activities in an open office environment and tackling heads down tasks at home. But while some believe collaborative work may be lackluster away from the office, interviewees from *Work. Place. Blurred.* surfaced that focused work, which relies on mental peace, is better accomplished at home.

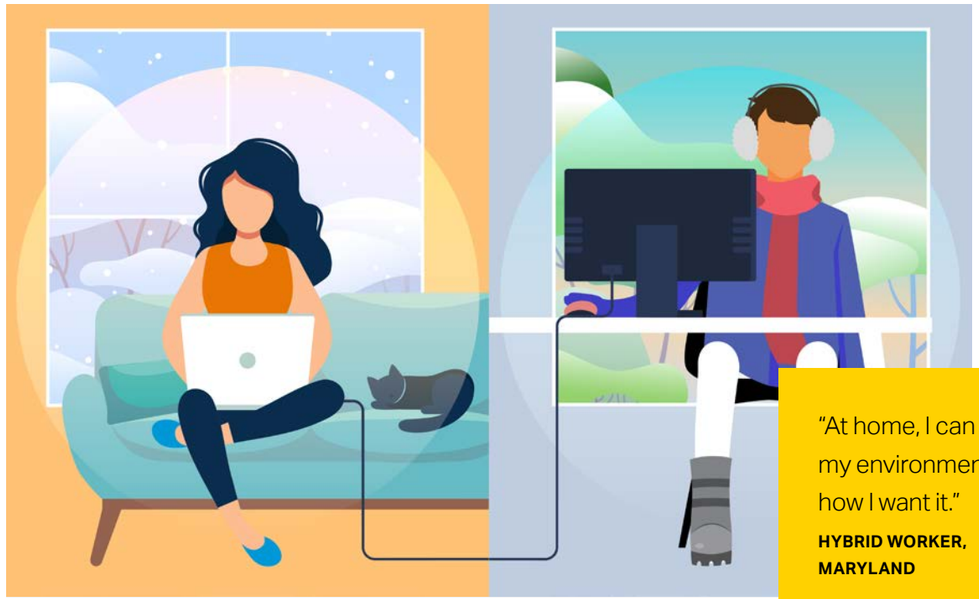
> "I don't mind making phone calls from home because it's quieter than in the office."
>
> **REMOTE WORKER, MINNESOTA**

> "I actually feel like there's more productivity when everyone's remote instead of at the office."
>
> **HYBRID WORKER, CALIFORNIA**

These opinions suggest that many contemporary workspaces lack appropriate spaces for mental focus. Workplaces should offer a variety of zones specifically tailored for retreat, with some immediately adjacent to traditional work areas. Convenience and access are key — and if positioned strategically, could break up the uniform rows upon rows of open office furniture, providing an acoustic buffer.

User Control

Temperature comfort levels vary by individual, and a one size fits all approach to indoor temperatures threatens to leave most occupants too hot or too cold. At home, blankets are welcome companions, not embarrassing (or unsightly) necessities, and you can draw the shades instead of dangling cardboard from the ceiling to temper heat from the late afternoon sun. Lack of personal temperature control in the workplace, however, isn't just about personal comfort — it can be detrimental to productivity.



> "At home, I can set my environment how I want it."
>
> **HYBRID WORKER, MARYLAND**

The universal office temperature — set decades ago, when women were a rare occurrence in the workplace — is derived from a formula that reflects the metabolic rate of a 40-year old man, weighing 154 lbs. And it doesn't just reflect male physical characteristics. Men's natural acumen sharpens in colder temperatures, while women, however, tend to perform worse in cooler environments, reducing their overall productivity. For every one-degree-Celsius uptick in temperature, women perform 2% better on math and 1% better on verbal tasks. A 10-degree difference can boost women's performance by 27%.[6] Men have the opposite effect, losing about 0.6% accuracy in both math and verbal tasks with each degree decrease. The sense of increased productivity at home may be in part, a reflection of personal temperature control.

In the future workplace, workers will appreciate measures that provide a choice in personal temperature regulation. Setting a "standard" temperature, however, helps the employer regulate energy usage, and ultimately balance the checkbook. But in response to a recent challenge posed by the Department of Energy, engineers are investigating variety of solutions that both personalize temperature control and at the same time reduce heating in the winter and cooling in the summer by 4-degrees-Farenheit, cutting greenhouse gas emissions in the U.S. by up to 2%, and saving building owners and operators around 12% in energy costs.[8] In 2019, innovations such as temperature-controlled office chairs, conductive company-branded shirts, and even incentives to purchase a wearable device for personal temperature controls, such as the EMBR Wave, are all ways companies are making temperature control personal.

As architects, we can also consider a few other alternatives. Underfloor air distribution, which

allows the employee to open and close diffusers, offers control at the individual level and is worth considering in projects that are conducive to raised access floor for cable management. Additionally, operable windows enables refreshing breezes, and brings employees into contact with the outdoors. While both of these solutions are popular in Europe, the U.S. has been slow to adopt. Now could be the time to re-evaluate.

In addition to personal temperature control, over the last year, remote workers have opened and closed shades, turned lamps on and off throughout the day, or even opted to work outside in the sun. As home dwellers, we customize our light levels to reduce glare, set the mood to focus, or simply, to see our work better. Additionally, studies show that proper lighting can reduce anxiety, increase motivation and productivity, and increase happiness.[7] Office environments, however, are evenly illuminated, and the control is in the hands of a computer program. Typically, more light is provided than is needed, and therefore, darkening overhead lighting in favor of humanely positioned lamps under control of the worker should become standard.

Even illumination throughout each space also leads to an all-encompassing "sameness" throughout a building — making modulation from space to space can be just as important. More detailed mental maps, memories, and intimate connections to our spaces can be heightened when lightscapes are carefully choreographed. Creating multi-sensory experiences change the way we form memories and can enhance positive engagement with space.

Outdoor Connections

Between work and home, U.S. adults spend at least 11 hours per day peering into illuminated screens. That's up from 9.5 hours just four years ago. With each additional minute of screen time, it is fair to wonder about the physical and psychological toll that this places on us. At home, we can opt to take a call or two on our balcony, write emails from the front porch, or do our studies from the backyard — a convenience that most office spaces currently lack.

Paths for walk and talk sessions offer an alternative to conference room meetings, and if work must be digital, it's possible to move that work outdoors. More than a place to take a break, outdoor spaces have the potential, if designed properly for shade, weather/wind protection, power, lighting, restroom access, and food and beverage, to be 24/7 workspaces. *Work. Place. Blurred.* interviewees stressed the importance of physical health and movement.

Likewise, a work from home analyst was happy to report that, when home, "now I can exercise at lunch." Access to exterior environments during the workday has been proven to increase happiness and energy, reduce inflammation, improve memory, and relieve stress — all contributing to more thoughtful and productive work. Not only are outdoor environments vital to any healthy workspace, but people across the world now equate outside air as "good", indoor air as "bad". This shift in perspective will influence design across multiple typologies — gyms, restaurants, and entertainment venues, among others — for the foreseeable future.

As companies wrestle with decisions about the role of remote work going forward, it's important that we as workplace designers confront the reality that the success of the office as the prime work environment hinges upon our ability to synthesize our new desires into delightful solutions that capitalize on the human need for control, comfort, variety, and connection.

"At home I have a healthier lifestyle."

HYBRID WORKER, MASSACHUSETTS

Curious Conversations

TANIA WHITE

The world of design is constantly evolving. As architects and designers, we can learn a lot from one another — but what about an industrial designer or a futurist?

Corgan's **Curious Conversation** series features industry professionals from a variety of different backgrounds. Each episode invites a guest to share their approach to creativity, exploration, and problem solving in the 21st century. How do they lead teams and guide clients through unchartered territory? What events in their life have shaped their career? How do human behaviors and emerging technologies impact their work?

We hope these conversations inspire a culture of imagination and the pursuit of endless possibilities as we share stories and engage with specialists outside of our field. It's a big wide world out there with plenty to learn.

LET'S GET CURIOUS.

Technology is a Partnership, Not a Contest

Throughout our conversations, guests shared their attitudes around technology. In our Curious Conversation with Steve Rader, he said that "Disney's *Snow White* was created by about 750 animators who made something like 2 million sketches and colorings. We now have software that enable the same job to be completed by 10 people. But if you look at the most recent and greatest films, something like *Iron Man III*, there were like 3,700 people involved in the making of that film. When we get technology that makes things easier, we don't just throw people away, we do more with it."

Concerns around technology also apply to users. As new technologies emerge, the people we design for need time to consider how technology applications are integrated into daily life. Guest and industrial designer, Donald Strum, expressed that "It's all about appropriateness and not forcing it on a product."

> **"What excites you about the future? "**

Cynicism Kills Design

When we asked Kristina Libby, Chief Science Officer at Hypergiant, what her team does when they encounter a complex problem, she said, "We see hurdles, not as something to stop by, but puzzles you need to work around." This approach breeds a mindset that *nothing is impossible*. Sure, the technological capabilities might be 50 years away, or maybe it'll costs $30 billion dollars; but don't say it's impossible. Our guests enforced the importance, as leaders in the field, to always encourage the growing of ideas. And while the first one might not provide the final answer, we never want to eliminate an idea altogether. Even if the idea has holes in it, we'll often find the solution was hiding three to four layers below.

> **"How do you manage roadblocks and the silos of creativity and science?"**

Make Time for Play

In the animal kingdom, creatures considered to be intelligent are the only ones that participate in acts of "play." Human beings are no exception. Throughout our Curious Conversation series, our guests shared hobbies and interests outside of work that ignite alternative passions and interests. They play banjos and Big Band bass, they paint during their spare time, they weave textiles, and lead group meditations. Engaging in various forms of hobby and play is essential for a well-rounded life.

Play, in particular, is "something that's done for its own sake. It's voluntary, it's pleasurable, it offers a sense of engagement, it takes you out of time. And the act itself is more important than the outcome."[1] Play is also linked to certain health benefits like a lower risk for Alzheimer's disease, stress relief, boosted creativity levels and improved connection to others.[2]

> **"How do you adapt products to work with technology?"**

Look Outside of Your Sandbox

Exploring outside your comfort zone can lead to wonderful discoveries. Studies conducted on open-source innovation have found that problems can often be solved by individuals who are from outside the field of expertise. Cross-disciplinary approaches to innovation are well-documented and are promoted as part of discovery practice. During our Curious Conversations, our guests often emphasized the importance of looking outside your own purview to better understand the world moving around you.

Donald Strum
Principal, Product Design
Michael Graves

"When an object has purpose and personality, it is going to last and be well desired. At the end of the day, designing things that people love helps with sustainability because they will have a longer life."

"In the industry of emerging technologies, the diversity of experiences in the room is important for creating a unified vision and engaging in an active dialogue to solve problems."

Kristina Libby
Chief Science Officer, *Hypergiant*

Jason Roberts
Founding Director, *Better Block*

"Whether it be in movies, books, or anywhere else, it's important for teams to talk about movements that are happening in the world and how those ideas and concepts can be infused into the spaces around us right now."

Steve Rader

Deputy Program Manager for NASA's Center of Excellence for Collaborative Innovation (CoECI)

"In my job, I get to see the future of open-source talent and what the future of work will look like. One of the things that is starting to emerge is that while our education system has invested in the very deep expert, we're finding more and more that the generalist who can connect the dot is becoming more important than it ever has been."

"The sonic characteristics of a voice interface are based on organic and cultural objectives and seamless customer engagement for any demographics. Voice interfaces are a growing trend to interface with buildings because they can preset immersive experiences and help with wayfinding and back-end technologies such as queue management."

Crispin Reedy

Voice User Interface Designer

Suzanne Tick

CEO, *Tick Studio*

"Tactility is more important than ever before as we crave texture and expansiveness to combat the flatness and contraction of our interactions with screens."

"Creativity is sacred, and it is not sacred. What we make matters enormously, and it doesn't matter at all. We toil alone, and we are accompanied by spirits. We are terrified, and we are brave. Art is a crushing chore and a wonderful privilege. Only when we are at our most playful can divinity finally get serious with us. Make space for all these paradoxes to be equally true inside your soul, and I promise – you can make anything. So please calm down now and get back to work, okay? The treasures that are hidden inside you are hoping you will say yes." [3]

Creating Without Judgement

ANITA DELGADO

Creativity is critical to successful communication and problem-solving – it is the ability to use our imagination to generate novel and original ideas and is therefore, essential in the practice of architecture and the arts. But where does it come from? Is it a product of discipline or is it the result of innate genius?

Picasso, one of the greatest creative minds of the 20th century, famously said: "Every child is an artist. The problem is to remain an artist once we grow up."[10] Recent studies have proven the veracity of this statement: we are all born creative, but lose our abilities with age.

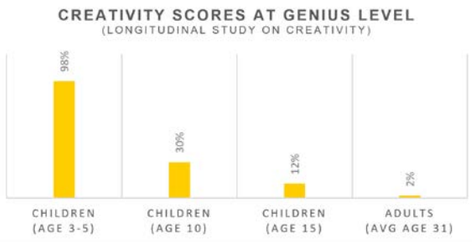
Our creative process as children is fluid and unhindered by self-criticism or human-forged limitations. As we grow, this process is influenced by our experiences and education. During our school age years, we lose our fluidity and our innate creative abilities. Research shows the decline is directly related to the teaching methods used in our school systems.[11] Surely, an unintended result, but a serious one that needs to be urgently addressed.

Watercolor works (Isabella Starnes – 2 years old)

There is much to learn from previous scientific research on creativity, famously conducted in 1968 by scientist and researcher George Land, which explores the difference in creative processes between children and adults. At the time, Land was working with NASA developing a test to identify the organization's most creative professionals. To generate a baseline, Land administered the test to

1,600 children younger than 5. Surprisingly, 98% of the children scored at the "creative genius" level. This extraordinarily high number led to the decision to re-test the same group five years later. By age 10, however, only 30% scored within the genius level, and by high school it decreased to 12%. When they tested adults, aged 31 and older, less than 2% scored at the genius level. Land concluded "that non-creative behavior is learned."[8]

Are we as a society unknowingly hindering the creative genius that is innate to our being?



Divergent Thinking vs. Convergent Thinking

In the 1950's, American psychologist Joy Paul Guilford was opposed to the widely held belief that human intelligence was a unitary concept. Guilford developed psychometric studies to understand cognitive processes involved in problem solving, and concluded there are two different modes of thinking: [7]

Divergent thinking is ideational and imaginative. Also known as lateral thinking, it searches for unusual connections through curious exploration. It contributes to innovative approaches and numerous solutions. It is spontaneous, fluid, and most commonly occurs while we are dreaming.

Convergent thinking, however, focuses on the rational evaluation of alternatives and bases explorations on trial and error. It analyzes the feasibility of ideas by using judgment prior to execution.

To use a simple analogy: divergent thinking is the accelerator while convergent thinking is the brakes. Unfortunately, our school system teaches us to put on the brakes before we even get going, which can have a disastrous effect on creativity. For many of us, creativity represents an elusive muse. It appears when we least expect it yet flees when we desperately seek it. We have all experienced innovative ideas quickly fade as we evaluate ways to make them a reality. Our logical approach marks the idea's demise and this in turns marks the stark difference between children and adults.

I have always been impressed at my two-year old daughter's eagerness to discover the world. Her Montessori school teachers insisted she truly enjoyed painting, and would send her home with works of art she had "created" — with their heavy-handed help, of course.

> "It took me four years to paint like Raphael, but a lifetime to paint like a child."
>
> **PICASSO**

School Work (Isabella Starnes – 2 years old)

Even so, I never really thought of her as a creative genius, until the pandemic hit in 2020 — when school was no longer in session and stay-at-home orders were in place — which meant we would both be working from the kitchen table for the time being. This unique time gave me the incredible opportunity to observe her innate creative process and abilities. Seeking to navigate our new reality while still enriching my daughter's at-home education, I introduced her to painting. At this time, I became more attentive to the impact the stillness of the year was having on our mutual awareness, reminding me of something Elizabeth Gilbert, author of *Eat, Pray, Love*, once said: "We all need something that helps us to forget ourselves for a while — to momentarily forget our age, our gender, our socioeconomic background, our duties, our failures, and all that we have lost and screwed up." [4]

I took Elizabeth's suggestion to heart, as I watched my daughter gleefully focus not just on the outcome of her creativeness, but on the entire process itself — there were no pre-conceived notions on what the final product needed to be, yet the results were incredible. Her unfettered curiosity led her to explore different tools, materials, colors, and methods — running back and forth to the backyard, gathering sticks, leaves and dirt to experiment with how the paint would texturize — which produced different results each time. Her eagerness inspired me to sit down next to her and paint as well.

However, it was immediately apparent that my work lacked the character enabled by her freedom. I was focusing on the final product — something worthy of hanging on my wall. For me, the process was secondary; for her, the true purpose lived in the process of discovery — just as it should be.

Being present and focusing attention on the moment is important to making an impact through creativity — two methods of working creatively we have learned from the ability to fluidly improvise, in addition to understanding the impact of pause.

Paint with Sticks (Isabella Starnes – 2 years old)

Turning Off Self-Judgment: Fluid Improvisation

"It's magical but it's not magic," [9] is how Dr. Charles Limb described the artistic creativity within Jazz musicians. His studies have shed light on the cognitive processes used during improvisation and have proved that jazz musicians have a higher capacity for divergent thinking when compared to those of other genres. They are experts at turning

off self-judgement while in creative mode. Their success lies in their focus on having fun in the moment, whereas other musicians concentrate on achieving technical perfection. [2]

"Creativity requires the courage to let go of certainties" [1], explains social psychologist Eric Fromm, whose work focused on innate human nature and our abilities to inspire freedom of choice in others. This ability to freely choose direction in the moment relies on "being present" in order to experience the excitement and novelty that true exploration engenders – novelty being intrinsically interwoven into every note of jazz music. It is divergent and imaginative, with multiple outcomes — no experience of the music is replicable, but must be experienced by allowing oneself to turn off the externalities of the world, and be fully present in the moment.

Procrastination: The Power of Pause

More than half a century has passed, yet his words are still imprinted in our memories today and they begin with: "I have a dream…" It was the speech that changed the world. Most would assume this powerful speech was written weeks, if not months, in advance, but Martin Luther King Jr. waited until the night before the march to begin writing it. This is not to imply that he had not worked on it beforehand. His brainstorming sessions had started four months before but by pausing and letting his subconsciousness work, he was able to internalize what he wanted to express.[6] This strategic method of procrastination has been proven effective by research, and has been utilized by other innovators such as Da Vinci and Frank Lloyd Wright.

As Giorgio Vasari noted, people "of genius sometimes accomplish most when they work the least, for they are thinking out inventions and forming in their minds the perfect idea." [5]
When we accept the need for necessary pause and reflection, we can then accept that procrastination is not "doing nothing", but simply waiting until the necessary moment to accomplish what needs to be done with the most impact. Pausing is a necessary part of meaningful action and deserves a thoughtful space in our lives.

Awakening Our Inner Child: Five Steps to Unleash Your Creative Potential

We have all experienced the dreaded "writer's block" when you need to be innovative. It is a desperate situation to be in, particularly when under pressure, as deadlines approach. Is it possible to unlearn the restrictive lessons we were taught in school, awakening our inner – more creative – child? While they may seem simple, there are several effective steps to unleash your innate creative potential that we often take for granted, and instead need to make more time for in our lives in order to reach our creative potential:

1. Play

When feeling "stuck," Einstein would leave the task at hand, and instead play his violin. He would refer to this tactic as "combinatory play" and used it consciously as part of his creative process. Giving yourself time do something you enjoy allows for you to detach from the problem so your subconscious can find an innovative solution. After all, Einstein was known to admit: "I never made one of my discoveries through the process of rational thinking." [1]

2. Move

Nikola Tesla took daily walks and claimed his best ideas were conceived during these strolls. Likewise,

Steve Jobs use to request "walking meetings" at Apple when faced with problems needing innovative solutions. So, if you ever feel that you have "writer's block" — take a walk! The movement and change of scenery will do wonders to boost your creativity.

3. Be Curious

Children are curious by nature. They explore and find beauty in the ordinary. Take time to tap into your inner child's curious spirit by exploring nature to find inspiration. But don't stop there — you might be surprised how easily your brain creates connections between the unusual when you take the time to pause and observe your environment.

4. Embrace Mistakes

Failure often leads us in the right path. Embrace your mistakes and lose your fear of failure. Being wrong will not make you more innovative but losing your fear of mistakes will allow you to be truly creative.

5. Enjoy the Process

Forget the outcome! Focus on enjoying the process of creating something. Lose yourself in your passion and turn off your self-judgment. You will produce something wonderful and we will all join you in celebrating your genius!

04

AERIAL PERSPECTIVES

New World

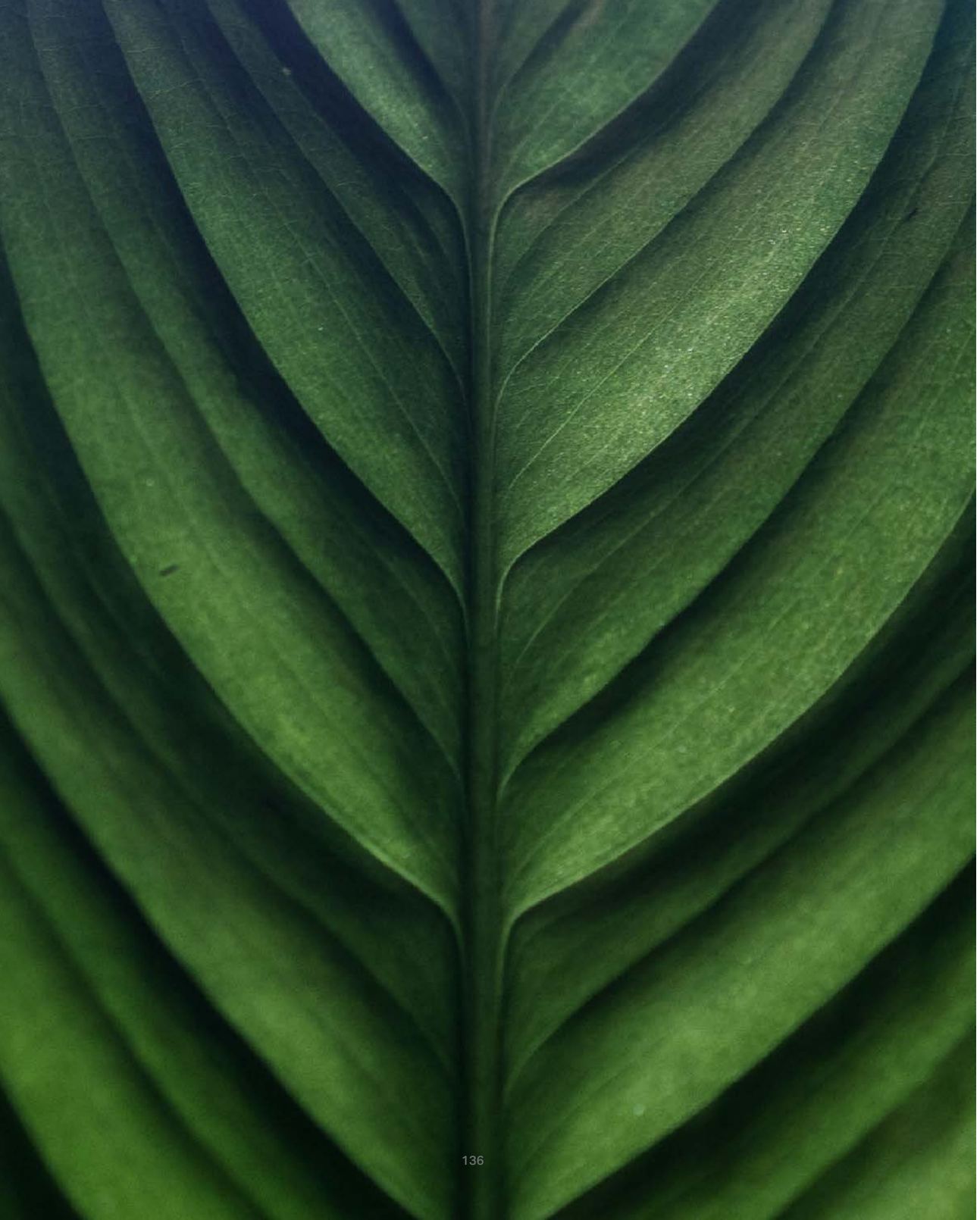
Upside-down trees swingin' free,
Busses float and buildings dangle;
Now and then it's nice to see
The world – from a different angle.

SHEL SILVERSTEIN, *FALLING UP*

What to expect

What shifts and trends can we observe from 30,000-feet above? How might changes in a cultural zeitgeist influence the way we design?

Picture yourself hiking up to the top of a large mountain. Does the world look different from this vantage point? While you might not see as many small details as when you're down low, you gain a bird's eye perspective that allows you to see the world with a different kind of clarity. This is the time to examine the big picture.



Learning from Nature: Productive Urban Landscapes for Health and Wellbeing

CHLOE HOSID

We spend our lives embedded within the built environment; immersed in this world we humans have designed for ourselves, and we forget that this isn't how the world always looked. Where there were once flourishing ecosystems in dense woodlands, undulating grasslands, flowing creeks, and marshy wetlands, we created cities, neighborhoods, shopping centers, and parks with neat rows of trees, weeded flowerbeds, and fields of freshly mowed grass. Our embrace of straight lines and artificial materials makes ours an unnatural presence, inelegantly grafted onto the wild complexity of the natural world.

The influence of human rationality and our desire for order has created a stark separation between the human domain and the natural world. We've drawn lines around nature to preserve its beauty while reinforcing its otherness, and our attempts to tame and contain it leave us with only a shadow of nature's potential to enhance our environment and our lives. This approach rejects the inescapable truth that we humans are a part of nature; a critical misstep that alienates us from the answers that nature can provide to so many of our most pressing challenges. However, if we were to embrace nature by integrating productive landscapes into the urban fabric of our cities, we could reap significant benefits for our health and wellbeing, climate resilience, learning and enrichment, and sustainable food production.

Greenspaces come in many forms in the built environment; ranging from well-kept lawns and thoughtfully planned parks, to the patches of grass that line our streets or serve as visual buffers between built elements. These spaces are largely ornamental, often require active intervention to maintain, and provide a limited scope of benefits. They could be so much more. To see beyond the

limitations of our current approach to the built environment, we must change our perspective. When we look down on the Earth from above — from an airplane or in satellite imagery, it is easy to see the mark we've left on the world. We can see everything we've built, and the incredible extent of human progress and ingenuity. But as we reach higher and higher, our buildings and roads become nothing more than scars and blisters on the landscape. From here, the human world takes on shades of gray and brown, and we can see the little pockets of unbuilt space we leave behind; both intentionally to create parks and lawns, or as forgotten spaces that serve no particular function at all.

These spaces may be green and dotted with trees, but their appearance is often barren and listless, marking them as missed opportunities in our urban fabric. Underutilized greenspaces, big and small, are scattered throughout the built environment, and there are many ways that they can be activated and elevated through thoughtful, nature-forward design. By integrating research-based design strategies, greenspaces can be designed to support physical health, psychological and emotional wellbeing, cognitive functioning, and the development of a strong, environmental ethos for humans while establishing robust and productive landscapes and green infrastructure for a healthy and resilient natural environment.

Nature, Health, and Wellbeing

Experientially, we understand the benefits of interacting with nature — we feel calm, yet engaged, and many of us seek out opportunities to immerse ourselves in the beauty of nature for recreation and enjoyment. Researchers in the fields of psychology and cognitive science have found empirical support for this intuitive understanding, and their findings connect exposure to nature with improved physiological, psychological, cognitive, and physical health and wellbeing. A recent study found that this feeling of calm contentment that we get when we interact with nature, and specifically in areas with an abundance of trees, means that our physiological needs for autonomy, relatedness, and competence are being met, and this feeling of wellbeing is linked to stronger feelings of place attachment.[1,2] These findings point to important relationships between our psychological wellbeing, our environment, and the social importance of nature.[2] Research conducted and consolidated through initiatives like "Healthy Trees, Healthy lives" at the Texas A&M Forest Service provides clear evidence that exposure to wilderness and treescapes promotes overall health; citing improvements in activity levels, reduced childhood obesity, reduced cardiovascular disease, a greater sense of safety and wellbeing, improved immune function, and more. [3]

Beyond the benefits, researchers have also sought to understand the underlying mechanisms that make exposure to nature such a powerful tool for wellbeing. Attention Restoration Theory (ART) posits that natural environments can help to restore depleted cognitive resources through *fascination*, an effortless form of attention that is activated in natural settings.[4] Researchers have found compelling evidence in support of ART, including improved cognitive performance for children[5] and adults,[6] reduced ADHD symptomology for children,[7] reduced incidences of violence and aggression due to mental fatigue,[8] and reduced mental health-related prescriptions in neighborhoods with more street trees.[9] Similarly, research in Stress Reduction Theory (SRT) has found exposure to nature to have a physiologically restorative influence to reduce stress[10] and improve physiological recovery and healing in hospital settings.[11]

When children engage in nature play, they show improved mood, and are more likely to participate in constructive play, dramatic and imaginative play, exploratory play, and cooperative play.[12, 13] Interestingly, the benefits of nature play also cross over into the classroom and improve children's originality and imagination, giving credence to the idea that spending time in nature can improve creativity.[12, 13] Additionally, students show improvements in focus, attention, concentration, and timeliness, along with decreased behavioral issues, providing further support for ART and SRT.[12, 13]

From an ecological standpoint, reincorporating nature into our cities can help us to develop a robust network of green infrastructure, make our environment more resilient, and positively impact our health.[1] Green infrastructure can provide critical ecosystem services, allowing our cities to respond more effectively to threats like flooding, climate

change, and pollution. [1] The destruction of natural forests and increased urbanization has given rise to the urban heat island effect.

Treescapes and greenspaces produce a cooling effect by providing shade and through the process of evapotranspiration, effectively combating this detrimental concentration of heat and making it safer and more comfortable to be outdoors.[14] Trees and plants filter harmful particles to provide clean, healthy, air and water, thereby reducing pollution and the risk of respiratory illness.[3] Native, diverse plantings of trees and plants can help to restore soil health, aid in the capture and sequestration of atmospheric carbon, and support pollinators and local wildlife.[15] Incorporating edible plants and fruit trees can help to democratize access to healthy food and reduce the load on industrialized farming and distribution networks, thereby contributing to a more sustainable and more equitable model of food production.

The depth and breadth of nature-focused research highlights the incredible power of nature to positively contribute to our health and wellbeing across several different metrics. Our current approach to the design of greenspaces does not allow us to take full advantage of nature's potential. Reframing our approach to urban planning and design to include green infrastructure, greenspaces, and treescapes distributed throughout our cities can ensure that every person has equitable access to the incredible benefits that nature can provide. We need our landscapes to be productive, and not merely ornamental.

Productive Landscapes

What makes a landscape productive? To reap the most benefit possible from urban greenspaces, we must design landscapes as mother nature herself would "design" them: with a density of function, symbiosis, and a net-positive, life-centered approach in mind. When they are designed thoughtfully and holistically, and allowed to flourish, the incredible array of benefits natural environments and green infrastructure can provide is unmatched by any artificial system we could try to replace them with. Productive landscapes provide critical ecosystem services like climate resilience, cooling, and clean air and water, support community-based urban food production, and create opportunities for improved health and wellbeing. If we can reimagine underutilized greenspaces by reinvigorating them with native plants, abundant treescapes, urban agriculture, and ecologically responsive landscape design, the grassy fields of today can become thriving assets for a healthy and balanced urban fabric tomorrow.

There are many different approaches that we can draw inspiration from in this transformative mission. The Continuous Productive Urban Landscape (CPUL) concept developed by Katrin Bohn and André Viljoen describes a green infrastructure system that essentially creates green pathways through urban environments to directly connect cities to food production, and on to the surrounding rural landscape.[16] By mapping existing open, greenspaces in a city or town and discovering opportunities to connect them with ecologically or agriculturally productive land and green infrastructure like bioswales and native plants,[17] it would be possible to fully integrate nature and urban agriculture into the built environment.[16]

Japanese botanist, Akira Miyawaki, developed a method for the reforestation of native vegetation on degraded land.[18] This afforestation method involves planting diverse and densely packed native species of trees and plants to create complex multi-layered forests that mirror the growth of natural forests.[18] Because the plants selected are well adapted to grow together symbiotically, the forest grows very quickly — about ten times faster and with thirty times greater density than with traditional methods — and require no maintenance after the forest is established in two to three years.[18] The method can be used in areas as small as thirty square feet, or in large areas to create urban forests, anywhere in the world. [18] The diversity of the native miniature forest supports greater diversity of pollinators and wildlife and has a regenerative impact on soil conditions. [19] The establishment of these forests is inherently community oriented, and the involvement of the local community establishes a strong connection to the Miyawaki forest, contributing to a sense of environmental stewardship. In just twenty years, these forests can grow to become mature ecosystems; significantly faster than the two-hundred years it would take for a forest to regenerate on its own, making this method a powerful tool for the rapid establishment of robust green infrastructure in cities around the world.[19]

Permaculture, a concept co-originated by Bill Mollison and David Holmgren, effectively overlays design principles on the science of agroecology to mimic and optimize natural ecosystems to create a framework for realizing successful, sustainable, and resilient agroecosystems.[20] Permaculture design is guided by three ethics: care for the earth, care for people, and thoughtful consumption and the redistribution of surplus.[20] Guided by the balance embodied by these core values, modern research and innovation, and existing methods and cultural knowledge of sustainable living, permaculture design represents a sophisticated, holistic, symbiotic, and productive landscape design methodology that contributes to human and ecological health and wellbeing [20]. Through in-depth analysis and observation of site-specific natural forces and the existing environment, permaculture design seeks to work with, strengthen, and integrate natural systems so that each element of the permaculture design feeds productively into the system as a whole in support of human goals and environmental resilience.[20]

Taking inspiration and utilizing methods from the Continuous Urban Productive Landscape concept, the Miyawaki Forest methodology, and permaculture design, among other concepts, can contribute to the design and realization of contextually-appropriate productive landscapes. Reframing our approach to greenspaces in this way can help us to meet the challenges of our time efficiently, effectively, and in a balanced, future-focused way, allowing us to support human goals and reestablish a healthy environment.

Design Application: Outdoor Learning

The principles and benefits we've explored so far can be applied to landscape design at any site and at any scale. We can create bioswales along streets, community gardens in abandoned lots, vertical hydroponic farming facilities in underutilized building typologies, and miniature forest ecosystems in city parks. One particularly meaningful application for productive landscapes would be the transformation of greenspaces on school campuses. From preschools to community college and university campuses, students of all ages could see health, wellbeing, and educational benefits from a new approach to the design of campus greenspaces.

Schools are located in the heart of our communities and within close proximity to other school campuses, community recreation centers, and parks, making these sites fertile ground for the implementation of productive landscapes. While their primary function is to educate, their purpose and importance goes far beyond that fundamental responsibility. Schools support the full spectrum

Reflection Forest

Permaculture Terrace

Learning Landscape

Discovery Pond

REFLECTION FOREST
Being immersed in nature is beneficial for physiological, cognitive, psychological, and physical health and wellbeing. Mood and creativity are also enhanced [1-15]

PERMACULTURE TERRACE
Working with the natural slope of the site, the inclusion of stepped terraces controls soil erosion, reduces water run-off, and creates an opportunity to grow food and other productive plants. Students will be able to engage in hands-on learning activities and develop a connection to their environment and to their community [17, 20, 21]

DISCOVERY POND
Streams and ponds provide critical ecosystem services while presenting educational benefits for students, allowing them to observe wildlife and natural systems [17, 21]

LEARNING LANDSCAPE
Students benefit from exposure to nature. Learning outdoors affords exciting learning opportunities and can connect students to the real world. Less structure and more exploration in their learning experiences can encourage students to be inquisitive, solve problems, and find inspiration in the world around them [21, 22]

MIYAWAKI FORESTS
Densely planted, native, miniature forests provide substantial ecological and educational benefits. For example, these fast-growing forests support incredible biodiversity- an exciting opportunity for on-campus wildlife observation [18, 19]

of health and wellbeing for students and families by providing meals, safety and security, social and emotional support, opportunities for recreation and enrichment, and a sense of community. Educational facilities are designed with multifunctionality in mind to provide for all of these needs, but outdoor spaces on school campuses are often one-dimensional, underutilized, and likely to be cut from design proposals due cost and maintenance concerns. But what if we redefined those outdoor spaces and approached their design with passion and the same density of function as we do for indoor learning spaces to create productive, inspiring, and valuable learning landscapes?

The benefits that exposure to and interaction with nature can provide ranges from physical health to cognitive performance, emotional wellbeing to creativity, and social interaction to environmental stewardship. From an educational perspective, a vibrant and engaging productive landscape could connect students to real-world, hands-on learning experiences that really excite them, inspire them, and foster inquisitive science-thinking.[21] **If we can break from the traditional "classroom" mold and embrace the organic, unstructured learning opportunities a productive landscape could afford students, outdoor learning could refocus education on life, passion, inquiry, balance, and problem-solving.**[22] Students can learn to explore, ask questions, cooperate, self-regulate, and connect to the world around them in a meaningful way.

Applying research-based concepts and productive landscape strategies to the design of outdoor learning spaces yields an inspiring vision: every student connected to nature through their education, and nature bringing life and energy into learning. A productive landscape for learning would support community and individual exploration in a green and varied landscape, ripe with opportunities for both reflection and active learning. Lush native plants would grow along winding pathways that lead you through a verdant Miyawaki forest, where students observe the development of a natural ecosystem. They can see the interactions between native plants, wildlife, and pollinators as the forest grows and evolves with the seasons and over time as they themselves grow and progress through their education. Ecosystem services like the water cycle, soil health, weather, and the natural cycle of growth and decay are on full display in flowing creeks and natural ponds. Students build a deep connection to their environment, and through the lens of permaculture design, they are empowered to engage directly with the landscape to optimize natural systems, respond to changing conditions, and implement design-build solutions to support the wellbeing of their learning landscape[21]. Spider webs and beehives offer lessons about structure, engineering, and food webs, while the tranquility and richness of an urban oasis inspire works of art, music, and creative writing. Nurturing the growth of edible plants instills a sense of excitement about healthy food and teaches students how to provide for themselves, their fellow students, and their communities in a sustainable way.

Productive landscape design for outdoor learning spaces can do all of these things and more for students and their communities. **From school-aged learners to "students of life", growing evidence shows that time spend outdoors and engaging with nature is invaluable for our health and wellbeing, and the resilience of our planet.** The benefits are clear, and the solutions are simple: we must reintegrate nature into the built environment, and productive landscapes represent one framework for doing so.

Sixty Years Later: An Addendum to *Death and Life*

RYAN CONNELL

In 2010 I was given a 50th Anniversary Edition of a favorite book, *The Death and Life of Great American Cities* by Jane Jacobs. I reread it, marveled at its enduring relevance, and lamented that urban development in my home city of Dallas continues to ignore so many of its principles. Then I set it on a shelf and didn't pick it up again until this year. As I read the first pages I felt something like nostalgia. For the first time it didn't feel as contemporary, and the more I reflected the more I wanted Jane here to tell me why.

For urbanists, Jacobs remains something of a rock star in black spectacles as her Death and Life has become canon in design and planning circles. But it's easy to forget the context of her masterpiece.

While there are enduring lessons for us in her response to the crisis she faced, we have unique challenges and changed perceptions ahead of us. One wonders what she might offer as an addendum to that great work after seeing the neighborhoods she helped save develop over the decades, had she experienced 2020 with the rest of us. I wouldn't presume to try to write it for her, but I think it might expand on a few themes.

2020 has reminded us that, in many important ways, little has changed in America since 1960. We continue to face crises of economic inequality, segregation, racial injustice, pollution, and climate change. These crises continue to compel designers and planners to respond with big ideas, but we've learned through history what happens when complex social problems are met with overly simplistic solutions. Jacobs's example of the "sidewalk ballet" was specific to her street but spoke to the complexity of human interaction and interdependence.

"Big cities have difficulties in abundance, because they have people in abundance."[1]

"Under the seeming disorder of the old city, wherever the old city is working successfully, is a marvelous order for maintaining the safety of the streets and the freedom of the city. It is a complex order. Its essence is intricacy of sidewalk use, bringing with it a constant succession of eyes. This order is all composed of movement and change, and although it is life, not art, we may fancifully call it the art form of the city and liken it to the dance — not to a simple-minded precision dance with everyone kicking up at the same time, twirling in unison and bowing off en masse, but to an intricate ballet in which the individual dancers and ensembles all have distinctive parts which miraculously reinforce each other and compose an orderly whole."

- JANE JACOBS, *THE DEATH AND LIFE OF GREAT AMERICAN CITIES*

As designers we instinctively strive for order and clarity, but as Jacobs rightly observed, the order that exists in vibrant healthy cities is a complex one, and it requires humility and observation to understand. **Advances in technology give us the opportunity to boldly envision and build new solutions to address the crises of our day, just as they did for LeCorbusier and other 20th century masters.** Jacobs's words endure to remind us not to repeat their mistakes.

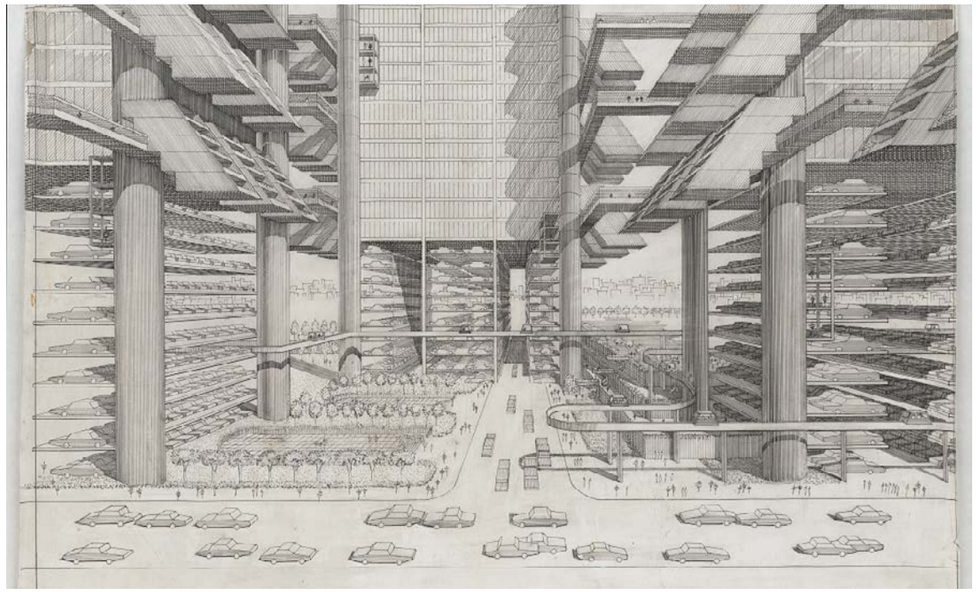
It's important to remember that the crisis that spurred Jacobs to write Death and Life was existential and deeply personal. Under "master builder" Robert Moses, many New York neighborhoods were razed for freeways and large-scale Radiant City-inspired projects; Jacobs's own Greenwich Village was threatened by the proposed Lower Manhattan Expressway project. Once those neighborhoods were saved and revitalized from within by dedicated residents and creatives attracted by opportunity, the inevitable happened; more people came and rents began to rise.[2]

Sixty years later, the crises New York and other American cities face are less about preservation of the urban fabric and more of preserving its character, vibrancy, and who has access to it. Jacobs had a clear goal and an enemy in the flesh. It's harder to define and rally resistance against more abstract and creeping threats.

"Diversity is natural to big cities."[1]

Jacobs grew up in Scranton, PA at a time when the coal industry its local economy relied upon was struggling. This combined with her natural aversion to authority helps explain why an icon of urban renewal and preservation was also a free market conservative and a fierce proponent of growth. She saw homogeny and stagnation as death to cities, and Death and Life described in rich detail why freeways, isolated housing towers and remote playgrounds bring stagnation rather than progress.

Jacobs wrote of diversity primarily in terms of uses and interests over the course of time. She likely recognized that economic, racial and ethnic diversity of the old neighborhoods she was trying to save was an essential part of their character. It must have seemed a given, and one wonders whether she considered how that character might change after the "unslumming," when left to free market forces. Seeing how rents have soared in these neighborhoods and priced out all but the



Streetscape rendering of the proposed Lower Manhattan Expressway. Paul Rudolph, Architect.

wealthiest, Jacobs would be forced to confront this natural tension that can exist between thriving economically and culturally.

I think Jacobs would recognize that her grassroots effort, effective in defeating Robert Moses, wasn't as well suited to resist gentrification in the decades that followed. Without city engagement and long-term planning, development is shaped by market forces and self-interest. As Adam Gopnik wrote of Jacobs's sidewalk ballet, "The butcher and the locksmith on Hudson Street were there because they could make a profit on meat and keys. They weren't there to dance; they were there to earn. The moment that Mr. Halpert and Mr. Goldstein can't turn that profit — or that Starbucks and Duane Reade can pay the landlord more — the tempo changes." [2]

"It may be romantic to search for the salves of society's ills in slow-moving rustic surrounds, or among innocent, unspoiled provincials, if such exist, but it is a waste of time."[1]

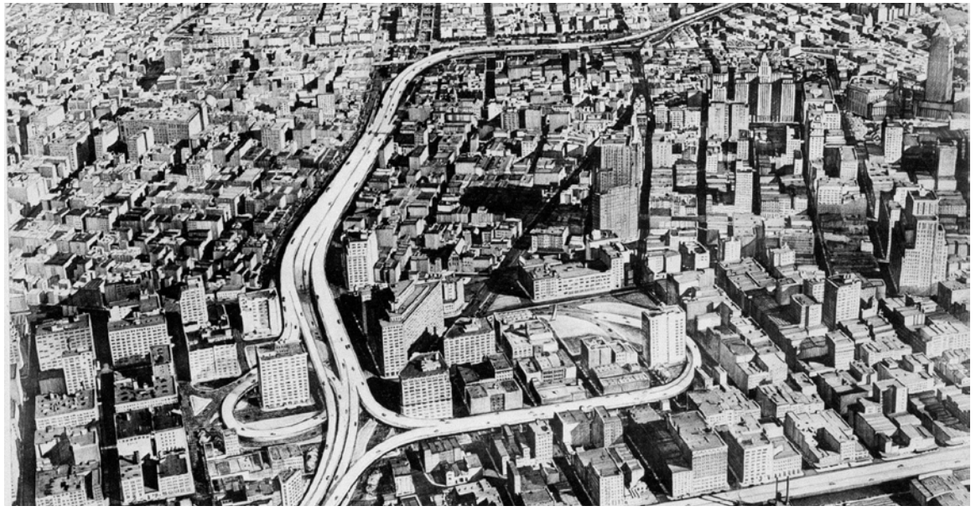
As 2020 began, Jacobs's sidewalk ballet looked very different, with many factors reducing the "eyes on the street" that are the lifeblood of a healthy city. We increasingly work, shop, and otherwise interact online. We've become accustomed to increased access controls, deeper building setbacks and vehicular barriers at entrances in the years since 9/11.[3] Then the pandemic hit, driving New Yorkers and city dwellers around the world into further isolation.

In her book How to Do Nothing, Jenny Odell looks at how communities in crisis historically have created strong and lasting bonds that surpass social boundaries, and upend norms to get the job of "surviving the crisis" done, in lieu of the inflexible institutionalized aid that follows. That was certainly true for Jacobs and her neighbors in 1960. Odell writes, "When something goes from being an idea to a reality, you can't easily force your perception back in the narrow container it came from." [4]

So how has our perception changed?

One can argue people have been socially distancing through technology for years, but there's something about mandatory closures and quarantines that makes one reflect on it with more focus. One result of the pandemic might be greater recognition of this isolation and our need to connect in person. At the same time our sense of personal space has

The Disappearing Face of New York



Artist's rendering, proposed Lower Manhattan Highway in 1959

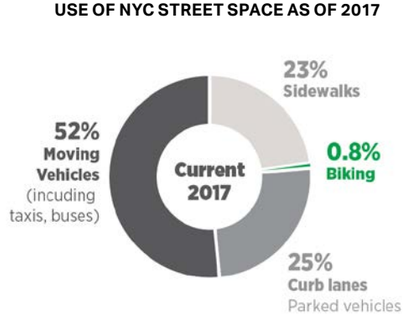
changed, and it's hard to know how long this may stay with us. Will people return to crowd sidewalks and subways as they did before the pandemic? How can our need for connection and space be reconciled where space is finite and highly valuable? Jacobs might suggest we do it by reclaiming and better utilizing a public space we already have- the street.

"The point of cities is multiplicity of choice. It is impossible to take advantage of multiplicity of choice without being able to get around easily."[1]

As of 2017, 77% of Manhattan's street space was dedicated to vehicular use, including 25% for curb lanes much of which lined with parked sitting unused for long periods.[5] Jacobs rode a bike and certainly did not share the postwar American love of the automobile, but she favored its attrition to its outright banning. Today we have 60 more years of evidence of what cars and misguided planning do to cities. It's not hard to imagine Jacobs updating her sidewalk ballet for 2020 with more space for people than vehicles. She might see a wider sidewalk, more outdoor seating at restaurants and bars, dedicated lanes for bikes and buses, and parkways with actual park space.[6] **More than aesthetic preference or idealistic crusade against the automobile, I think Jacobs would see the primary goal as increasing access and choice.**

Public Transportation

Will the subway continue to be part of that multiplicity of choice? The Metropolitan Transit Authority was already struggling financially before the pandemic reduced ridership by 70%, and now could face drastic budget cuts. [7] One might want



to reimagine the system as the city's underground distribution network, but its infrastructure is not suited for freight, with insufficient size and connectivity. The Lowline Project studied how an abandoned underground trolley station could be converted to green space and is currently under construction.[8]

While there may be continued repurposing of underutilized infrastructure, the subway is so engrained in New York's identity and essential to its daily flow of people, it is difficult to picture a future without it. Countries with robust modern transit systems like South Korea have shown that subways are not inherently dangerous in a pandemic, but MTA is a far cry from modern or robust in reality or perception.

"Lively, diverse, intense cities contain the seeds of their own regeneration, with energy enough to carry over for problems and needs outside themselves."[1]

Jane Jacobs died in 2006, her last book a pessimistic outlook for cities titled Dark Age Ahead.[3] She was distrustful of technology, and it's unlikely that the explosion of smartphones and social media would have made her more hopeful. But I think there are several projects that have been realized since her death that might have given her some optimism that big ideas can be artfully woven into the urban landscape. For example, the High Line opened in 2009, taking a stagnating stretch of rail and transforming it into an elevated sidewalk of sorts with its own unique ballet, connecting people and businesses from the Meatpacking District through Chelsea. It preserved the old without romanticizing it, and in doing so, brought new eyes to the street attracting over 20 million visitors annually.[9] Jacobs would also be heartened by a plan underway to add 250 miles of protected bike lane to the city's streets, and a more ambitious plan being pushed to nearly double that. And several initiatives underway in NYC Planning, like the "Shaping the Sidewalk Experience" and "The SoHo/NoHo Neighborhood Plan" have missions that read like Jacobs herself wrote them:

"SoHo and NoHo are dynamic mixed-use neighborhoods with a diverse blend of residential, office, creative and retail spaces. The SoHo/NoHo

Image Credit: RAAD Studio

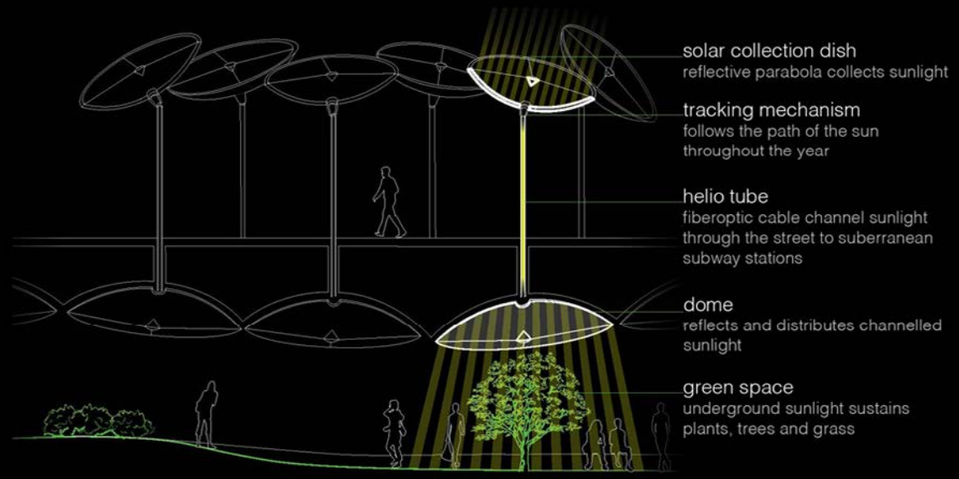
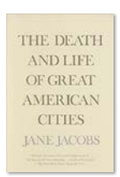


Image Credit: RAAD Studio

Neighborhood Plan seeks to expand housing opportunities for New Yorkers and promote equity, support continued cultural and economic success in a holistic way and reduce regulatory burdens for the people who live and work there. – **NYC PLANNING**[10]

So while we'll have to imagine what Jacobs would offer as an addendum to her greatest work, I think it's safe to say she would encourage us to continue to approach *Death and Life* with a critical mind and recognize that the order of cities and our perceptions of them are not static. Better said by Jane herself, "I hope any reader of this book will constantly and skeptically test what I say against his own knowledge of cities and their behavior." [1]



Add this to your reading list.

The Death and Life of Great American Cities

If Trees Could Speak

CHLOE HOSID

If you close your eyes, you can hear their quiet symphony; carried by the wind through thousands of leaves as branches sway and dance with a gentle breeze. You can feel the forest take in a collective, cleansing breath, and exhale eddies of cool, pine-scented freshness that carry with them a promise of life. In their stillness there is grace and power as great, grounded trunks reach up into dancing canopies that cast ever-changing patterns of light and shadow onto the earth below. In their tranquility, there is a nurturing spirit.

Every tree is a home; each one bringing energy, balance, strength, and community to everything it touches- the air and the soil, microbes and insects, water and light, woodland creatures, other plants, and even us. They breathe life and beauty into the world around them; their roots and their branches weaving together the complex elements of diverse ecosystems to behave as a collective whole. When we look at a tree, we cannot see an intelligent face gazing back at us. We cannot see the wisdom of their years spent watching time unfold, from the beginnings of life on this planet through the entire history of humankind. We cannot see that "life" is truly at the center of their intelligence, and yet it is there- sophisticated and unwavering in its ethos. There is depth and complexity to their peaceful quiet, and their voices should not go unheard. The trees are speaking to us in their own way, but are we hearing what they're saying?

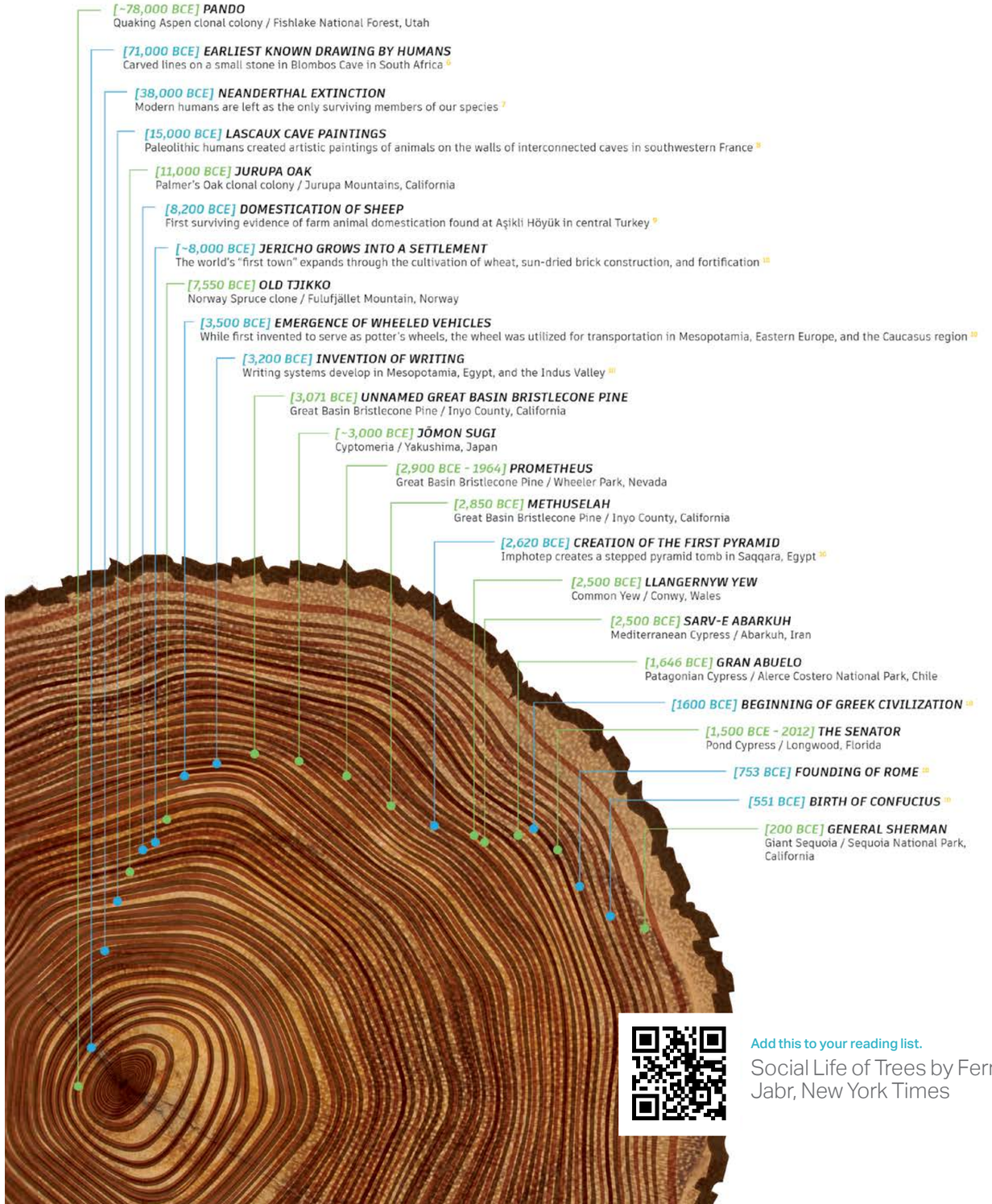
As our Earth has evolved, nature has become increasingly diversified, complex, and creatively adapted to an ever-changing environment through perpetual, elegant, and organic innovation. Living beings and natural forces all interact with one another to achieve balance and contribute to thriving ecosystems. Together, they provide incalculable benefits and support for all life on this planet through closed-loop systems in which every element plays a unique role. Trees have grown to become the tallest living things; their impressive stature setting them apart from other organisms. They are gentle giants and benevolent guardians of the natural world, and the spirit, the structure, the heart, and the lungs of so many of the world's most critical ecosystems. Some of the world's great forests have been here, growing and thriving, for hundreds of millions of years. And within those great forests across every continent, there are ancient trees; two thousand, five thousand, thirteen thousand, even eighty thousand years-old, protected, studied, and given names. The Senator, Gran Abuelo, Sarv-e Abarkuh, Llangernyw Yew, General Sherman, Methuselah, Prometheus, Old Tjikko, Jurupa Oak, Jōmon Sugi, and Pando came into being during the Paleolithic period, the Stone Age, or at the birth of the first human city states.[1] With such a long-standing and enduring

presence, these ancient organisms carry within them incomparable knowledge of resilience, balance, longevity, and symbiosis.

If we think about trees as a representative for the voice of the natural world- what wisdom might they share with us? They see the world through a different lens. Their lives are long, and their survival depends on the wellbeing of their entire ecosystem, making their values future-focused and collectivistic. We may think of trees as stoic, solitary, and insentient, but in reality, trees are intelligent "super-cooperators". [2] They form and maintain highly complex mycorrhizal networks through their root systems that allow forests to communicate, share resources, and pass on wisdom to promote the health of the entire forest ecosystem.[2] Trees have both strength and compassion. They provide critical natural infrastructure to cleanse the air, provide clean water, cool the earth, and support healthy soils. So called "Hub Trees", or "Mother Trees", nurture their saplings in the understory by providing nutrients, creating space in their root systems for the sapling to grow, and sharing their insight by sending defense signals to these young trees, allowing them to respond more effectively to future threat.[2] As trees mature, they create homes and provide nutrients for birds and animals in their branches and canopies, they sequester atmospheric carbon[3], and foster biodiversity. Theirs is a life-centered intelligence. They behave as one organism, with deep-seated altruism, to support the diversity, resilience, and wellbeing of the entire forest and all of the life it contains.[2] It's this ethos that guides their behavior and informs their net-positive relationship with the world around them.

Nature's sage and balanced approach to life, and the creation of natural systems and infrastructure exists in sharp contrast to the human approach. We behave like an invasive species with our penchants for inorganic, disruptive environmental intrusions. We don't think about the balance of ecological systems as a whole, but instead prioritize narrow-focused, human-centered priorities that neglect and degrade the systems that nature has in place. We replace diverse ecosystems with monocultures, we interrupt the delicate balance of water and soil systems, we create waste and pollution, and we consume resources at an unsustainable pace. We ourselves are a part of nature, but we seem to have forgotten how to respect and live in balance with the world around us. If trees could speak to us in a way that we could understand, they would tell us that this disconnect we humans have with the natural world jeopardizes not only our future, but the future of our planet. They would tell us that we must behave like stewards of this Earth and learn from the wisdom of nature to re-conceptualize our relationship with the world around us.

To achieve harmony with nature, we need to shift our current Human-Centered focus to a Life-Centered mindset. If we can embrace Life-Centered Design, and think not just about ourselves, but about the planet as a whole, we can make decisions that set us up for a healthier, more sustainable future[4]. Where Human-Centered Design fails to meaningfully respond to the large-scale, pressing challenges we face as a global society, like climate change, poverty, and systemic racism, a Life-Centered Design mentality could help us to look at problematic systems holistically to make positive change.[5] Designing humanely, thoughtfully, and purposefully for longevity, balance, equity, and wellbeing within the Life-Centered Design framework will allow us to solve real problems through collaborative innovation and cooperation.[5] Our dominance and our influence on this planet are far too pervasive to continue thinking only of ourselves and behaving without consideration for the full impact of our actions. We must learn to live in balance once again. Learning from trees and from nature can open our eyes to new ways of thinking so that we can bring life back to our cities and restore the delicate balance between human activity and the natural world.



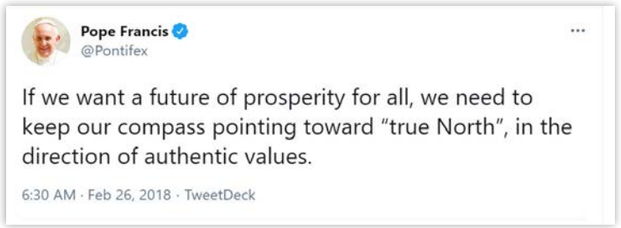
Add this to your reading list.
Social Life of Trees by Ferris Jabr, New York Times

But What's in a Map, You Ask?

Research suggests that north-south orientations on a map can have psychological consequences. In general, north is associated with "richer people, more expensive real estate, and higher altitude," while south is associated with "poorer people, cheaper prices, and lower altitude."[1] This is referred to as the North-South bias.

When research participants were presented with south-up oriented maps, this north-south bias disappeared. Researchers speculate there are a variety of reasons why we have biased associations between map position and goodness/badness (north = good, south = bad). These reasons have been documented throughout numerous contexts, such as: power/status, profits/prices, affect/emotion, and even the divine).[2]

For example, when plans aren't working out they we'd hope, we might say "things are going south" to imply a negative outcome. In 2018, Pope Francis tweeted the term "true north" in reference to authentic values.



Popular song lyrics provide further evidence of "north-south bias" among English speakers. Examples include, using "Uptown" to mean "high class or rich" ("Uptown Girl" by Billy Joel), or using "Downtown" to convey lower socioeconomic status ("Bad, Bad Leroy Brown" by Jim Croce).[1]

Rural Air Mobility

SCOTT GORENC

Much of the excitement around vertical take-off and landing vehicles (VTOL), has been around the prospect of a new modality that redefines the urban environment. Urban Air Mobility will facilitate community connectivity, reduce the reliance on the car, and ultimately return time and experience back to people who live in our cities.

Corgan has spearheaded this vision with forward thinking designs for Skyports to facilitate large throughput as well as the more community-centric "Mobility Hubs." Much of this promise has been centered around the advancements in battery technology, automation, and improved safety of the operations of the vehicle, but before we can realize the vision set forth for aerial ride-share, the technology needs to be tested, proven, and repeatable.

The Proof is in the Logistics

Logistics provides the venue to prove the reliability of VTOL technology and gain community confidence in air mobility prior to its inclusion in the urban fabric. Companies like Elroy Air have been developing the aircraft to facilitate cargo movements. Elroy Air's Chaparral is a VTOL that is capable of carrying up to 500 pounds of cargo over 300 miles.[1] As test flights are completed, it will be important to get this technology to the industry partners who can use it. Hillwood, a Dallas-based real estate developer, is looking to create what they call "Mobility Innovation Zones" to do just that.[2] They aim to create a synergy between technology stakeholders, industry partners, and regulatory oversight to help prove out and accelerate adoption of this technology.

To date, much of the vision for VTOL has been from the urban perspective hence the term, Urban Air Mobility. However, we should be looking at the opportunity from a rural perspective to allow us to define a symbiotic relationship where the technology can not only be proven, but provide a net gain to rural communities via the availability of goods and services as well. From a logistics perspective, providing a supply chain to rural locations can be particularly challenging. First, the necessary infrastructure to be able to give the rural demographic access to goods and services may not be adequate, particular essential goods and services such as access to healthcare. Second, the geography at certain locations can make logistics challenging, particularly if there is any disruption from the weather. Finally, the cost for providing services to rural locations can be prohibitive, particularly when the catchment area demographic tends to be poorer than those in urban areas. [3] Rural Air Mobility has the opportunity to capitalize on all of these challenges.

Rural Inroads

Infrastructure

From highways to dirt roads, getting goods and services to those in need relies on a coordinated, significant chain of infrastructure. Whether it is

by water, air, rail, or road, with every link and every transition, there is an opportunity for failure. Many of these connections, particularly in urban communities, are constantly maintained and adapt to emerging technologies and other disruptions. This is not the case, though, in remote communities. A particular challenge is not only the condition of the infrastructure in rural communities but, whether or not there is any availability of transportation infrastructure at all. A great example of this is the pilot shortage that has impacted air service across the board. It has been noted, though, that due to competition for pilots, rural air service has been impacted the most with a reduction in ability to meet demand.[4]

The interesting take away from many of the studies into Urban Air Mobility is the significant infrastructure requirements to handle the demand anticipated at the scales imagined. Skyports would require access to significant amounts of power, be cognizant of the neighboring community and be strategically located to accommodate airspace requirements. Rural Air Mobility wouldn't have that challenge. The VTOL technology would operate in a quick drop configuration, similar to the traditional helipad experience, and not have the challenge of significant throughput, vehicle maintenance, and constraints of a densely populated community.

Geography

Geography plays a key role in how we get from point A to point B — in some cases, we must traverse mountains, rivers, and canyons as a natural part of the environment. What might be a short distance in mileage, could possibly take an exceeding amount of time due to winding, twisting, mountainous terrain. Rural Air Mobility would be able to supersede this. In doing so, it could demonstrate how this technology is able to adapt to the natural environment. In addition, one of the major challenges for skyport design in urban communities will be to provide sufficient airspace to accommodate current FAA standards for Approach and Transitional Surfaces. As the technology matures, its ability to navigate rural communities will have an impact on how to prove out any modifications to the regulations moving into the future.

Additionally, the adaptability of the technology to weather concerns such as snow and ice could demonstrate its ability to be utilized in disaster response exercises. Drones have already been proven to be useful in response to disaster relief in a way to assess damage and locate stranded people.[5] We are starting to see drones take a more active role. For example, drones are starting to an active role in fighting fires to strategically fight fires in ways not possible before, resulting in increased safety for fire fighters. [6]

Community Acceptance

The aerial cargo market would have a quicker path to market by operating in areas with less population and providing a needed service. **As part of a study in Rural Air Mobility, Corgan surveyed residents of towns with less than 2,500 population to understand the public's perception of access to goods and service and the potential impact of air mobility to improve this.** Approximately 70% of those who participated in the survey were comfortable with the idea of drone delivery on the scale of VTOLs, with most of those visioning an improved quality of life as a result.

That is not to say, however, that the residents of rural communities don't have some commonalities with those in urban. There are two concerns that are the critical path items that vehicle manufacturers must address for community acceptance, both rural and urban: *Noise* and *Sustainability*. Residents of rural towns commented that that they expect VTOLs to be quiet. As one resident put it, "…It would be disturbing that I've moved to this country place for peace and quiet from the big city — and now — I have this loud racket from the things in the sky."

Additionally, sustainability was important. Many residents of rural communities recognized that it could take quite an effort to get goods, from both planning and execution. "You always have to be prepared and that your car is in good working condition before you go anywhere long distance…" one resident said. They recognize the trade-off though, "We need to be good stewards of the earth, and if it means destroying Earth to get my cleaning supplies or medication on time... it is not worth it, I'll just find another way," another said.

The Future is Mobile

It is important to keep in mind, as we focus on creating new services or doing things to improve lives, that we don't only focus on the big city centers. While return on investment is important, if we can focus on the greater good, it would benefit society beyond expectations. Zipline is a UAV Delivery Service doing just that. Zipline has been distributing critical medical supplies throughout Africa for over four years now and was recently tapped to deliver personal protective equipment and medical equipment in North Carolina in response to the COVID-19 Pandemic. [7] The connection with the appropriate regulatory groups allowing this type of drone delivery and the company's ability to tout its track record in Africa can't go understated.

Undoubtedly the impact that VTOLs will have on our cities will be significant. It will redefine how we live, how we commute, and how we value our time. To get there, the technology still has an uphill battle. Not only does many of the emerging technology required to make this future a reality not really exist yet, but when it does, it will need to be thoroughly vetted before we see it flying around city buildings. However, this future may not be as distant as one might think — and just maybe, we will see this technology flying through our amber waves of grain first.

Insights from Corgan's Rural Mobility User Study

"Most businesses... when they focus on creating new services or doing things to improve life for their customers. They focus mainly on the big city centers.... I think if some of these innovations... could be implemented, in rural communities... it would help out with a lot of the problems (with) the difficulties of obtaining supplies."

RURAL RESIDENT

"You have to go to one of the closest cities to get what you need. And sometimes those cities don't have what you need so you drove 40 minutes to get nothing. "

RURAL RESIDENT

"In the winter it's pretty difficult (to get to the next major city depending on snow fall, ice on the roads, things like that. We live off of a dirt road so that it's not always plowed."

RURAL RESIDENT

"When you need to get somewhere, you're pretty much biking, walking, or driving yourself because we don't have anything like buses or services. Nothing comes out this far..."

RURAL RESIDENT

"The place that I'm in, the GPS won't take you to this exact location because it just doesn't know this area very well. For the most part, I end up purchasing things online and having them shipped to me cause UPS does deliver here, which is great."

RURAL RESIDENT

"I'm very comfortable with the concept of drone delivery... my only concern is sound. It would be disturbing that I've moved to this country place for peace and quiet from the big city. And now I have this loud racket from the things in the sky. So, one hopes that this is a quiet machine."

RURAL RESIDENT

Takeoff Technologies: Hyperlocal e-Grocery Shopping

Both Urban and Rural Air Mobility have an opportunity to integrate other systems and emerging infrastructures. Takeoff Technologies is an e-grocer solution where orders are placed online through established retailers and Takeoff's automated technology fulfills the order using robots in micro fulfillment centers. Automated micro-fulfillment centers operate at a much lower cost-to-serve than other e-commerce platforms, which solves for both the cost of assembling the order and that of the last mile.

Takeoff's micro fulfillment centers are intended to be built throughout the U.S. resulting in convenient and hyperlocal solutions for grocery shoppers nationwide. **This type of technology can address inequities that exist within the food system, which often impact rural communities are cut off from urban infrastructure.**

On October 2, 2018, Takeoff Technologies launched the first automated hyperlocal fulfillment center, referred to as the world's first robotic supermarket in partnership with one of the largest Hispanic grocers in the U.S., Sedano's Supermarkets. In this model, customers place their orders via an online app and, with the help of Sedano's employees, the transaction is completed by Takeoff's automated micro-fulfillment center. AI-enabled robots assemble full supermarket orders of up to 60 items in just a few minutes, helping Takeoff achieve their goal — hyperlocal fulfillment centers that have one-eighth the footprint of a typical supermarket.

Dueling Perspectives

19.9%
national office property vacancy rate projected for 2021, growing to **20%** in 2022[6]

In contrast, to increase spontaneity, Amazon signed leases for office space in 6 cities around the U.S., totaling

900,000 SF
in 2020[3]

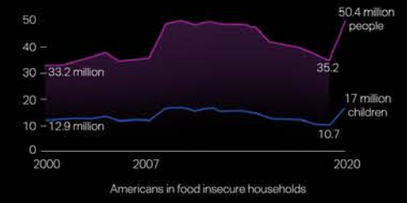
34%
increase in productivity when using personal portable devices for work tasks[2]

In 2019, employees worked away from their desks **50%-60%** of the workday[4]

22%
of employees can work remotely between 3-5 days a week without affecting productivity[3]

66%
of employees are expecting to work from different locations post-crisis[5]

40%
U.S. food is never eaten. If more precise growing areas are closer to demand, **15%** of the lost food could be captured, feeding **250 million**[15]



2020 drove an additional **15.2 million** people into hunger[11]

On average, food travels **2 weeks** from farm to city table, reducing the nutritional value by

45%[15]

20-35%
cost reduction[15]

The potential for remote work in

Finance **86%**[3]

Agriculture **8%**[3]

100,000
U.S. jobs will be generated in indoor agriculture in the next 10 years[13]

1 acre
for every **80 acres** of traditional farming[14]

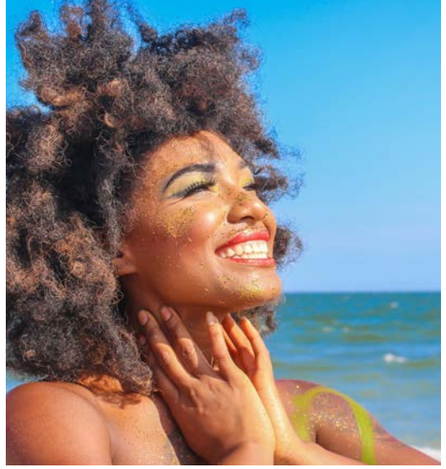
40 to 1
plants yielded with vertical farming versus traditional agriculture[15]

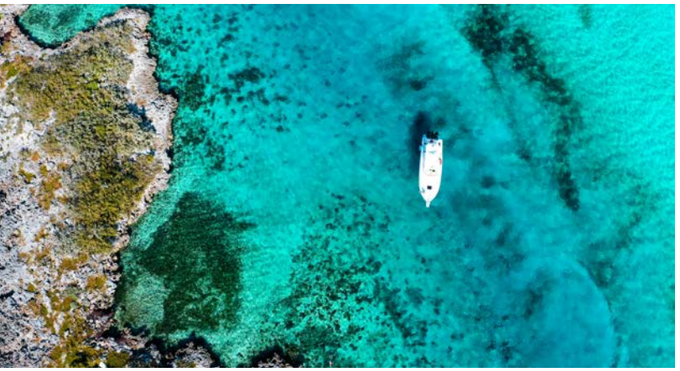
PRODUCE

Our central business districts have always been the center of work productivity, with equally resilient economies. However, the virus has broken through cultural and technological barriers that prevented remote work in the past, setting in motion a structural shift in *where* work takes place[3], and ultimately, leaving valuable real estate in flux. While not all tasks are created equal, and most workplaces with tasks that require on-site physical presence will return post-pandemic, it's possible some spaces can provide opportunities to support the growing cities and communities within which they exist. All they need is a new kind of office plant.

More than 23.5 million people live in urban food deserts across the U.S.[9], unable to put fresh-quality food on their plates due to high costs and lack of access. Conversely, urban gardens and container farms grew in popularity during 2020, without sicgns of slowing anytime soon. With the recent office vacancies during the COVID-19 pandemic, there is an opportunity to bring quality food for less money to the center of our cities. Companies like Growtune[10] have already begun transitioning offices into vertical farms through the use of A.I. to improve quality, moving the produce closer to the demand — and giving access to quality food to those who need it most.

PRODUCE





Reshaping the Caribbean

TENAJ PINDER

From the Bahamas to Guyana, Grenada to Puerto Rico, the Caribbean archipelago represents a diverse set of island nations, their cultural identities, and the communities that support them. This region has been a longstanding tourist attraction that features a mix of various land masses from mountains to flat beaches, jungles and diverse ecosystem.

However, while the Caribbean is a source of international tourism and intrigue, its location presents substantial challenges as climate change leads to rises in sea levels and sea surge erosion along the coast. According to NASA, sea level is expected to increase by 1-4 feet by 2050 which could impact coastal Caribbean communities if they are less than 10 feet above the sea level. [1]

The field of architecture fundamentally examines how people live. And as different communities around the world adapt to changing forces like climate change and emerging economies, it is our responsibility to understand this evolution in human behavior.

The Caribbean diaspora is a result of Indigenous, African, and European populations that have occupied the region throughout history, producing a diverse cultural identity that is defined by its relationship to land and water.

A Closer Look: The Bahamas

In contrast to its sister islands, this island nation is flat, having no mountains, and as a result, no rivers either. With no protection from the Atlantic Ocean, the Bahamas is one of the most vulnerable Caribbean communities. Beautiful in sight, its unique landscape offers little to no room for refuge from eventually being swallowed by the ocean — only the surrounding coral reef structure provides the islands protection from erosion.

However, recent catastrophic storms like Hurricanes Matthew and Dorian have pummeled through the region, reaching Category 5 level intensities. The year 2020 has recorded as many as 30 named storms, destabilizing the natural storm breakers such as coral reefs, mangroves, and the surrounding ecosystem which results in less natural protection and contributes to rise in sea levels.

These hurricanes don't just impact Bahamian terrain; they alter the way people live. They impact our social networks, the jobs we seek, the media we consume and the choices we make. **As erosion destroys coastal tourism, agriculture, and freshwater resources, how will Bahamians adapt to new ways of living and working?**

Influencing for the Future

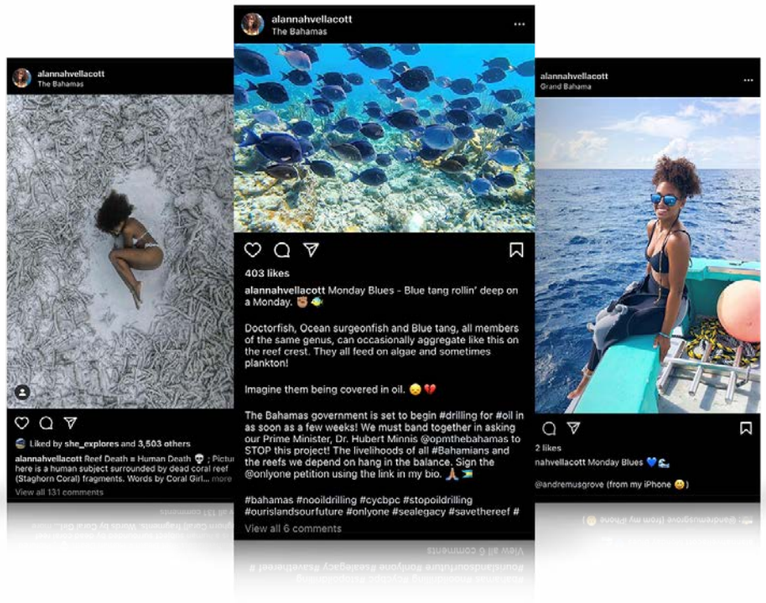
These Bahamian influencers have taken to the seas (and their Instagram platforms) as they consider what living on the ocean could look like due to a sinking island habitat.

Alanah Vellcott

Marine Ecologist

Alanah Vellcot believes the region needs to spend the time and money on green solutions that are already in place. Natural flood prevention like mangroves and coral reefs utilize the naturally built environment to break wave impact and prevent sea floor erosion. Rehabilitating these reefs and replanted mangroves soak up the incoming flow of water before coming inland and it reduces storm surges. Alanah currently uses an aquarium lab that grows coral to rehabilitate and replant it back into the ecosystem.

“Invest in green solutions.”



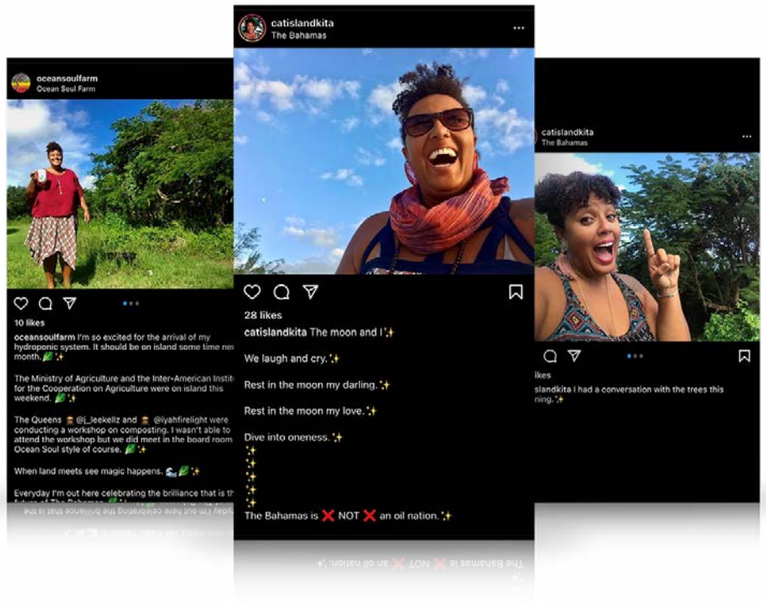
Nikita Sheil-Rolle

Marine Biologist

A leader in biodiversity, environmentalism and climate justice in the region, Nikita believes the Caribbean’s colonial roots play a prominent role in its fight against climate change. She envisions a 10-year plan called *Operation Teal* to help break the bad environmental habits of the past.

Nikita spends her time educating the next generation of young marine explorers on how people can live seamlessly with their natural surroundings. Nikita believes it is important for young generations to learn how to take care of their environment. Her responses to the arrival of climate change, “It’s been here!”

“Climate change: it’s been here!”

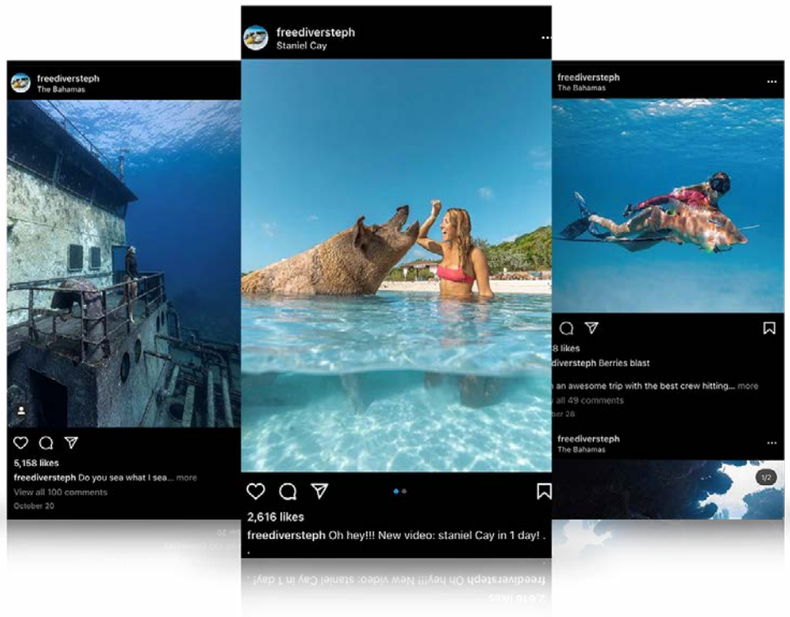


Stephanie Lynn

Charter and Free Dive Instructor

Stephanie spends more than 98% of her time at sea where she charters her catamaran and trains divers visiting the Bahamas. During a recent discussion about climate change, she was asked about the possibility of living entirely on the ocean. For her, it was a no-brainer and "completely possible". Stephanie lives mostly on the ocean already, and only goes into port for minimal items like propane gas, fuel for the boat, and reef-safe toilet paper.

"Put the planet first. Mimic what nature has to offer and what it's doing before destroying and recreating artificially."



Can you imagine what living on water would be like?

The following communities survive in their regions by floating on the surface of the nearby body of water. These communities have been thriving for decades, if not centuries, maintaining their culture and creating a sustainable lifestyle.

Halong Bay, Vietnam[1]

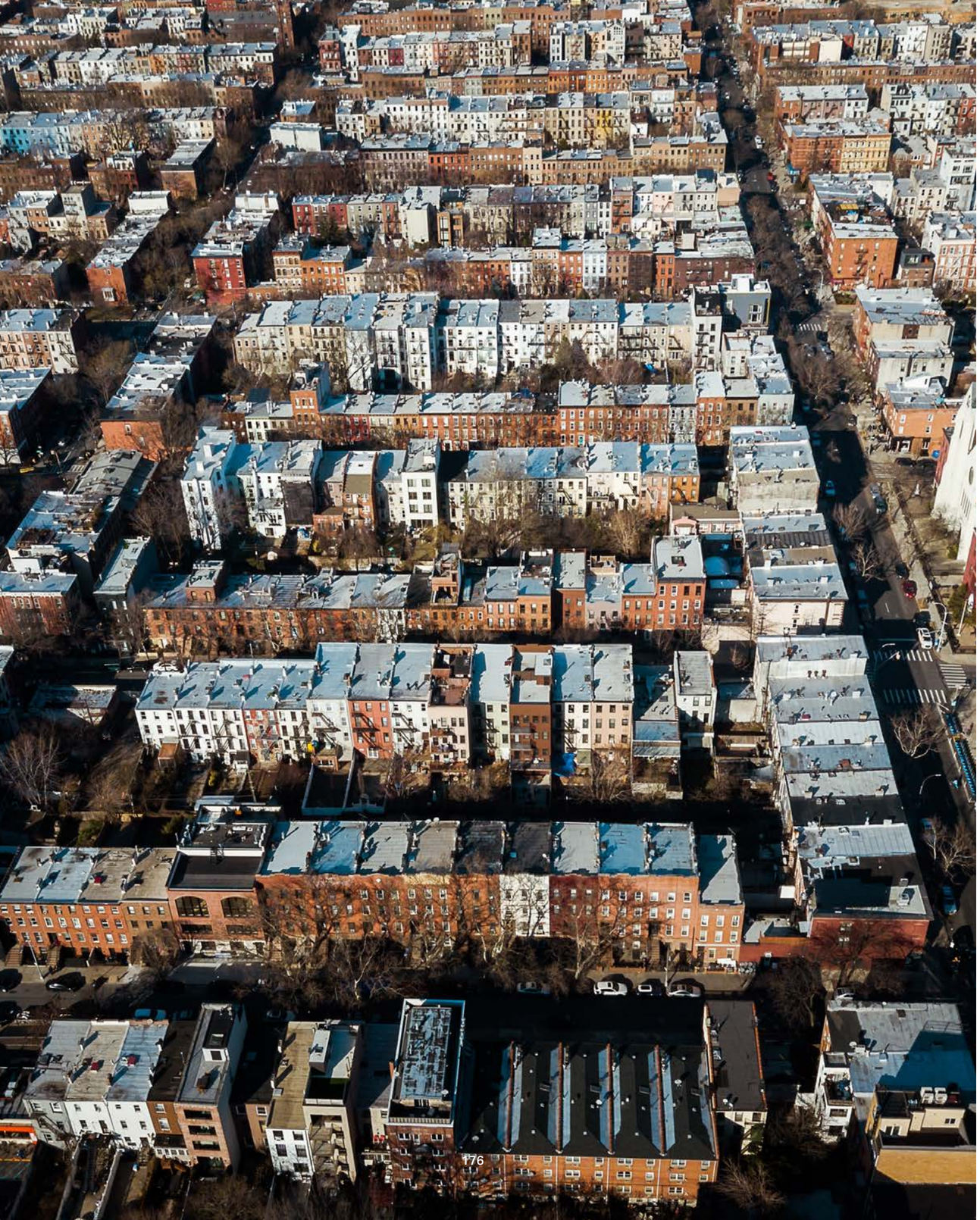
- Population: 1000 inhabitants
- Founded: 19th century
- Pitched roofs and houses that float on empty barrels

Uros Floating Village, Peru[1]

- This original concept was intended to provide defense against rival inhabitance
- Entire island man-made by locals
- Material: Dried Reeds (totora)
- Longevity: 30 years

Ganvie, Benin[1]

- This stands to be the largest village in Africa
- Population: 30,000 inhabitants
- Founded: 1600th century
- Income: fishing and regional tourism



Dividing the Past, Deciding the Future

SAM DODD

Whether they run North and South, East and West, are man-made or natural, dividing lines across American cities determine not only where we live but how. Where you live profoundly impacts access to social determinants of health like transportation, financial support, food, childcare, education, and employment. And while segregation by law has been illegal since the Civil Rights Act of 1964, these dividing lines continue to support unequal access to what has inevitably been suggested as part of the modern-day American dream: home ownership and the right to own property.

As a result of discriminatory real-estate practices and the creation of segregated neighborhoods after the ratification of the 13th amendment in 1865, these dividing lines still exist and often result in extreme racial majorities on either side.

In Kansas City, nearly 40% of zip codes are homogeneous, where at least 80% of the residents are the same race. Some of these divides are created by infrastructure, such as Detroit, where there are 18 zip codes south of 8 Mile Road with populations over 80% African American. Others are geographical, like in Washington D.C. where every metro area zip code has a population over 80% Caucasian, but the population east of the Anacostia River is 90% African American. [2,3]

What would it take to prevent these dividing lines?

> Architecture spatializes political, social, and historical relationships as well as instrumentalizes subjectivities. It brackets place, time, and materiality to events in order to produce meanings and discourse."
>
> **MARIO GOODEN, DARK SPACES** [1]

Scan this QR code to check out the *Racial Dot Map* here and see for yourself.

Systematic Racism

While research suggests that systemic racism is often learned through experiences, it can also be taught through more formal channels like education. In February of 2020, CBS News investigated how African American history is taught across the Unites States and found inconsistent standards. Because there are no national guidelines for social studies like the Common Core State Standard Initiative for mathematics and English language arts, each state decides what their public-school students are required to learn about United States history. **The study found that eight states do not mention the Civil Rights movements, seven do not directly mention slavery, and only two states mention white supremacy in their standards.** Although staff members could choose to supplement state requirements, the topics are left subject to their personal interpretations and preferences. [4]

Let's Look Back in Time

Legal housing discrimination started in 1877 with the introduction of Jim Crow Laws that enforced racial segregation. Part of these laws included exclusionary zoning requirements that specifically prohibited the sale of property to African Americans. These were eventually deemed unconstitutional in 1917 but were replaced with racially restrictive covenants which were agreed upon between property owners to prohibit the future sale of individual properties to specific racial groups.

In 1934, the Franklin. D Roosevelt (FDR) administration passed the New Deal and the Federal Housing Administration (FHA) incentivized home ownership as a recovery effort from the Great Depression. Using a process called redlining "banks and other institutions refuse to offer mortgages or offer worse rates to customers in certain neighborhood based on their racial and ethnic composition." [5] These "residential security maps"[5] were created for over 200 American cities. These maps inevitably decided which neighborhoods were safe investments for the government to make when issuing mortgages.

These racial covenants were declared unconstitutional in 1947, and redlining was prohibited as part of the Fair Housing act of 1968 [5]; however, both practices had already solidified the dividing lines across American cities. Although not explicitly written, racially discriminating practices are still used today — a 2019 Newsday investigation reported multiple real-estate agents in Long Island, New York were asking for different financial qualifications from White and Black homebuyers and steering them towards different communities. [6]

Scan this QR code to view an interactive map of historical residential security maps across the United States that indicate Best, Still Desirable, Definitely Declining, and Hazardous neighborhoods. These ratings were used by banks and institutions to refuse mortgages and other loan opportunities.

In the United States, homeownership is viewed as a critical steppingstone for acquiring and passing on generational wealth. A house itself can be inherited, or the equity within it can be used for a down payment on another house, a college education, or business capital to set up future generations for success. According to the 2020 U.S. Census first quarter data, 73.7% of White families own their home, compared to only 44% of African American families. [7] And according to Urban Institute, the today's gap is larger than the 27% difference that existed in 1960.

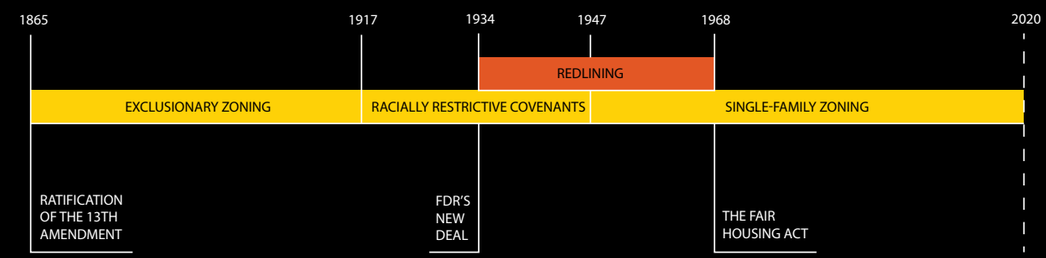
Additionally, the Federal Reserve reported in 2016 that the average renter had a household wealth of just $5,200 compared to the average homeowner at $231,400. Before 1968, African American families were not only kept out of specific neighborhoods where property values were increasing, they were also forced to settle for subprime loans with higher interest rates. [6]

Minneapolis, a national focal point after the death of George Floyd in May 2020, has the widest gap between African American and White homeownership at 25 and 76 percent respectively. [7] The neighborhoods with the most racial covenants were soon after exclusively zoned for single-family residences, keeping the land development pattern locked. Today, houses in Minneapolis that once had racial covenants attached to them are worth 15% more on average than identical houses without.

Looking into the Future

As of October 2019, the city of Minneapolis will be the first major American city to eliminate single-family zoning as part of their new zoning plan. The Minneapolis 2040 initiative aims to create more housing density near transit systems and jobs, addresses racial inequality and combats climate change. [8]

Oregon soon after followed suit on a state-wide level to eliminate single-family zoning in all cities with populations above 10,000 people. They refer to this movement as "upzoning" as it seeks to provide the "missing middle" housing that falls between single-family homes and mid or high-rise apartment complexes. [9] Although both plans faced opposition, they will ultimately create opportunities for affordable housing outside of dense and polluted urban areas.



In addition to physical and economic boundaries, dividing lines can also be created through planned infrastructure that results in health disparities by polluting the environment around them. Half of the highways in America originated as part of the Federal-Aid Highway Act of 1956 (thirteen years before the Fair Housing Act) and were disproportionally placed in minority neighborhoods. The suburbs flourished thanks to the ability to quickly escape the city. Consequently, in the first 20 years of development alone, over one million people of color were forced to leave their homes that stood in the path of highway developments. [10]

> The Asthma and Allergy Foundation of America reports that African Americans are five times more likely to go to the emergency room for asthma-related issues, and three times more likely to die from them than White Americans. [12]

What do communities impacted by large-scale infrastructure projects face today? A study in California analyzed eight cities across the state and found in all cases, historically redlined neighborhoods contained nearly twice the amount of diesel particulates in the air. [11] Diesel particulate matter is a component of diesel exhaust that combines carbon, ash, metallic abrasion particles, and silicates. In high concentrations, exposure can cause severe headaches, dizziness, and irritation of the eyes, nose, and throat. Long-term exposure is proven to increase the risk of lung cancer and cardiovascular, cardiopulmonary, and respiratory diseases like asthma. Those in the mining, construction, freight, machinery, and auto-maintenance industries are at the most risk of exposure, but their health is covered by various safety and health administrations and industry standards put in place. [11] There are no such protections granted to residents of infrastructure-dominated communities, and they came with no warnings of long-term health effects.

Racial inequity in America still faces many barriers, one of which is caused by the permanence of buildings. The physical buildings designed by architects are not the final end-product. Buildings have lives and roles beyond the celebratory ribbon cutting and they will continue to have profound ripple effects on the surrounding communities in which they are located.

> "With dual pandemics in our midst — both the novel coronavirus and the long-standing pandemic of systemic racism — the opportunity for design to make impact is great."
>
> ***WITH, NOT FOR: WHAT DESIGNERS CAN LEARN FROM SOCIAL WORKERS WHEN ENGAGING WITH COMPLEX SOCIAL SYSTEMS*** [14]

Designing a Distributed Education Typology

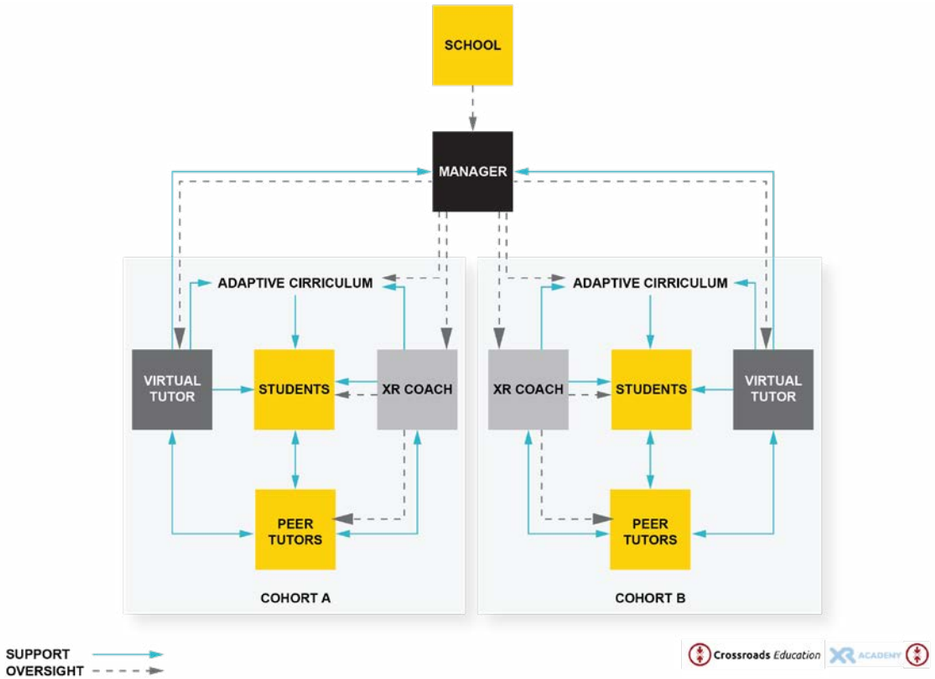
SAMANTHA FLORES AND SAM DODD

Design Sprint Team: Sam Dodd, Gabriel Oros, Anran Li, David Rose, Tania White, Samantha Flores, Lauren Jablonski, Anthony Wang, Jason Mellard, and Scott Gorenc

Over the past decade, evolving teaching methods and innovations have changed the way our students absorb information in and out of the classroom setting. However, the sudden shift to remote learning as a response to the coronavirus pandemic has certainly changed the pedagogical necessity of leveraging and evolving these more personalized teaching methods and new technologies while at the same time placing a burden on the parents who are now juggling working from home and taking on more robust roles as educator, technician, entertainer, and therapist.

We are now deeply indebted to technology for enabling the ability to physically distance, reduce in-person experiences, and slow the spread of COVID-19. However, as we've come to realize increased use of technology has not been an ideal substitute for in-person learning — video calls, online textbooks, and pre-recorded lectures can make learning more challenging for some students. It has exposed a widening technology gap between students and teachers alike, exacerbated a crisis among lower-income families who depend on the school system to distribute meals for their children, and has decreased students' ability to build the social bonds they so desperately need.

Working together with Crossroads Education, a non-profit e-learning management service, we conducted a three-week design sprint to reimagine a new educational system of distributed facilities that augment school districts by providing access and support in a variety of locations. This conceptual network of one-room schoolhouses will leverage unleased spaces vacated due to the pandemic in urban areas and integrate into suburban neighborhoods at a reduced footprint. A mesh network of remote education facilities will work alongside existing school districts — both public and private – to provide a hybrid education system that reduces class sizes for educators, allows for safely distanced in-person learning, provides both a digital and personal support system for students, and leverages innovative learning methods that support individual needs.



Design Sprint: Crossroads Education Learning Pods

To understand the needs of those that directly use these spaces, we conducted 39 separate interviews with a mix of parents, teachers, and those assisting with remote learning pods and other remote learning styles. Each participant shined a light on the various realities that exist in remote education. More than 20 hours of recorded anecdotal data revealed three key factors that are shaping the learning experience — exposing welcome opportunities for change within the remote learning landscape.

Insight 1: The Socio-Economic Divide

"For a student who is in a lower socio-economic status, it's not even just the supplies or the view on education. It's also the food. We have many homeless students. Their individual success hinges on if they can get a good meal, if they can get enough sleep, if they find a place to wash their clothes and shower." – Alternative School Teacher

In 2020, nearly 463 million students[1] and 63 million teachers[2] around the globe were left without access to equipment needed for remote learning, putting the most disadvantaged at risk of learning loss, such as students who do not have the appropriate hardware, software, connectivity, digital skills, and familial support systems required for remote learning. Likewise, teachers themselves struggle as they have in most cases not been trained to be the content creators and health safety enforcers this pandemic has required of them. Crossroad remote learning facilities will need to provide the technical support for both students and teachers alike.

Technical support, however, is not the only concern. In many cases, our schools are not just where students learn, but have become central to students' livelihood and wellbeing by providing meals, healthcare, safety, support systems, mental wellness checks, in addition to access to technology. How can remote facilities provide enough support to students and teachers alike across all socio-economic levels, and continue to advance education through innovation?

Insight 2: The Social Aspect

"When students aren't with their peers they don't learn as well. I think some of that peer pressure is a good thing because it encourages them to do well. If they see their friend doing well, they want to do well too." – Private School Teacher

In crisis mode, the way we educate children and encourage socialization brought obvious challenges. Location, people, and a sense of security have an extreme effect on how we socialize. In-person social interaction helps young children start to develop their sense of self, and also start to learn what others expect of them — whether through conversations, interactions, body language, or learning from each other's behavior. The act of gathering shapes the way we think, feel, and understand the world around us.

But over the past two decades, technology has increasingly become an integral part of the way we communicate and socialize and will likely continue to. To be successful, remote education facilities should safely address in-person socialization, by reducing class sizes to enable safe distancing, and incorporated various and innovative learning strategies among the cohort that foster self-discovery, peer-to-peer learning, and heightened engagement.

Insight 3: Personalized Experiences

"My approach to simplicity has really been beneficial for the students by [allowing] them to practice what they're learning in an experimental way and allowing them to branch out and not do things that were so traditional in the classroom." – Alternative School Teacher

Evolving teaching methods are changing the access students have to more personalized learning experiences that tap into their personal interests — and at the same time provide tools for educators to help modernize the learning experience to increase satisfaction and engagement. In some cases, this means that students are learning by doing. Hands-on experiments — whether instructor-led or not — were a staple for parents trying to engage children in activities while they tackled their own work-from-home duties. Some parents even mentioned taking their children to the zoo when their lessons involved animals or biology. Would it be possible then, for remote education pods to facilitate on-site learning, to tailor learning experiences for students with an aptitude for science, biology and nature? Why not learn about giraffes while feeding one!

Another way to personalize the experience is to make the school more accessible. Remote facilities offer the opportunity to walk to school, and a distributed network — both in urban and suburban locations — could provide safe walking distances that are parent-approved.

"Education today is at a crossroads — it is at a tipping point where the old model doesn't meet the current needs of society. When faced with a crossroad, and you make a choice by understanding what your own needs are, and how they can be supported" – Dr. Kevin Berkopes, CEO of Crossroads Education

Each of these key factors played an important role in establishing the size, accessibility, safety, and spatial requirements that a distributed education system will require in order to be successful for the students, parents, and teachers alike. These insights led us to six overarching needs for each remote learning facility: security, focus, collaboration, socialization, privacy, and engagement.

Each learning zone supports specific needs within the peer-to-peer education model, and can be adapted to fit into any location, regardless of shape or size.

To maximize accessibility across socio-economic levels, the secure entry will need both high-tech and low-tech solutions, such as scanning a smart phone or using a key fob. More personal amenities near the entry include restrooms, laundry facilities, a nursing station with an isolated exit, and a private meeting space – all of which create a well-rounded support system for students and teachers that may not otherwise be able to available to them. The space also includes a small café and pantry, to provide food and snacks for the students who depend on the school system for food security.

Upon entry, students are encouraged to interact with the "class plant" — a trellis wall that reinforces Crossroad's mission to collaborate, innovate, and educate while enabling students to plant their own seeds and watch their plants grow, together.

Flexible Furniture

To maximize agility on the interior, custom furniture solutions enable the space to effortlessly transition from coursework to community support facility — adapting to the various uses of the students or surrounding community as needed. Each zone is designated by the flexible furniture system — such as a modular learning stair in the social zone — in lieu of walls.

The flexible furniture kit allows the students and coaches to fully customize the space, including the ability to store every item to maximize the open space. Configurations can adjust to accommodate any activity – enabling collaborative exploration or acoustic barriers for focused coursework. Seat tops may also be swapped out for an exercise ball, allowing students who struggle to focus the ability to "fidget" while seated.

Privacy Pod, XR Coach Pod, Mobile wifi-enabled Touchscreen, Mobile power pack and lockable storage cart, Pin-up boards

Within the privacy zone, XR coach pods can be used for grading, personal storage, and one-on-one meetings. Privacy pods can be used by the students for independent learning while maintaining a visual for coach supervision. Additionally, flexible classroom tools such as a portable interactive touchscreens, mobile power packs, lockable device storage carts, and a lightweight pin-up boards are ideal for adjusting the space to support collaboration at a moment's notice.

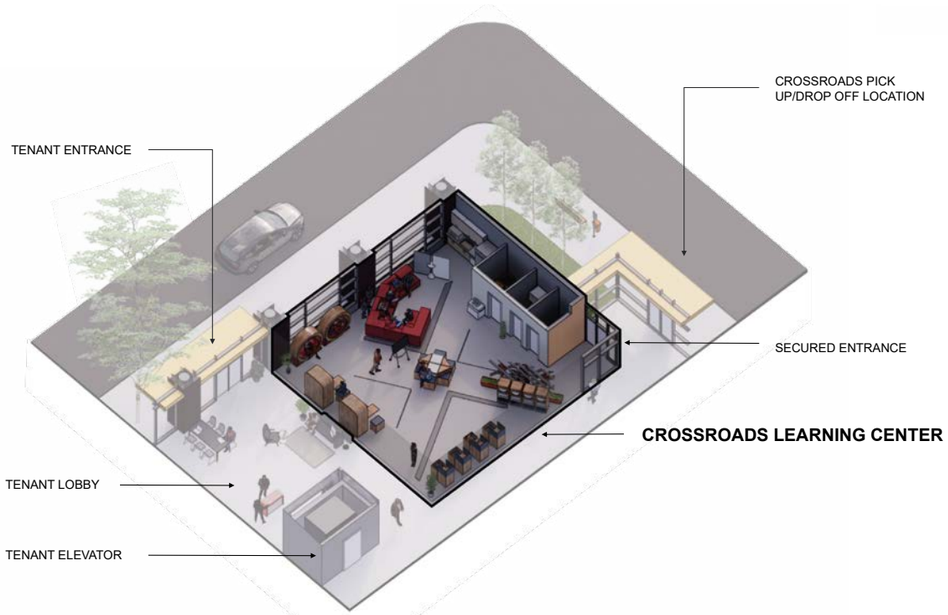
Retrofitting Tenant Lease Spaces

The 2020 pandemic left us with a growing number of vacancies in commercial real estate properties across urban environments – and with a workforce that is becoming more mobilized, most of those spaces have an uncertain future use. Normally, in cities like New York City for example, vacant retail spaces could be turned into hipster lofts, selling at a premium. However, with a recent exodus from the city, they remain vacant without a purpose.

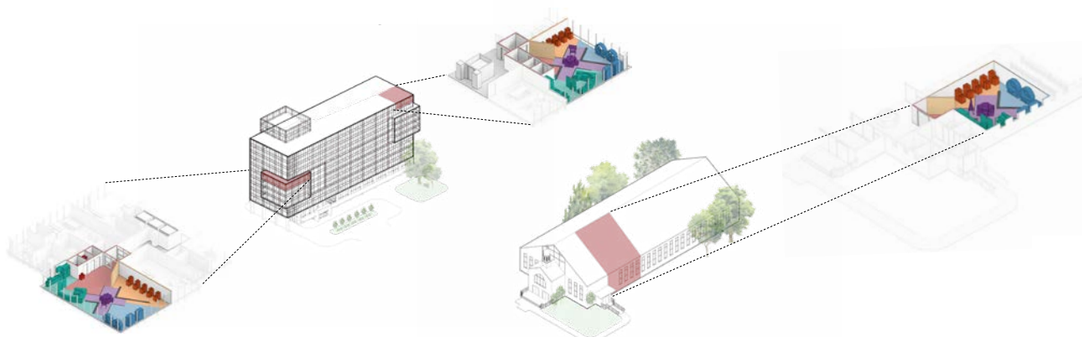
However, New York City also has the largest inner-city school district in the U.S. — with more than half a million students impacted by school shutdowns, forcing students to experience a discontinuity of education. This abundance of vacant real-estate dispersed throughout the city could be ideal locations for remote learning facilities to support the many students living in urban environments.

Using the learning zones developed to support remote education, these commercial units could be easily retrofitted — at a low cost — into a network of remote learning facilities, leveraging space in office buildings, and retail environments.

Likewise, the reduced footprint allows designers to easily integrate them into multifamily residential buildings – whether it be new construction or retrofitting existing public space. Additionally, smaller communities may even consider leveraging a network of churches.

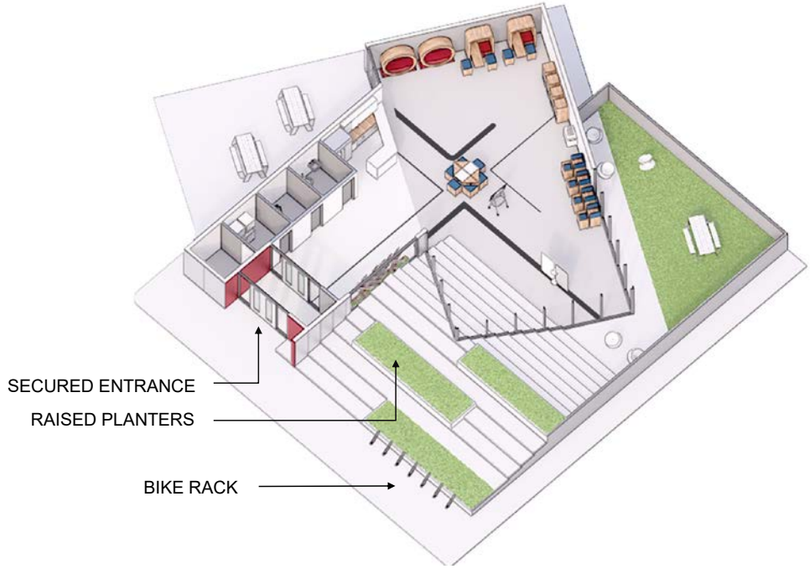


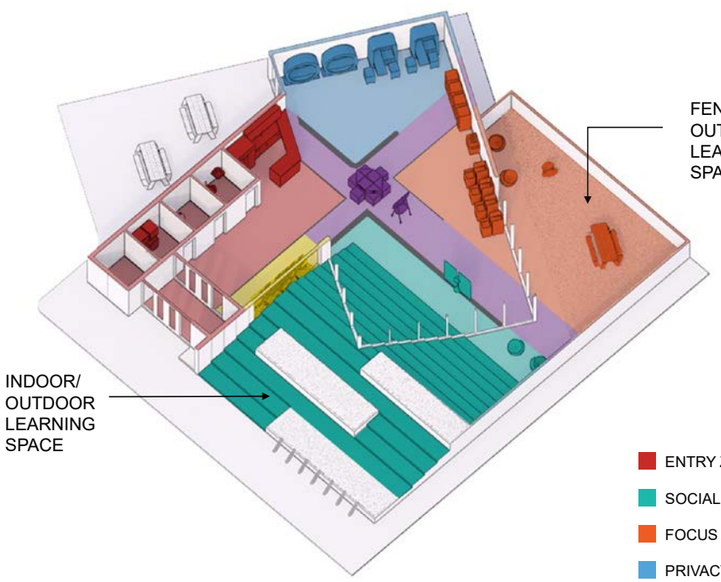
Vacant office or retail space retrofitted into a Crossroads Remote Education Facility



Multi-family Residential Solution

Church Solution





ENTRY ZONE
SOCIAL ZONE
FOCUS ZONE
PRIVACY ZONE
COLLABORATION ZONE
ENGAGEMENT WALL

One Room Schoolhouse

In addition to urban solutions, the same components can be integrated into one-room schoolhouses can be built to provide similar amenities within safe walking distances to the suburban communities. In this case, it is important that the scale and visual of the facility reflect that of the neighborhood, in addition to providing safe, well-lit sidewalks and bike racks to support pedestrian access.

This design engages the community by encouraging residents to grow plants alongside the students in a series of vegetable garden planters, or to engage in the indoor/outdoor learning stair.

Additionally, exterior picnic tables and parking are reserved for local food trucks participating in subsidized efforts to feed the students lunch each day.

When considering the challenges brought on by COVID-19, providing a network of distributed education facilities is a solution that can support remote education for students as well as augment the teaching experience by redistributing and reducing currently overcrowded classrooms. This vision can support a variety of learning experiences across demographics and geographies. At last, we can see a future of quality education, basic health support systems, and personal mentorship for all.

Designing Access to Education

TINA NARAGHI-POUR MCKONE

How might we design equitable education experiences?

Children raised in poverty face overwhelming challenges that significantly impact their mental and physical health which, in turn, effects their ability to learn. These social determinants of health, like reliable transportation, financial support, job opportunity, and access to fresh food, have profound impact on children as they complete their education and cultivate a curiosity for learning.

> "If we don't understand our own power and privilege in relation to the communities within which we work, we can perpetuate biases in our design outputs and negatively impact the relationships we build."
>
> **WITH, NOT FOR: WHAT DESIGNERS CAN LEARN FROM SOCIAL WORKERS WHEN ENGAGING WITH COMPLEX SOCIAL SYSTEMS** [7]

One of the fundamental requirements for emotional health in children is attunement, a relationship building process where one receives ten to twenty hours of "harmonious, reciprocal interactions."[3] Attunement is necessary to form a range of healthy emotions including joy, anger, sadness, and empathy, and has the most impact during the first six to 24 months of life.

Historically, low-income families face circumstances that require many parents to work long hours (or multiple jobs) outside of the conventional 9-5 workday. As a result, children raised in low-income households may lack opportunities to build certain emotional skills their peers have built in these early, formative years.

And while formalized segregation of schools was outlawed at the state level in 1954, isolation and inequities remain.[8] (School Segregation and Integration n.d.) Cities across the United States have a history of designing infrastructure in prime locations that strategically disconnect low-income neighborhoods from the rest of the city, exacerbating the situation.

As designers, we have a responsibility to critically examine the educational infrastructure and support systems we are recommending — not only for the development of our cities — but more importantly for the communities that inhabit them.

Ways architects and designers can integrate inclusive design features into their school sites:

- When it comes to extracurricular activities, consider a strategic location for SES students that is easily accessible by public transportation.
- Consider access to bike lanes and safe walking paths that are well-lit for young children or individuals without private cars.
- Activate greenspace on campus for students to convene and be together outside of regular school hours. The difference between hanging out and loitering is place — let us provide that place.
- Offer on-site laundry services for students who may need them.

The Mega-School Approach

In the 1970's, consolidated schools — also known as mega-schools — began replacing neighborhood schools. These mega-schools pulled students from a diverse set of backgrounds with a goal to desegregate and provide additional course options and extra-curriculars to a larger population of students. The well intention to further accessibility, combined with their economic efficiency, accelerated their popularity. However, complications started to manifest when EACH was not addressed due to large, overwhelming class sizes.

It was apparent that students from more affluent backgrounds were outperforming students from low-income households, whose disproportionate financial struggles were contributing to their emotional and social development. Multiple studies attribute affluent student success to higher levels of parent involvement and in some cases, the ability to afford tutors. These studies also show that, regardless of socio-economic status, all students attending smaller schools have higher test scores, lower dropout rates, and are more likely to enroll in college. [9]

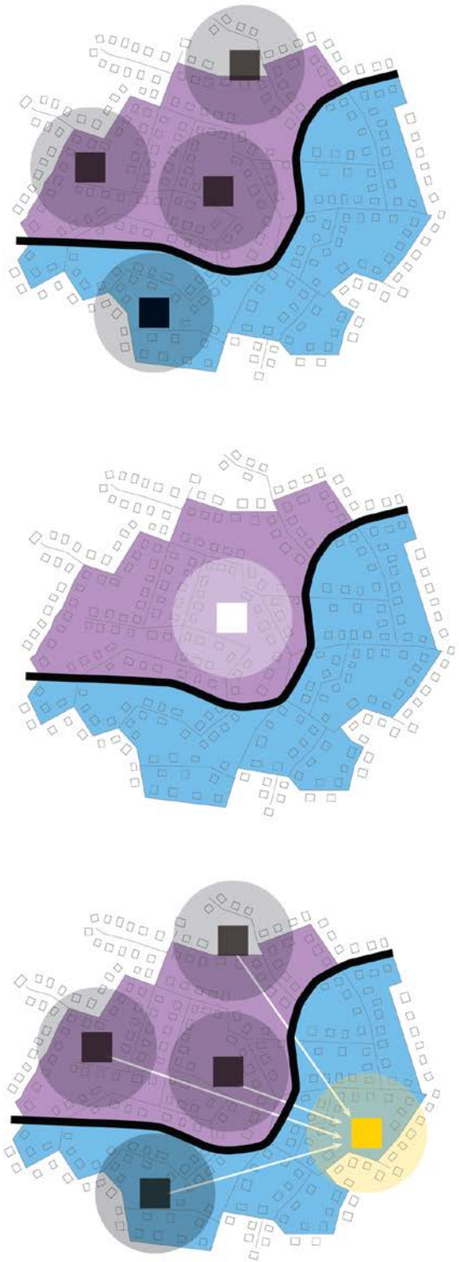
However, mega-schools have proven to be successful at one thing — the range of student it attracts. By drawing students from a larger catchment area, diversity — in both household income and ethnicity — increases. This leads to a reduction of prejudice and a deeper empathic response between students as opposed to isolation and separation. [10]

Desegregation Busing

Beginning in the 1950's, a controversial effort to speed up the integration of schools began by busing minority children to predominantly white schools and vice versa. Although research proved that desegregating schools significantly increased educational and occupational achievements, college quality, and adult earnings for black students, a series of court rulings in the 1990's deemed desegregation plans no longer necessary. Today, a 2019 report by EdBuild found that more than half of U.S. children attend schools in districts where the population is either more than 75% white or more than 75% non-white.[11]

Diversity and class variety were two original goals set by the mega-school methodology. Today, however, some districts are looking at how they can provide the variety without having to expand the size of existing schools. The Barbara Jordan Career Center, a public vocational school within the Houston Independent School District, serves eight neighborhood schools on two schedules. Students are bussed in during their designated time and can complete certifications in areas such as welding, cosmetology, and culinary training. When classes end, they return to their neighborhood schools.

This has been viewed as a successful model for two reasons. First, it achieves the goal of providing more elective opportunities to students. And secondly, it diversifies the student populations between schools, enabling a wider range of students to interact with each other daily, expanding their world view and opening the door for alternative perspective.



05

TELESCOPIC PERSPECTIVES

"To take the telescopic perspective in any way — is to humble ourselves, to dwarf our hyperlocal human dramas against the backdrop of a far vaster reality. If only we could move through the world with the continual awareness that we are each but tiny particles of universal matter."

MARIA POPOVA

What to expect

How will our role as architects and designers evolve into the future?

It's time to look up at the stars and into the future. Technology is advancing every day and, with it, pushing the boundaries on what we ever thought was possible. As human beings venture to the moon and beyond, what will non-earthly architecture look like?

Digitizing Scent for Space Exploration

SAMANTHA FLORES, TANIA WHITE, AND CHERIE MATTHEW

The association between fragrance, emotion, and memory is not just the invention of poets or perfume-makers. Rooted in the deepest parts of our brain, our sense of smell relates to many precognitive processes like memory, emotion, navigation, and intuitive spatial awareness, which makes it a powerful architectural tool for designing meaningful experiences.

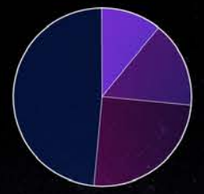
No other sense is directly wired to the emotion-processing part of the brain. When every other sense is engaged, you think before you respond — but with scent, your brain responds before you think, making it one of our most reliable senses. For this reason, it's the most primal of the human senses with an unrivaled power to inform the way we design human experiences.

As we begin to explore the cosmos, we can't help but realize that outer space, however, is devoid of smell. Due to the sensitive environments of spacecraft, spacesuits, and space stations, there seems to be no place for aromas and fragrances. However, space is about to be a frontier opened to all and understanding the need for multi-sensory experiences to calm anxieties, focus the mind, and create a well-rounded memory is important for the success of commercial space travel. Today, astronauts are trained, on average two years, to become fully qualified for space flight — and that includes understanding the mental health fatigue that spending weeks, months, or even years in space can bring. Known as the "Third Quarter Phenomenon," people in extreme, isolated environments will see a decline in behavior and performance, regardless of mission duration. During this time, there is a growing anticipation to return home. Currently, the astronaut's psychological support system does not include scent. Knowing the positive effects scent can have on focus, memory recall, and creating a renewed connection to loved ones — and as we begin to design a human-centered experience for future commercial space passengers — how can we ignore one of the most powerful human senses?

Chosen as a finalist for the Moonshot Poster competition for SpaceCom 2020, our research surfaces the need and ability to digitize scent for positive memory recall during the Third Quarter Phenomenon. By recreating scents of loved ones or fond memories of terrestrial origin, our sense of smell can stabilize our emotions and help to successfully process ongoing stress. Using this foundational understanding, the Olfactory Experience Design Tool reconnects both experienced astronauts and novice space explorers with the essence of home through memory and emotion.

Dueling Perspectives

New campers are more diverse than the overall U.S. population[1]



49% white

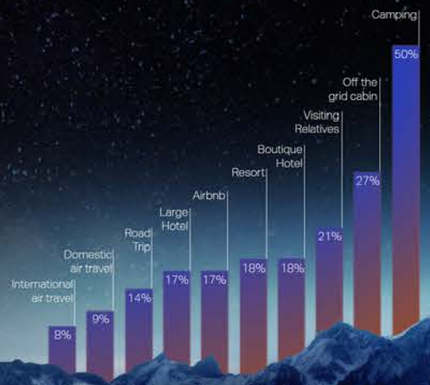
51% non-white

16%
of all leisure travel in 2020[5]

91 million
U.S. camper households in 2019[2]

Most campers stay within

100 miles
of home[4]



North American travelers believe camping will be the safest way to vacation once COVID-19 restrictions are lifted.[3]

The Great Smokey Mountains national park is the most popular place to camp in the U.S.[4]

TERRA FIRMA

The outdoor hospitality industry has steadily increased in popularity for the past decade — escalating even further during the coronavirus pandemic. Camping is proven to have a variety of emotional and physical health benefits, and because campsites can be found far and wide (within reasonable travel distances) and the equipment to participate ranges in price, the recent explosion is leading to greater diversity in ethnicity, income levels, and generational mix. This renewed love for nature is long overdue, and is revealing the need to view the world from a different lens.

exosphere
621miles

Space Perspective[6] and Virgin Galactic[8] flights starting

2021

$125,000
per ticket initially - as demand rises, the price will drop to $2,000[6]

12 mph
for a 6 hour flight[7]

thermosphere
56 miles

mesosphere
53 miles

stratosphere
31 miles

Space jumping starts at

22 miles[9]

troposphere
9 miles

Space campers will stay within

19 miles
of earth's surface[6]

76%
of people surveyed would take a vacation in space[10]

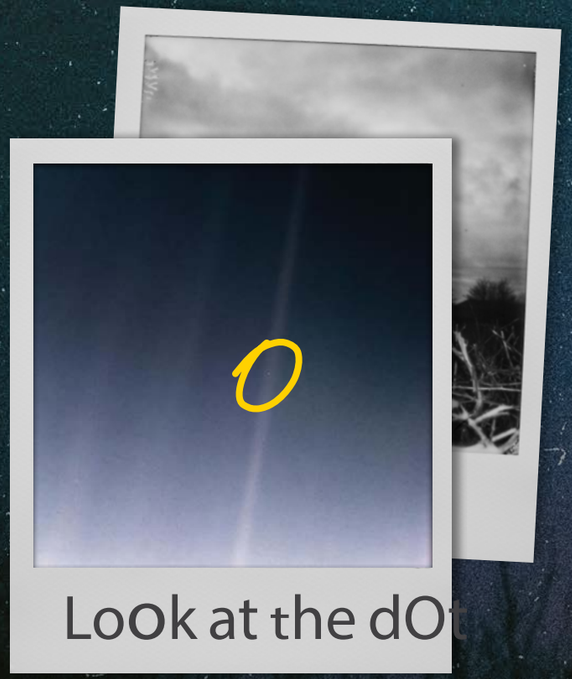
west
over the Gulf of Mexico during summer flights[6]

east
over the Atlantic Ocean during winter flights[6]

Initial flights will launch from the old Shuttle Landing Facility at NASA's Kennedy Space Center[6]

TERRA INCOGNITA

The benefits of camping are not unlike those gained through the Overview Effect — a phenomenon that incites hope for goodwill, concensus, and profoundly changes the person viewing earth from space. Pioneers in the space industry are hard at work, fundamentally changing the way people have access to space by creating life-changing experiences for all to connect with our planet. And back on Earth, major new economic regions based on the manufacture of spacecraft, supporting infrastructure, tourism, and launch sites are beginning to emerge.[10]



Pale Blue Dot is a photograph of planet Earth taken on February 14, 1990, by the Voyager 1 space probe from a record distance of about 3.7 billion miles. The planet occupies less than a single pixel in the image. Credit: NASA/JPL-Caltech[1]

"Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there — on a mote of dust suspended in a sunbeam."

- CARL SAGAN, PALE BLUE DOT: A VISION OF THE HUMAN FUTURE IN SPACE.[2]

The Beeches by Asher Brown Durand, 1845

Transcendentalist Revolution: An Alternative Timeline

CHLOE HOSID

It is impossible for us to anticipate every consequence to any decision that we make. Whether our concerns lie in the near future or the distant one, it is not within our power to see beyond the present moment with complete clarity. Often, the chain of events that move us forward or lead us astray are the consequence of many decisions that unfold over generations.

We are born into the world as it is, and we are carried with the current of forward progress whether it's moving in the right direction or not. But every now and then, there is a rare moment when the world stops, and we have the opportunity to take a breath and look at what we've created with fresh eyes. It is our responsibility in that moment to reflect and to seize the opportunity to recommit to future-focused values that prioritize health, wellbeing, and balance. We have found ourselves in one of these rare moments; living in a precarious time of simultaneous stillness and chaos, and never has the importance of our collective actions been so apparent.

Issues surrounding evolving technologies, economic ambitions, human health and wellbeing, environmental stewardship, and changing social dynamics are deeply intertwined within the human experience. How those issues were dealt with in the past shapes our experience now, and the choices we make now will shape the future, in turn. If we reflect on the past, not just to change a singular event, but at opportune moments where a change in mindset could have set us up to follow a better path, we can internalize lessons from our own history and make better decisions moving into our future. **So, let's engage in a little thought experiment — what would the world look like today if the ideals of the transcendentalist movement and naturalist philosophy had guided or influenced the progression of the first industrial revolution?**

At the turn of the 19th century, the West was in the midst of a period of rapid technological advancement that fundamentally changed the structure of our formerly agrarian societies and shifted human populations into industrialized, urban centers. [1] With this transition from a culture of hand-made, finely crafted, local, "cottage industry" production, to one of centralized mass production utilizing new machines and techniques fueled by coal-powered steam engines, we saw the rise of big cities and a changing relationship to our communities and the natural world. [2] From our perspective, here in the 'future', we know that these

incredible advancements, as important as they were, came at a cost: to feed this great machine of forward industrial progress and technological innovation, everything become a resource, and concern for the consequences for human life and the wellbeing of our planet were largely swallowed by a spirit of ambition and the machine of industry.

In 1836, an idealistic philosophical resistance group and social movement championed by great thinkers like Ralph Waldo Emmerson, Henry David Thoreau, and Margaret Fuller arose.[3] Guided by the principles of *naturalism*, which viewed science as the route to discovering important truths about reality, including the human spirit, and Kantian thinking [4], the *transcendentalist* movement opposed the conformity that characterized the industrialist age; and instead encouraged individuals to embrace the inherent divinity and "goodness" of nature and humanity by connecting deeply with themselves and the natural world.[5] The movement was characterized by its uniquely American idealism, spirit of reform, and progressive views on feminism, abolition, and communal living.[3]

In essence, the transcendentalists believed in equality, individualism, self-reliance, integrity, and optimism. Theirs was not a philosophy of idleness, nor was their perspective at odds with ambition and innovation.[5] Rather, for the transcendentalists, human creativity and imagination would allow individuals and collective society to "transcend limits and reach astonishing heights", all while maintaining their veneration for nature and human wellbeing.[3]

There was an opportunity during this moment in history to reframe our collective approach to forward industrial progress that could have set humanity up for a healthier, more sustainable future. Integrating the transcendentalist focus on nature and humanity into mainstream thinking towards the end of the first industrial revolution could have had a positive, balancing influence on industrial pursuits; ensuring that advancement, ambition, and technological progress does not have to come at the expense of the natural environment or human wellbeing. Had our connection to the natural world and our true human nature been prioritized at this time, many of the downstream, negative impacts that later resulted from the shift towards industrialism could have been mitigated before they became the significant problems we face today.

What would our world look like today had this alternative version of history come to fruition? With a big-picture, future-focused mindset that integrates science, nature, technology, economics, and human needs into innovation and decision making endeavors, a transcendentalist overlay on the industrial era could have resulted in a more decentralized model of urban development.

Focusing on maintaining a sense of community and empowering those communities to meet their own needs, a change in scale would support efficient, localized production of goods and resources that reduces the environmental impact associated with large-scale, industrialized farming, manufacturing, and shipping practices. Combining a community's intimate understanding of their local, natural environment with advancing technologies could have yielded a sophisticated and efficient urban permaculture design methodology that balances human needs and interests with environmental stewardship. An industrious spirit paired with this environmental ethos would forward the advancement of sustainable sources of energy, thereby curbing the dramatic increase in pollution that was associated with the industrial age. Retaining specialized knowledge, craftsmanship, and a connection to the local environment would support community autonomy and preserve knowledge that would otherwise be lost to the industrial machine. And finally, having science, and a respect for nature and humanity placed at the center of our philosophy could have propelled us towards a more inclusive society while promoting an ethical, future-focused mindset that prioritizes balanced, long-range outcomes like a healthy planet, economic prosperity, and human wellbeing. While we are under significantly more pressure in the present moment to achieve these same goals, it is not too late to refocus our collective energy and work towards implementing a Transcendentalist Revolution in our own time — our future depends on it.

Voyage of Life - Youth by Thomas Cole, 1842

The Departure by Thomas Cole, 1837

NATURAL FOREST

A natural forest will be maintained and protected around the perimeter of the city. Sustainable forest management practices will be followed to protect the health of the forest ecosystem while providing responsibly harvested timber for necessary use in the city. The natural forest will provide a wide array of ecological and human health benefits.

HABITAT PRESERVATION AND AQUACULTURE

Wildlife habitats and ecosystem services will be protected in large nature preserves beyond the city's urban core. Scientists will monitor the health of the natural environment to ensure minimal impact from human activities, and the nature preserve will be open to city residents for recreation and exploration. Sustainable aquaculture will be practiced to provide a locally sourced, low-impact food source for city residents.

URBAN CORE

This city's strong focus on integrating nature and the development of warm, resilient communities is complemented by the scale and density of a vibrant urban core where the larger city community can come together as a whole. Shared gathering spaces, urban resources, and connections to other cities seamlessly integrates modern development with benefits of a more distributed, lower density, nature-based, hyper-local, community-based society.

AGRICULTURAL INNOVATION COMMUNITIES

Cooperative communities at the perimeter of the city integrate local knowledge with advancing science and technologies to focus on ecologically balanced, regenerative farming practices. These communities support the health of the entire city through food production and environmental stewardship and have a close connection to schools and universities, workforce training, industry partners, scientific research institutions, and healthcare.

GREENBELT PARKS

Greenbelt Parks are located throughout the city, ensuring equal access to green space for health, wellbeing, and recreation. Greenbelt Parks will be enlivened with community gathering spaces and will bring balance to the built environment.

GREEN ENERGY AND TRANSIT CORRIDORS

Renewable, emissions-free energy production is carried out in green energy corridors that permeate the rings of the city grid. These corridors feature solar, wind, and other green energy production technologies. The energy produced will power the city's public transit systems and systems for the transportation of goods produced in the agricultural innovation and maker communities. These corridors serve as connectors for urban and nature-based function in the city's greenbelt parks.

MAKER COMMUNITIES

An emphasis on the local production of goods means Maker Communities are an integral part of the city's culture and functionality. Local artisans craft quality goods using their specialized skills and modern technology, creatives enrich life in the city through their innovation and originality, and intellectuals collaborate with scientists, makers, entrepreneurs, and students to inspire innovation throughout the city.

From ***How to do Nothing***, by Jenny Odell

Where Does My Rain Come From?

[It's] impossible to draw a hard line around bioregion. That's because bioregions aren't anything more than loose conglomerations of species that grow well together in certain conditions that necessarily vary geographically — a similar pattern to human language and culture.

The borders of bioregions are not only impossible to define; They are permeable. I learned this most of all last March, when I idly noticed an article on the front page of the local newspaper about an "atmospheric river" that would be arriving from the Philippines... [Atmospheric] rivers are temporary narrow regions in the atmosphere that transport moisture from the tropics... its water vapor cools and falls in the form of rain. Atmospheric rivers are hundreds of miles wide and can carry many times the amount of water as the Mississippi River. I was surprised to find that California gets 30 to 50% of its rainfall from atmospheric river events...

I had never really thought about where rain comes from, other than the sky. Or more precisely, where my rain comes from. I suppose if you had asked me, and I considered it for a moment, I could have told you that rain comes from somewhere else, but I wouldn't have been able to say where precisely, how, and in what shape... I couldn't put out of my mind the idea that the coming rain had just been in a country where half my family was from, a place I had never been...

I find something comfortingly anti-essentialist in the way ecology works. As someone who is both Asian and white... It's not possible for me to be "native" to anywhere in any obvious sense. But things like the atmospheric rivers...[give] me an image of how to be from two places at once... [Not] only is my mother an immigrant, but [there] is something immigrant about the air I breathe, the water I drink, the carbon in my bones, and the thoughts in my mind.[1]

> The average American today is less empathetic than 75% of Americans 30 years ago.[2]

Just like atmospheric rivers and bioregions, our identities, relationships, and ideas are fluid concepts that are shaped by the experiences we allow into our lives. Therein lies a power we have that nature does not: refusal. We can customize our filter bubbles through algorithms to control the flow of information we receive — filtering out what we deem "unnecessary" — and, as a result, redefine the physical and conversational boundaries within which we live. In a sense, we are rejecting nature by refusing to be shaped, formed, and weathered with wisdom that naturally comes from looking at the world through multiple perspectives.

We emerge from moment to moment, just as our relationships do, our communities do, our politics do. Reality is blobby. It refuses to be systematized. Things like the American obsession with individualism, customized filter bubbles, and personal branding — anything that insists on atomized, competing individuals driving in parallel, never touching — does the same violence to human society as a dam does to a watershed. We should refuse such dams first and foremost within ourselves.[1]

Add this to your reading list.

How to Do Nothing

RESISTING THE ATTENTION ECONOMY

Mars Task Analysis

LAUREN JABLONSKI AND TANIA WHITE

Can People Go to Mars? That was the question NASA set out to answer in their February 2004 blog post with the same name. In the blog, Frank Cucinotta of NASA's Space Radiation Health Project at the Johnson Space Center stated, "It's a question of radiation… We know how much radiation is out there, waiting for us between Earth and Mars, but we're not sure how the human body is going to react to it." [1]

Fast forward seventeen years, and now NASA has a plan, but the path ahead is still full of challenges. While *radiation* is considered the first major hazard, it's now joined by four other close contenders: [2]

- **Isolation** for extended periods of time
- **Distance** from Earth
- **Hostile**, closed environments
- Lack of **gravity** and its physical impact on the human body

But when we imagine the future of space travel to Mars, we often encounter visions of fierce expedition and conquered landscapes — of established extraterrestrial colonies with robust infrastructure and futuristic technologies.

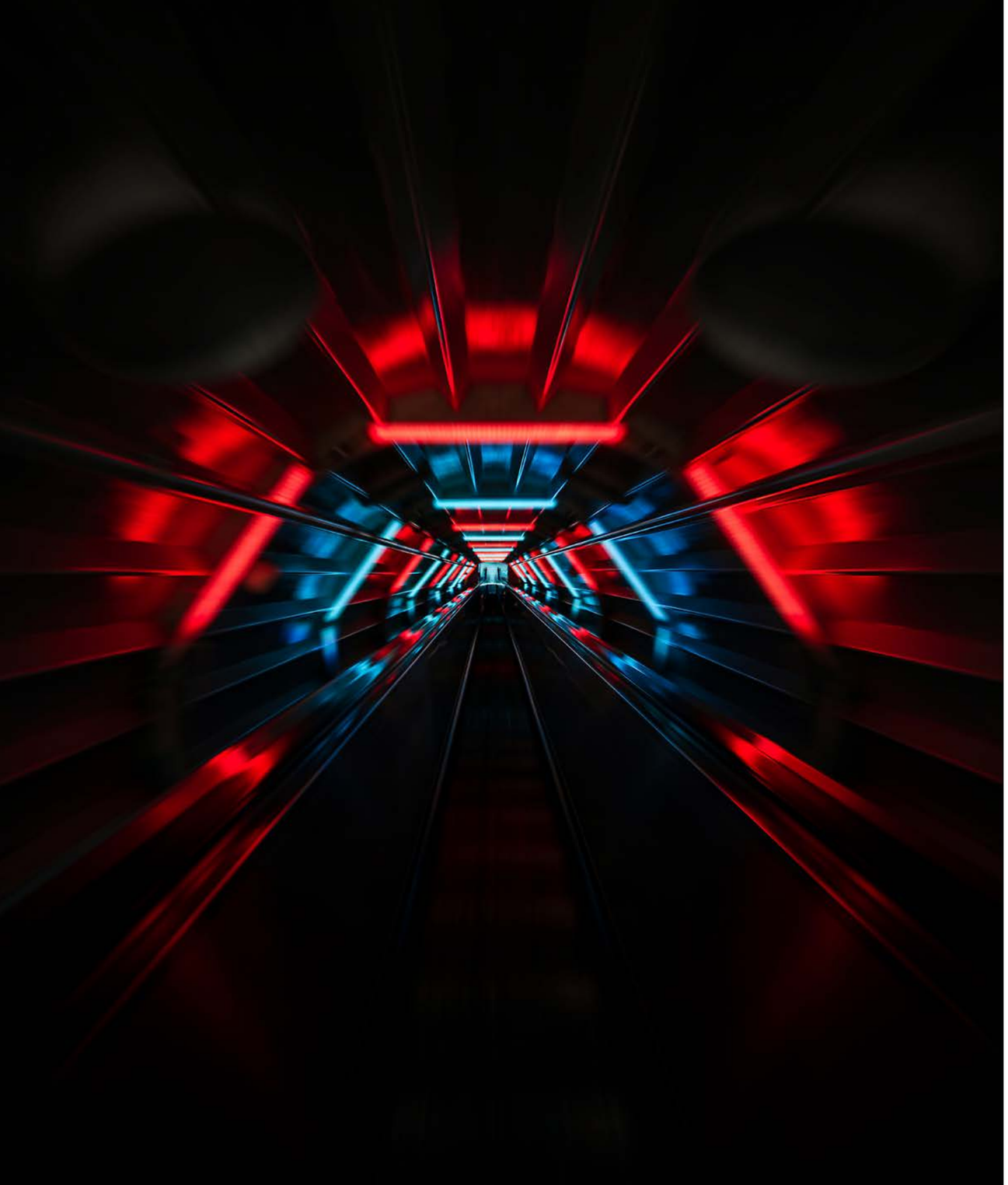
However, perhaps architects and designers need to consider a more realistic version. A version where astronauts don't just hop out of their spaceship and start building their shelter. Instead, his research suggests a version where astronauts require ample time for bodily adjustment as well as cobot assistance to alleviate impact from long-term space travel.

As architects of physical space and researchers of human behavior, Corgan is uniquely positioned to participate in this dialogue. We see strong potential to help astronauts and future space tourists prepare their bodies, minds, and shuttle homes-away-from-home for the critical risks they will encounter through immersive design, emerging technology, and material science.

In 2019, Dr. Jack Stuster and his team of researchers were contracted by NASA to examine a total of 1,125 tasks that are likely to be performed during the 12 phases of the first human expeditions to Mars.[3] Tasks included:

- Inspect circuit board, visually, to detect scorching or other evidence of electrical short.
- Rise from prone position, using arms and legs while wearing surface extravehicular (EVA) suit, to recover from fall in loose regolith.
- Pound seismometers into rock, manually using slide hammer while wearing surface EVA suit, to deploy sensors.

Dr. Stuster and his team concluded that certain tasks will be significantly more difficult than others, particularly those that require lifting oneself and equipment after months of space travel from Earth to Mars. His research will be pivotal in terms of prioritizing where and how technology innovations and design resources are deployed to help NASA combat the five major hazards of long-term space travel.



So, what's your perspective now?

There is no question that in this present moment we face unique challenges. The solid ground we thought we once stood on is suddenly shifting — and the pace of this change is accelerating.

Throughout this report, we tried to share a wide variety of perspectives. We looked at the coronavirus as a disrupter and as an accelerator; we explored automation and its ability to augment our abilities, not replace them; we listened to trees; we learned from influencers; we looked bias straight in the face; and we spaced out — far out — enough to see that we are all connected by this tiny piece of rock we call home.

With each day, we gain a new perspective — one that empowers our actions, ignites our passions, and tells us that the impossible is always possible with enough elbow grease. Changing our views can help us understand the transformative effect that empathy, compassion, and determination can have on the world — and the novel solutions we can create when we truly listen to one another.

As we explore emerging technologies and architectural typologies that are being transformed before our very eyes, we know that the future we want today belongs to someone else tomorrow. We want to design a future that includes all perspectives because the way communities support one another matters deeply.

And yes, this will mean looking at things differently from time to time and getting a bit uncomfortable. But think of it like adding a new tool to your toolbox. Changing your perspective just means you now have a new and different lens through which to look at the world. And if we can tackle problems while standing in someone else's shoes, then we have the chance to shape a future that is more inclusive, just, and prosperous.

Broaden your view. Learn something new. Explore more. Listen. Adapt. And as always, stay curious.

Our Contributors

This report, this collection of shared ideas, has been created through a collaboration across multiple teams at Corgan; a group of busy bees actively cross-pollinating to share with you how evolving user behavior and emerging technologies are shaping each other throughout our practice.

Thank you to all of those involved for your incredible insight, bright ideas, and willingness to jump into the future with us!

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