THE 2020 CURIOSITY REPORT

EMERGING TECHNOLOGIES FOR A NEW DECADE

HUGO

Technology isn't the only thing that experiences exponential growth.

In the time it took us to prepare this book, and share it with you, the world has changed. Astronaut Christina Koch broke the record for longest single spaceflight by a woman. The United Kingdom confirmed its plan to leave the EU. We closed out a decade, and ushered in a new one. But most notably, we confronted a sweeping pandemic that will fundamentally change the way we live, and work, and as a result, the way we design.

We are constantly addressing changes in human behavior, watching for transformative relationships between our society, and emerging technologies, all while looking for new ways to pioneer for our clients. We used this year's publication to explore where our curiosities lie — to connect the dots between emerging technologies, and our day-to-day design practice. We wanted to chase down ideas, and challenges outside of our usual comfort zone, confronting some of the hardest questions facing our profession. To imagine a world that could be. But most importantly, we came here to learn.

So grab a chair, and get comfy — we hope you enjoy the first of many Curiosity Reports to come.

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Contents

Letter from the Editor

How many of you are artists, entrepreneurs, experimenters, or you just have a wild imagination? Welcome, this book is for you.

We are excited to share things we find curious, inspiring, quirky or even (dare I say) impossible. Beginning with the 2020 issue of The Curiosity Report, we will learn from one another about Corgan's culture of curiosity, and how we can apply our wild and innovative thoughts to Corgan's day-to-day practice. After all, curiosity is crucial for success.

Whether you are holding this report in your hands, or viewing it from your cell-phone screen, you are about to take a plunge into a meaningful and inspirational — we hope — package of ideas, words, and images that ask questions outside of our comfort zone. It's a purposeful, research-driven approach that allows us to pioneer for our clients — looking forward and toward the future innovations that are changing our industry and the way we design. This report is a place for us to share ideas about the future, to investigate and explore emerging markets, and to gain a collective understanding of how technologies of tomorrow are shaping the world we live in today.

And why are we sharing? To us, the most critical factor in innovation is not just the imagination (although that is needed), the perspiration, or even the discipline to get the job done. The most critical influence is communication. This is even more necessary now as the pace of change continues to accelerate exponentially, as technologies merge, and as entire industries are being disrupted.

At Hugo, we think the future has a lot in store for us… and that future is now. Successful innovation requires experimentation, iteration, and sometimes failure. With The Curiosity Report, we are asking you to take a few risks, voice your opinions, and be the person who comes up with the crazy ideas worth discussing and trying.

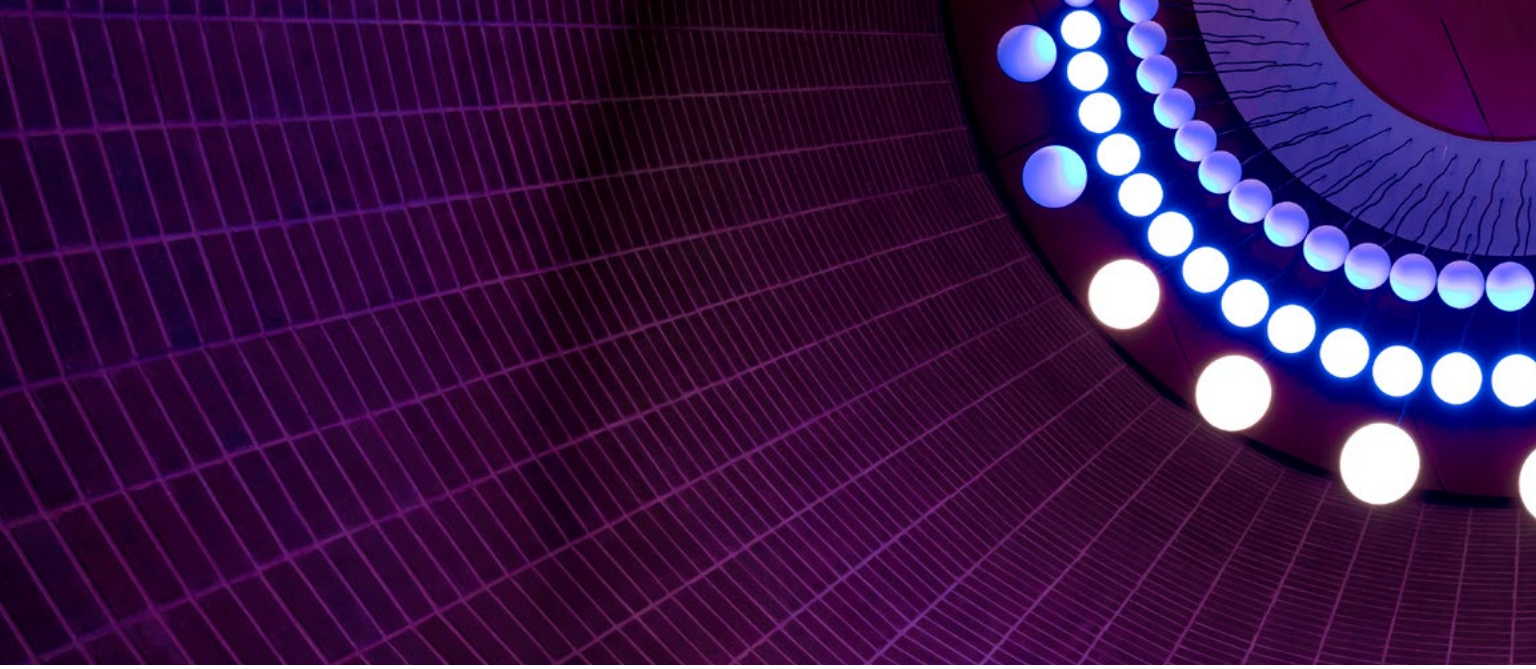
This report, this collection of shared ideas, has been created through collaboration across multiple teams at Corgan; a group of busy bees actively cross-pollinating to produce what you have in your hands (or on your screens) today. Our approach isn't expensive, though it does take time and energy. It isn't a crystal ball, though it does have revolutionary insights. And it isn't finished… because innovation and exploration are unending.

Throughout this report, you will learn how evolving user behavior and emerging technologies are shaping each other. Together with experts from each market we serve, we share precedent studies that exhibit new value we can leverage in our practice, we highlight Corgan projects that exhibit innovative new methods of exploration, research, and data-driven approaches, and best of all, we explored the future of each industry we serve and asked, "What if…?"

We hope you enjoy the first Curiosity Report. Will it flop? Maybe. Are we wasting your time? We certainly hope not. Are these ideas even worth sharing? **Absolutely.** We trust you find this report useful and inspirational. We look forward to seeing more ideas, sharing deeper insights, and imagining futures that go further for the next edition. We can't wait to push the limit. Let's do it together.

Stay with us—and always expect more.

HUGO



In 2019, Accenture published their report, "The Post-Digital Era Is Upon Us."[1] This era represents the digitization of our lives over the last decade through SMAC technologies (social, mobile, analytics, and cloud)[2]. But more importantly, it claims that being digital is no longer an option but rather the expectation of doing business. In the same report, Accenture proposed that we are now stepping into a future powered by a new set of technologies — DARQ. Here we walk you through them, and the potential they may hold for the field of architectural design.

01

Distributed Ledger Technology

The way we share, and store digital information is changing. Distributed Ledger Technologies provide a secure network to do this.

02

Artificial Intelligence

Sometimes referred to as the Third Era in Computing, this branch of computer science is concerned with building algorithms, and cognitive machines that mimic human behavior.

03

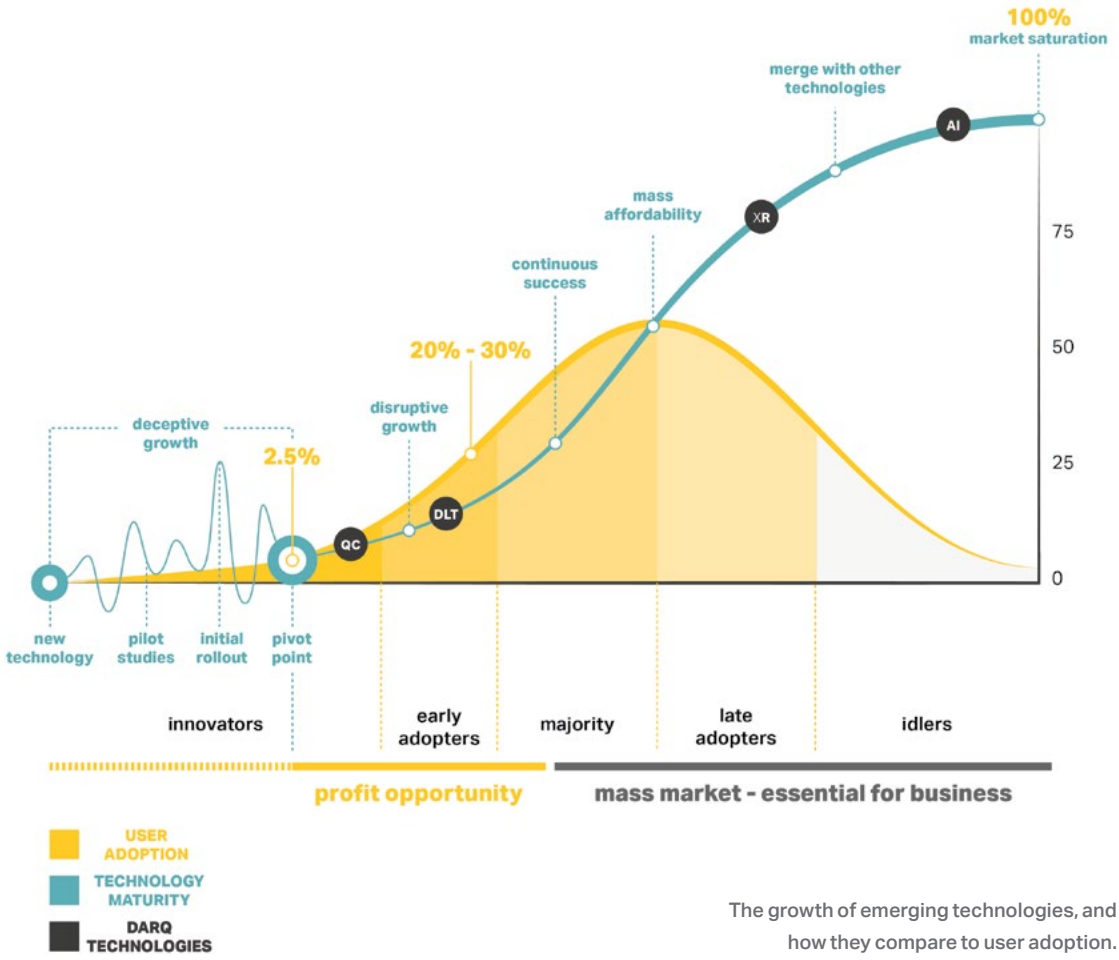
Extended Realities

The concept of virtual reality has been around for hundreds of years, but this technology is just beginning to mature — and the opportunities are endless.

04

Quantum Computing

As Classical Computing's counterpart, Quantum does not rely on the binary system of 1's, and 0's, opening a door of countless possibilities.



The growth of emerging technologies, and how they compare to user adoption.

“The future is decentralized.”

UNITED NATIONS DEVELOPMENT PROGRAMME, 2018[1]

Distributed Ledger Technology

Whenever we transfer money or information, we've traditionally used a central authority (like a bank) to validate that transaction. But sharing valuable information on the internet is a tricky thing. How do we ensure that an online asset can't be transferred more than once? Or that it's actually being shared by its rightful owner?

These digital transactions frequent our lives, and, while we can rely on third parties to validate these transactions, they're usually associated with a fee, and certain operational inefficiencies.

Distributed Ledger Technology (DLT) presents a new paradigm for how information, and money — anything of value — is transmitted across digital databases (or ledgers).

This technology directly facilitates agreements, and alignment between multiple parties, reducing the need for a central authority to coordinate or verify transactions.[2]

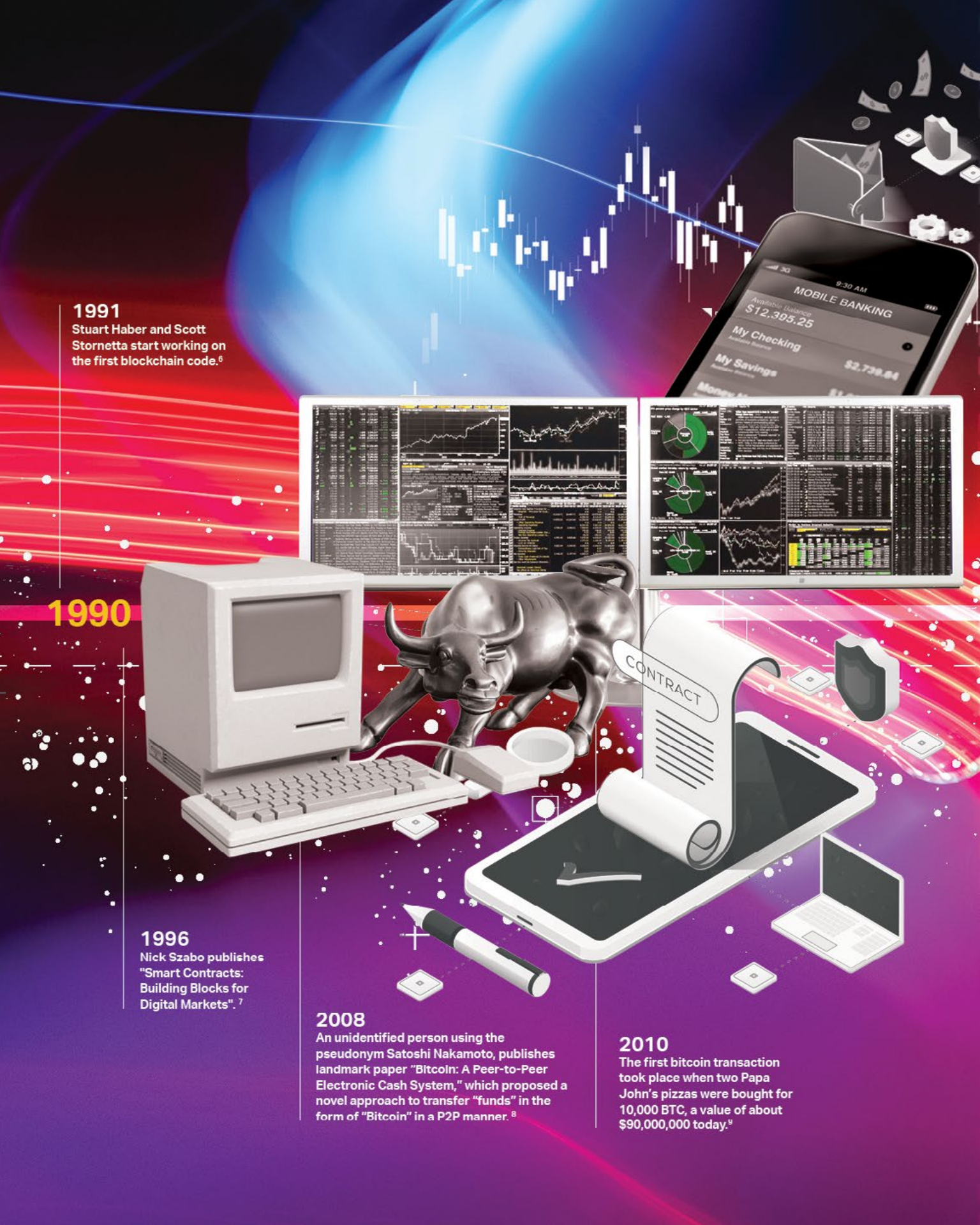
Using algorithms, a distributed ledger updates new information in real time, and will only add new entries if consensus amongst all parties is confirmed. Each new entry is then time-stamped using a cryptographic signature. This peer-to-peer technology (P2P) promotes transparency by giving control of all its information, and transactions to the users.[3]

DLT is not just limited to transferring money. It can store, and share valuable records like land registry titles, birth and marriage certificates, vehicle registrations, business licenses, educational certificates, student loans, credit scores, social benefits, and votes.[4]

James Wallis, Vice President of Blockchain Markets, and Engagements for IBM, says "you'll see uses for DLT that you can't even think of today but that it will involve a level of data sharing that hasn't really existed before."[5]

This is because our access to data, and how we share it with others will become increasingly important. While sending money through Venmo is technically a form of data sharing, so is the biometric information being generated by your Apple watch, and the conversations you have with Alexa.

This data is valuable, and as the world becomes more connected, we'll need trusted ways to secure it.



1990

1991
Stuart Haber and Scott Stornetta start working on the first blockchain code.[6]

1996
Nick Szabo publishes "Smart Contracts: Building Blocks for Digital Markets".[7]

2008
An unidentified person using the pseudonym Satoshi Nakamoto, publishes landmark paper "Bitcoin: A Peer-to-Peer Electronic Cash System," which proposed a novel approach to transfer "funds" in the form of "Bitcoin" in a P2P manner.[8]

2010
The first bitcoin transaction took place when two Papa John's pizzas were bought for 10,000 BTC, a value of about $90,000,000 today.[9]

2016

The Tokyo Stock Exchange and IBM announce their plans to start testing blockchain for recording trades in low-transaction markets.[12]

2019

Accenture, Mastercard, and Amazon, announce blockchain-enabled supply chain; the IMF and World Bank launch Education Token, which is not a cryptocurrency and has no monetary value, but will rather be used to explore blockchain technology in the educational sector.[14]

2020

According to projections of blockchain trends, the early adoption phase (research & development) will end in 2022. The regulatory and commercialization phase will last from 2023 to 2025. Beyond 2025, it's expected that blockchain will become a mainstream technology in these industries.[17]

2019

About 430,000,000 blockchain-based transactions have been made.[15]

2020

2014

The general community begins to understand that blockchain can be used for more than cryptocurrency.[10]

2015

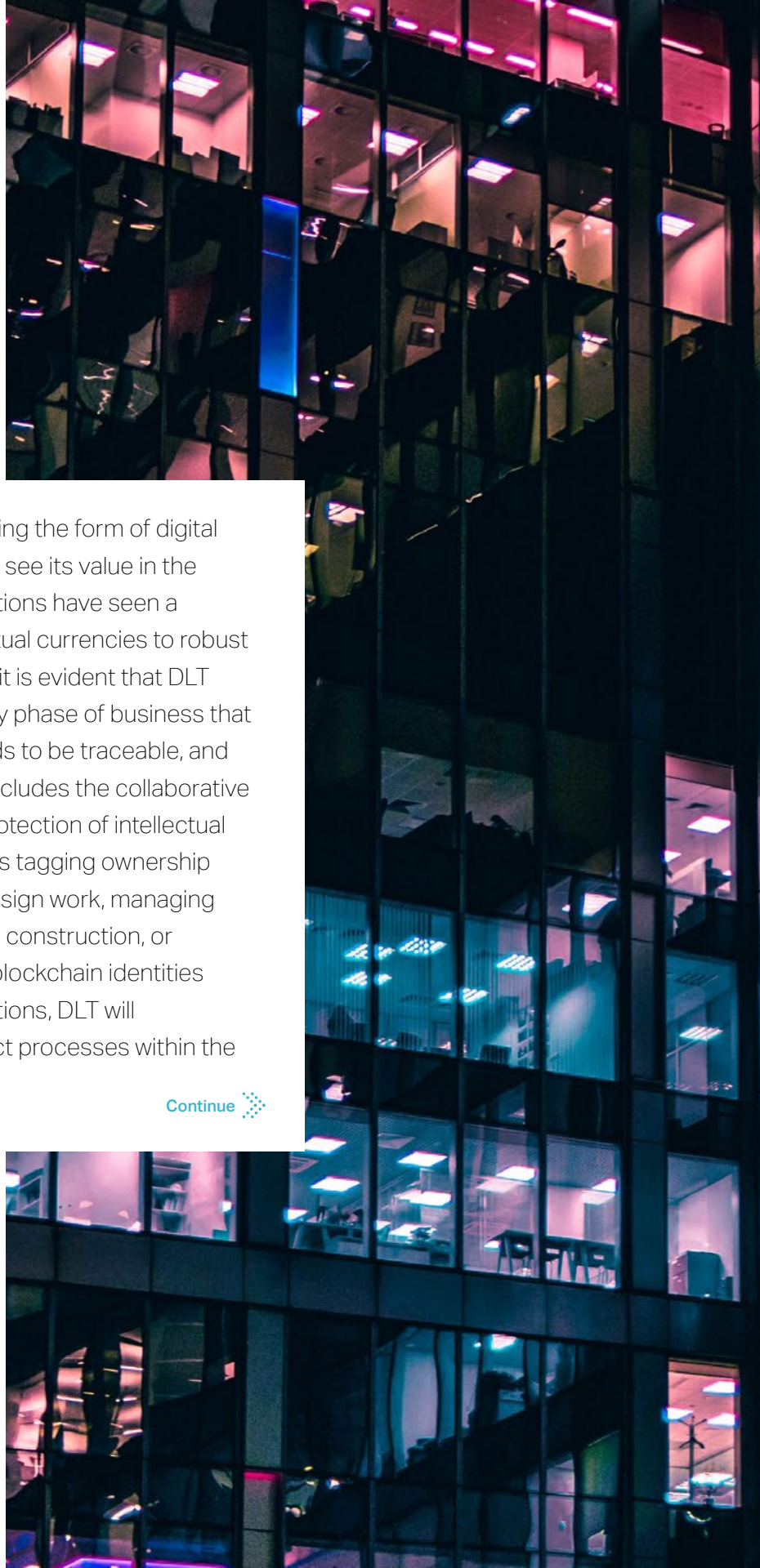
The U.S. Securities Exchange Commission approved a plan by online retailer Overstock.com to issue financial securities by way of blockchain.[11]

2018

The Great Crypto Crash: After an unprecedented boom in 2017, the price of Bitcoin fell by about 65% during the month from January 6 to February 6, 2018. About 90% of U.S. and European banks and financial institutions had begun exploring the adoption of blockchain technology.[13]

2019

The world's first piece of digital couture created by The Fabricant and worn by Johanna Jaskowska sold for $9,500. As a blockchain digital asset, the unique existence of the garment makes it both clothing and cryptocurrency.[16]



With DLT's world debut taking the form of digital cryptocurrency, it's easy to see its value in the financial sector, as transactions have seen a transition from nascent virtual currencies to robust smart contracts. However, it is evident that DLT holds a unique value for any phase of business that requires transaction records to be traceable, and are kept secure, and that includes the collaborative design industry, and the protection of intellectual property rights. Whether it's tagging ownership in evolving collaborative design work, managing payment processes during construction, or tokenizing, and managing blockchain identities between end-user destinations, DLT will revolutionize several distinct processes within the architecture industry.

Continue

What does DLT mean for architecture?

Distributed Ledger Technology is an important emerging technology to consider when examining the role of smart devices/Internet of things. As more, and more of our daily objects connect to the internet, they will collect more, and more data points on the individuals they serve. A DLT offers a more secure, and trusted way to store that information without a third party. This will be imperative as we develop networks within our cities to support next-day drone delivery (using drones that need to communicate, and autocorrect in the air to avoid collision) from a network of micro-warehouses, and multiple smaller distribution centers.

SMART CONTRACTS

On a larger scale, current construction engineering management suffers numerous challenges in terms of the trust, information sharing, and process automation. Blockchain-enabled contracts, also called smart contracts[18], execute a part of the function by itself. This can be used for recording all sorts of data sets, such as: construction quality, construction progress, the quality of raw materials, and installation. Since every transaction is visible in the blockchain ecosystem, it is easy to trace backward the supply of each product or service with authenticity, and know for certain which materials are responsibly sourced. This is especially important for lifecycle analysis as we move into a much more globally conscious era focused on reversing the effects of climate change.

Blockchain is so versatile that besides recording financial transactions, it can be used for storing medical records, concluding binding agreements, tracking the flow of goods, storing personal credit records, tracking the provenance of artwork, verifying payments through a supply chain, and much more.

MICROGRIDS

How we manage, and reduce energy consumption can now be completely distributed, reducing its impact on our cities. Traditionally, major utility companies produce energy, and then sell it to consumers. However, now you have large numbers of individuals that can produce their own electricity through solar panels, and then sell it back to the utility companies for credit. This results in "prosumers"[19] who are producing energy, *and* consuming it. Since these prosumers have their own energy production capabilities (wind turbines or solar energy systems) they can alternatively sell their surplus energy directly to peers within a "microgrid".[19] A microgrid is a distributed generation of power sources that can bypass a traditional utility company. They use DLT to ensure that accurate records of these peer-to-peer energy transactions are maintained.[20]

DID YOU KNOW...?

$120,000

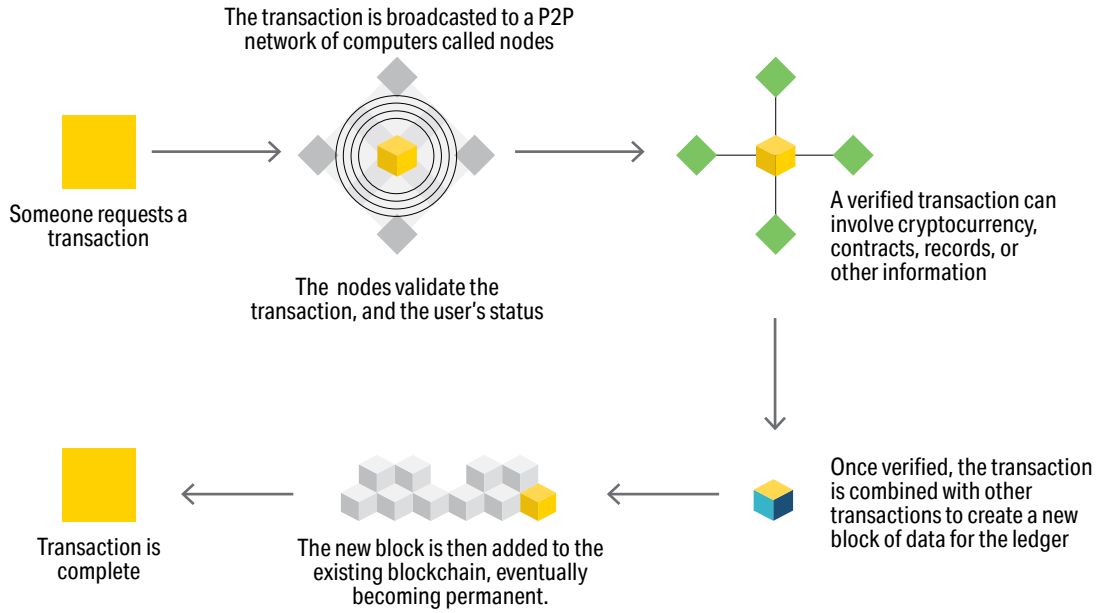
is the going rate for a virtual piece of real estate blockchain property.

- Source: The New York Times[21]

$1.3B

was invested into blockchain technology in 2018 by Silicon Valley venture capitalists.

- Source: The New York Times[21]

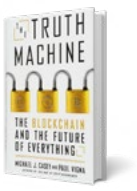


- Source: United Nations Development Programme[22]

Add this to your reading list.

The Truth Machine

THE BLOCKCHAIN, AND THE FUTURE OF EVERYTHING[23]



“It’s alive. Alive!”

FRANKENSTEIN, 1931

Artificial Intelligence

From the moment we wake up to the minute we fall asleep, we are making countless decisions, big, and small. Many of these decisions—like what podcast to listen to, what food to buy at the grocery store, or which doctor to pick—are made using very little data (, and imperfect data at that). Imagine ordering a cup of coffee from the café, and you automatically know that it's 190º (caution: that's hot!), you are given a breakdown of its ingredients, and how that works with your personal metabolism, and you are also told that the caffeine will enter your bloodstream in 22 minutes (that's perfect – just 8 minutes before my presentation!)

AI is a constellation of technologies—from machine learning to natural language processing—that allows machines to sense, comprehend, act, and learn. This branch of computer science is concerned with the development of smart machines that are capable of completing tasks that typically require human intelligence. These types of tasks include things like learning, reasoning, problem solving, understanding language, and perceiving a situation or environment.[1]

The advantage that AI possesses over humans, however, is in its ability to process larger amounts of data sets than a human brain is capable of.

From this standpoint, we can think of data sets as the "fuel" for AI computing by which specific algorithms must then be designed to interpret. Take a search engine like Google for example. As soon as we start typing a few letters into the search box, an algorithm is trying to predict the full search term based on what many previous users have typed in before. These predictions are captured in a drop-down menu (the "auto suggest box") that helps us zero in quickly on a relevant search result. This is because every keystroke, and every click has been captured as data, and every data point improves the predictions for future searches.

When we talk about AI, we also often hear about two of its subsets: machine learning, and deep learning. Machine learning analyzes data, and tries to identify patterns without being explicitly programmed where, and how to look.[2] Deep learning is a subset within machine learning that can perform a task repeatedly, tweaking its approach each time to improve the outcome.[2]

Other terminologies like "Weak AI" or "Narrow Intelligence," refer to a machines ability to complete very specific, and/or limited tasks like spam filtering or recommending a playlist.[3] "Strong AI" or "General Intelligence" refers to a more sophisticated system that is able to complete any task assigned to it.[3]

Some would say narrow intelligence is where we have been, and general intelligence is where we are going. That being said, at this point, AI algorithms are only as good as the people designing them, and need a significant amount of development before the "robots take over."

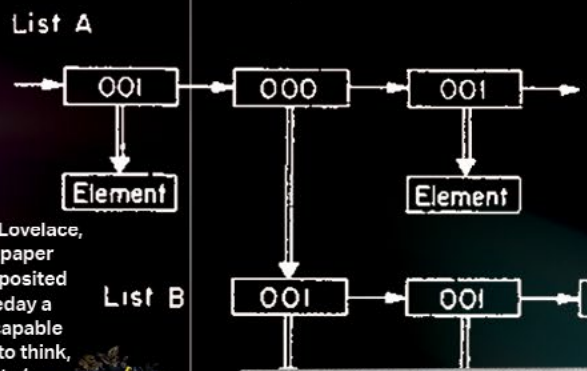
1800

1852
Mathematician, Ada Lovelace, in the footnotes of a paper she was translating, posited the theory that someday a computer might be capable of creative acts and to think, just like we humans do.[4]

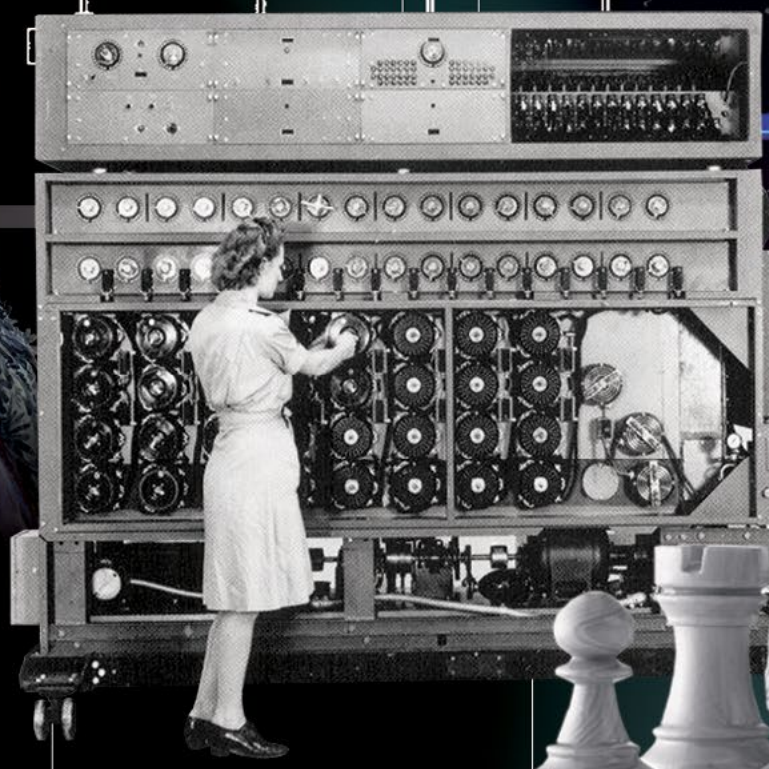
1948
William Grey Walter creates the first autonomous robot with complex behavior.[5]

1950
Alan Turing,a young British polymath, publishes "Computing Machinery and Intelligence." He suggests that humans use available information to solve problems and make decisions. Why can't machines do the same thing? [6]

1955
The Logic Theorist program is funded by Research and Development Corporation. It's designed to mimic the problem solving skills of a human – the term AI is coined by John McCarthy to describe the "science and engineering of making machines".[7]

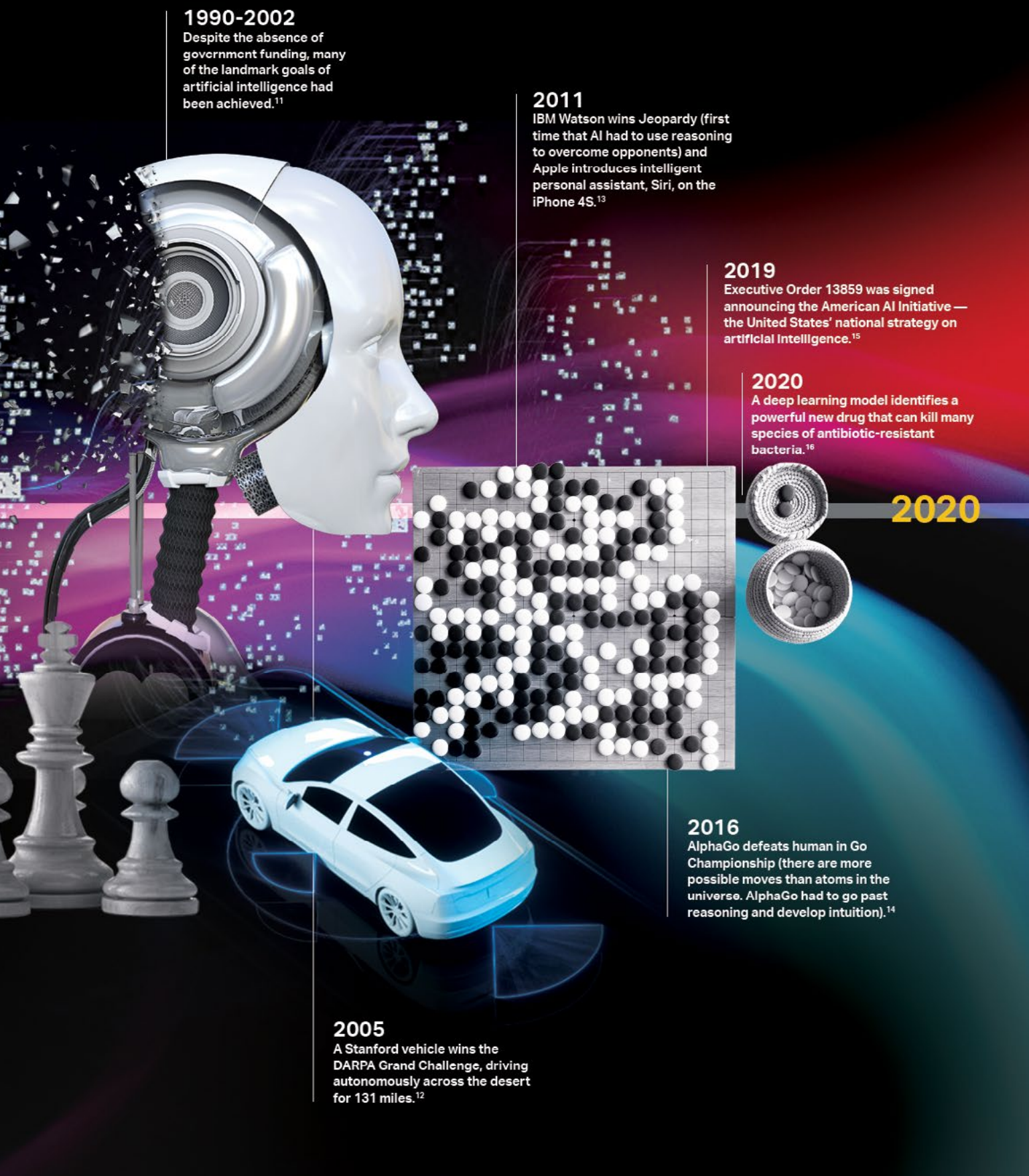


1957-70's
AI research flourishes. Computers can store more information and they become faster. Machine learning algorithms also improve and people get better at knowing which algorithm to apply to their problem. Optimism is high and expectations even higher.[8]



Late 1970-1980's
The AI winter: Researchers had been working towards a functional AI, using the human brain for inspiration, but they didn't have access to enough compute power, data, or people trained to advance the field. As a result, the field entered what's known as the "AI winter," when funding and enthusiasm dried up – temporarily.[9]

1997
Reigning world chess champion and grand master Gary Kasparov was defeated by IBM's Deep Blue, a chess playing computer program.[10]



1990-2002

Despite the absence of government funding, many of the landmark goals of artificial intelligence had been achieved.[11]

2005

A Stanford vehicle wins the DARPA Grand Challenge, driving autonomously across the desert for 131 miles.[12]

2011

IBM Watson wins Jeopardy (first time that AI had to use reasoning to overcome opponents) and Apple introduces intelligent personal assistant, Siri, on the iPhone 4S.[13]

2016

AlphaGo defeats human in Go Championship (there are more possible moves than atoms in the universe. AlphaGo had to go past reasoning and develop intuition).[14]

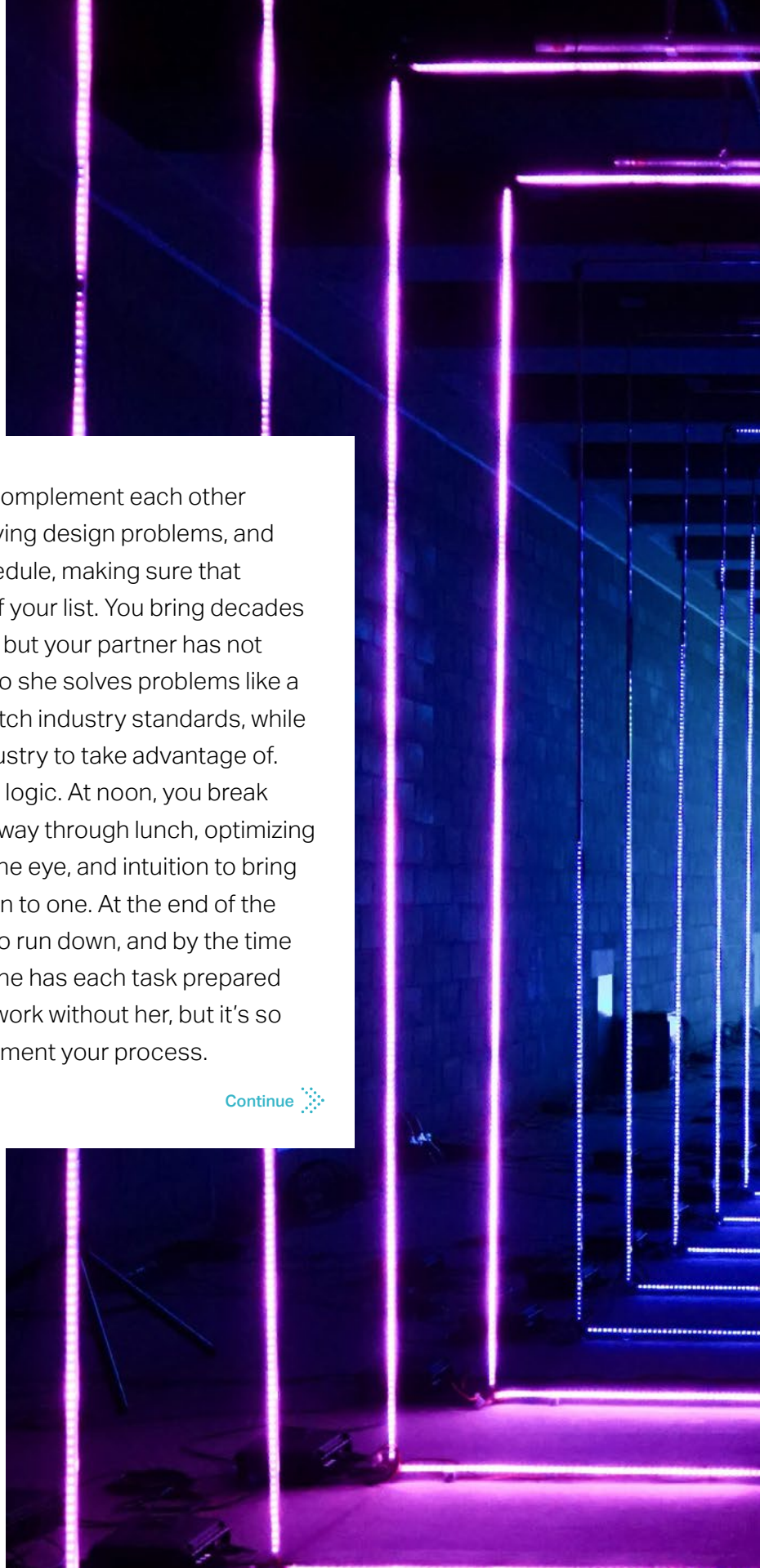
2019

Executive Order 13859 was signed announcing the American AI Initiative — the United States' national strategy on artificial intelligence.[15]

2020

A deep learning model identifies a powerful new drug that can kill many species of antibiotic-resistant bacteria.[16]

2020



You, and your team member complement each other perfectly. You are good at solving design problems, and she keeps the project on schedule, making sure that you've checked everything off your list. You bring decades of experience to each design, but your partner has not yet learned "what not to try," so she solves problems like a successful disruptor. You stretch industry standards, while she magnifies gaps in the industry to take advantage of. You bring emotion, she brings logic. At noon, you break while she keeps hammering away through lunch, optimizing the façade design. You have the eye, and intuition to bring her 1,000 design options down to one. At the end of the day, you give her a few tasks to run down, and by the time you get in the next morning, she has each task prepared to discuss. You could do this work without her, but it's so much better having Alexa augment your process.

Continue

What does AI mean for architecture?

Often cited as leading the Fourth Industrial Revolution, AI might be the single biggest technological advancement the world has ever seen.

Moving beyond automation of simple tasks, AI is quickly becoming a powerful collaboration tool between humans, data, and various machines, allowing our work to become much more collaborative on a larger scale. Understanding the full potential of AI asks companies to completely reconsider the direction of their business, and how they operate from day to day. While this may seem scary, we are no stranger to major revolutions in the work environment.

We spent several million years in the Hunter-Gatherer Age of work, several thousand, and in the Agricultural Age, several hundred in the Industrial Age, and only a few decades in the Information Age. Today, we are entering our next great era for work: The Augmented Age.[17]

In his Ted Talk on the "The Incredible Inventions of Intuitive AI," Maurice Conti explains how, in this new era, "your natural human capabilities can be augmented by computational systems that help you think, robotic systems that help you make, and digital nervous systems that help you sense the world far beyond your natural abilities."[18]

AI will transform the relationship between people, and technology, changing how we look at creativity, redefining our skill sets, and creating new expectations of productivity where human ingenuity is enhanced by speed, and precision; and that future is happening now.

More than 1,500 companies are currently implementing AI, and human partnerships, or "Humanistic AI," leveraging the best of each to form a more efficient partnership.[19] Hong Kong International Airport, for example, is currently testing security screening systems for carryon luggage to be screened at 20x the typical rate by using machine learning to augment the human screening process. The critical advantage of machine learning is it can learn, and improve over time. In this case, as items are noted by the human partner as being "safe to travel with," the AI partner is learning to identify each object immediately as a threat or not. This partnership is not only increasing security precision, but it is also reducing guard fatigue, decreasing wait times, and needs zero additional infrastructure.[20]

An AI algorithm noticed an unusual bump in pneumonia cases in Wuhan, China nine days before the World Health Organization would flag what we've all come to know as COVID-19.

- Source: MIT Technology Review [22]

Similar methods are being used in healthcare, to more quickly, and more precisely identify cancerous cells, with the humanistic AI partnerships reaching a 99.5% accuracy.[21] AI is a tool that we can use to our advantage. Tools, generally speaking, can be classified in one of three ways:[17]

Passive
Passive tools require commands from us in order to create. Some examples of passive tools in architecture would include Revit, Sketchup, and Rhino. However, there are some cases where passive tools are becoming more generative.

Generative
Generative design tools use algorithms to synthesize geometry, and "generate" new designs using *your* goals, and *your* constraints. Using AI in this way, we now have the ability to explore thousands of options that are specifically optimized to meet our needs.

Tools like TestFit can dramatically reduce the time needed to explore design options through using generative design algorithms to test innumerable possible options in real-time.[23] Adjusting parking spaces, and ramps, testing single-loaded or double-loaded corridors, and identifying conditioned vs. unconditioned spaces, can all be automatically reconfigured through a simple slider tool. These tools are helping us gain efficiencies that previously went unexplored. "There may be good design solutions that are never found because they are laborious to discover, and labor is at a premium. **This is what AI, and machine learning are for.** Taking enough of the labor out of exploration that we make it easy, and fun, so that we're improving peoples' work lives, and their confidence," explains David Benjamin, from The Living.[24]

DID YOU KNOW...?

A survey of 350 executives found that

80%

of respondents recognized that their organizations need to begin mastering the art of human/machine collaboration.

- Source: Forbes Insight Survey [25]

While AI will, in some way, influence most of our jobs, less than

20%

of roles are considered to be threatened by high exposure to AI.

- Source: CityLab[26]

Intuitive

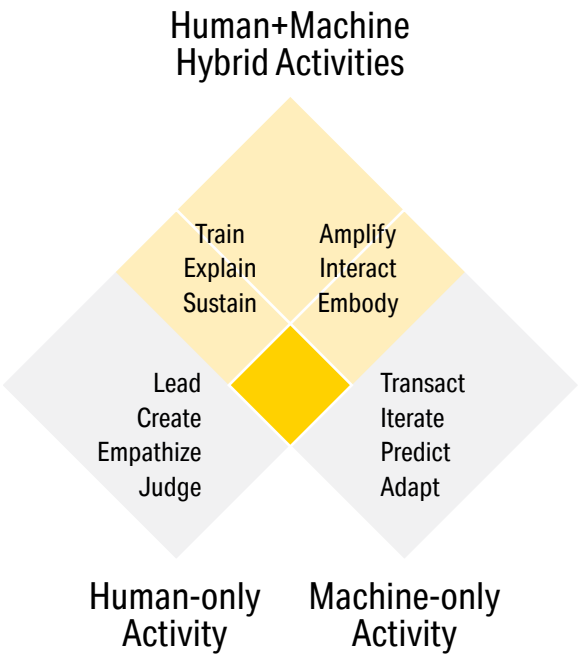
Intuitive tools are similar to dogs: they pay attention, remember what happens, retain that information, and create a pattern in their mind to reduce cognitive load, and free up mental capacity to allocate attention to other new tasks. Some tools are now exhibiting intuition – deep learning systems – to solve problems that were simply out of our reach as plain old unaugmented humans.

Automating vs. Augmenting

One way to think about the range of available AI solutions is to evaluate them in terms of both automating, and augmenting. Automating involves taking over underlying tasks routinely done by humans, such as simple data entry, to allow them to focus on higher value work; augmenting bolsters workers skills, knowledge, and experience, helping them become smarter, and more productive or effective.

AI humanistic partnerships are already becoming commonplace in our daily lives *(Alexa, what's the weather like today?)*. Tools like the EMBR Wave[27] allow us to control the temperature of our bodies when we can't control the temperature of the space we are in; indoor Virtual Positioning Systems (VPS)[28] are creating personalized indoor wayfinding maps; and robotic assistants are helping the elderly comb their hair, and sip their soup – humans, and AI augment each other.

This augmentation is changing the landscape of our industry entirely. While certain robotics are leveraging AI to help us explore new frontiers like space, and unexplored ocean floors, OpenAI, a San-Francisco based AI research lab, is on the other hand using reinforcement-learning algorithms to unlock the value of general purpose robots that can adapt in open-ended environments such as a home kitchen.[29] Recently, they have trained robotic hands to manipulate objects with remarkable dexterity, a huge leap in AI, and robotics.



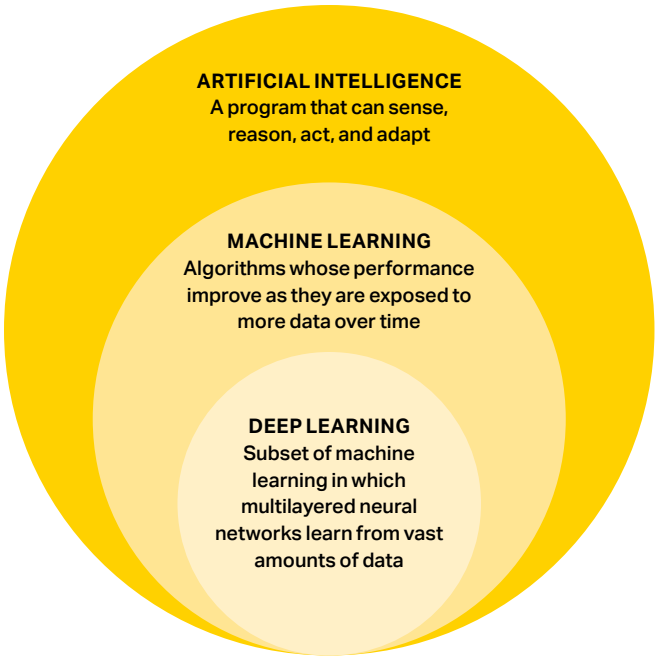
- Source: Human+Machine: Reimagining Work in the Age of AI[30]

Autodesk's applied research lab in San Francisco, also focuses on human, and robotic partnerships with Bishop, a robot designed to help construction workers with repetitive tasks, like cutting out holes for outlets or light switches in drywall. The user gives Bishop a command in plain English or with simple gestures, and Bishop will execute on those instructions with perfect precision. AI is leveraging what a human is good at, awareness, and decision making, and combines it with what the robot is good at, precision, and repetitiveness. The AI in this case keeps track of the human, and robotic tasks as well as each of the thousands of individual components on site.[31]

AI may be our most valuable tool, as we begin to implement Digital Twins to optimize design operations, and occupant experiences with IOT, and AI-driven insights.

A Digital Twin is a virtual representation of a building across its life cycle, using real-time data to gain insights on energy-usage, tenant engagement, and asset management, down to the doorknob. It enables predictive maintenance via machine learning to alert maintenance staff of upcoming warranty expirations, reduce conditioning in under-used conference rooms for energy efficiency, or even show where all the missing chairs are located. Digital Twins can even communicate efficiencies gained from building to building, and adjust in real-time to balance the other.[31]

AI will significantly impact the roles, and responsibilities of architects; and yet we haven't even begun to realize its full potential. Imagine the possibilities – autonomous construction vehicles, exoskeletons for construction workers, 3D printed building elements, drones that can manage the construction site, and digital twins to manage a building's assets post occupancy, **we simply need AI**.



Add this to your reading list.

Human+Machine

REIMAGINING WORK IN THE AGE OF AI[30]

**“Where should I go?” asked Alice.
“That depends on where you want to
end up,” replied the Cheshire Cat.**

LEWIS CAROL, ALICE’S ADVENTURES IN WONDERLAND
& THROUGH THE LOOKING GLASS

Extended Realities

Just like Alice, we dream of other worlds. The places we could travel to if money, and time weren't so restrictive. But bringing these realities to virtual life is more than just fantasy play. It's proving to have some pretty significant opportunities for the world of design.

Extended Realities (XR) is an umbrella term used to describe immersive technologies that can merge the physical, and virtual worlds.[1] All immersive technologies "extend" the reality we experience by either blending the virtual, and real worlds, or by creating a fully immersive experience. These extended experiences are usually facilitated by a Head Mounted Display (HMD) or a mobile device.

The extended realities platform, while it's considered a "mature technology,"[2] is still waiting for other supportive technologies to catch up. For example, cloud processing needs to increase in speed, and efficiency in order to render graphics, and send them down to small, low-powered headsets in real-time. World-mapping technology also needs to be further developed so virtual objects can be pinned to coordinates for lots of people to see at once.

While the field is rapidly evolving, there are three major buckets of "extended realities" we want to cover[3]:

Virtual Reality (VR)– In this setting, users are fully immersed in a simulated digital environment. Individuals put on a VR headset to get a 360° view of an artificial world that fools their brain into believing they are walking on the moon, swimming under the ocean, or stepping into whatever new world the VR developer has created. VR comes in two main forms: 1. outside-in tracking where external sensors track the motion of the HMD, and controllers, and 2. inside-out tracking where cameras on the headset, and computer vision track the motion of the HMD, and controllers.[4] *Examples: Oculus Rift S (Inside-out wired), Oculus Quest (Inside-out standalone wireless), HTC Vive (Outside-in)*

Augmented Reality (AR)– An AR environment means that virtual information is being overlaid onto the real world. This experience enhances the real world with digital details such as images, text, and animation. You can access this experience through AR glasses or via portable screens. This means users are not isolated from the real world, and can still interact, and with what's in front of them. AR experiences can target all senses like auditory, and olfactory, even though the most used sense is visual. *Examples: Pokémon GO, Snapchat filters, AR art tours, digital, visual or auditory wayfinding*

Mixed Reality (MR)– This is the latest immersive technology, and is sometimes referred to as hybrid reality. Digital, and real world objects co-exist, and interact with one another in real-time. MR uses computer simulation to seamlessly integrate the digital experiences with the real world. *Examples: Merge VR cube, Niantic Occlusion Research, ARKit Human Occlusion*

As XR technology, and supporting services improve, we will see Extended Realities blend together in ways that challenge our perception of the digital world.

It can be difficult to understand these animated technologies in written format, so feel free to watch this quick video for a more interactive recap.[5]

1800

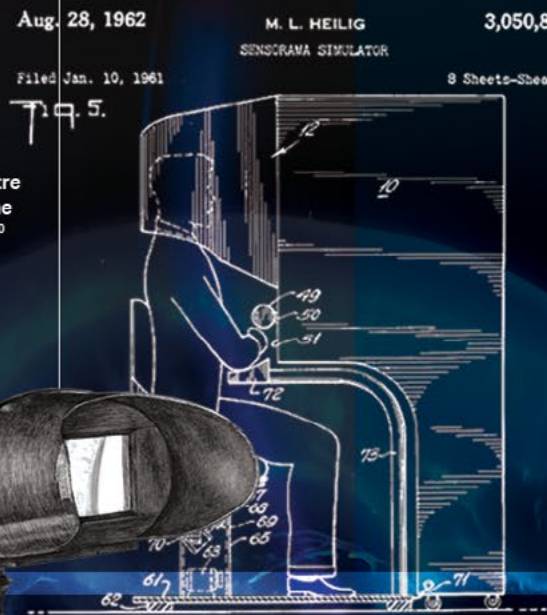
1838
Charles Wheatstone's publishes a paper describing a curious illusion he'd discovered. If you drew two pictures of something, from two slightly different perspectives, and then viewed each one through a different eye, your brain would assemble them into a three-dimensional view. To demonstrate this, he created the world's first stereoscope.[6]

1929
Link Trainer, the first flight simulator: Edward Link created the Link Trainer, probably the first example of commercial flight simulator.[7]

1935
Science fiction story, Pygmalion's Spectacles, contains the idea of a pair of goggles that let the wearer experience a fictional world through holographics, smell, taste, and touch.[8]

1939
The View-Master stereoscope is patented and popularized for "virtual tourism" – the design principles of the Stereoscope are still used today for the popular Google Cardboard and low budget VR headset.[9]

1962
Morton Heilig developed the Sensorama, an arcade-style theatre cabinet that would stimulate all the senses, not just sight and sound.[10]



1987
Computer scientists and "founding fathers of VR," Jaron Lanier and Thomas Zimmerman leave Atari and found VPL Research, Inc. the first company to sell VR goggles and gloves.[11]

1990
Tom Caudell, a Boeing researcher, coined the term "augmented reality."[12]

1992
LB Rosenberg created what is widely recognized as the first functioning AR system, Virtual Fixtures, for the US Air Force.[13]

1999

The Matrix: The film features characters that are living in a fully simulated world and brings the topic of simulated reality into the mainstream.[14]

2008

The iPhone is introduced to market; VR re-emerges largely because the technology it requires – LCD screens with tilt sensors – is suddenly made cheap by the boom in mobile phones.[15]

2012

Entrepreneur, Palmer Luckey, unveils a Kickstarter campaign to produce the Oculus Rift and raises $2.5 million. Within 601 days the company is eventually acquired by Facebook. Fact: Palmer had an early fascination with VR and claims to have the largest collection of historical VR headsets in the world.[16]

2015

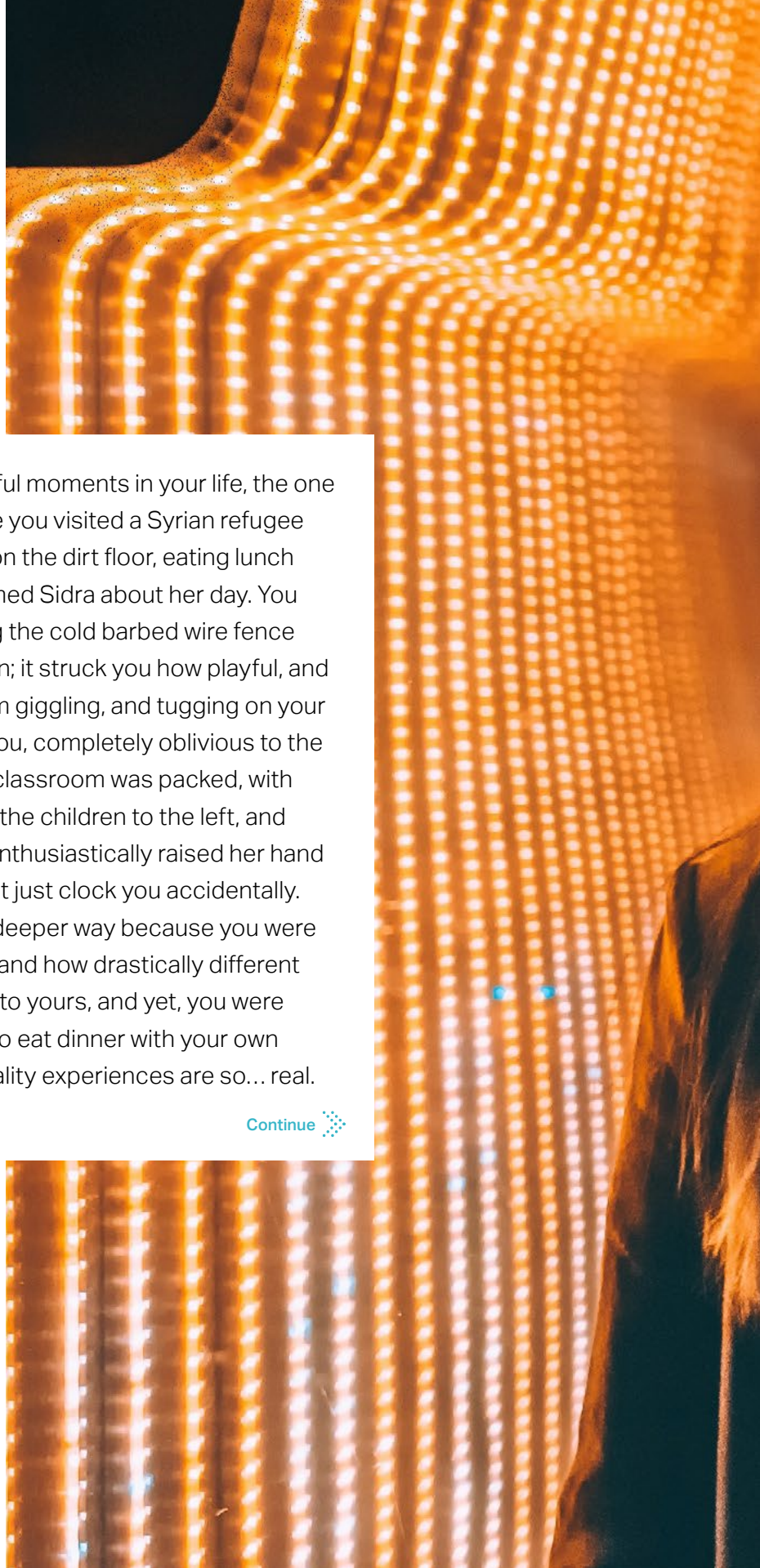
Technologist, Chris Milk, gives a TED Talk where he refers to VR as the "Empathy Machine."[17]

2019

Microsoft unveiled the latest version of its Hololens "mixed reality" headset and was available for purchase later that year. VR/AR startup valuations reach $45 billion.[18]

2020

Disney files a patent for AR enabled windows that can engage the onlooker with animation, as well as a patent to produce holographic enabled benches that allow users to engage in true conversation with the Disney characters as they sit and relax.[19]



When you think about impactful moments in your life, the one that sticks with you is the time you visited a Syrian refugee camp. You remember sitting on the dirt floor, eating lunch and talking to a young girl named Sidra about her day. You recall the walk to school along the cold barbed wire fence with the other refugee children; it struck you how playful, and happy they were, each of them giggling, and tugging on your clothes wanting to play with you, completely oblivious to the gravity of their situation. The classroom was packed, with little space between you, and the children to the left, and right of you; each time Sidra enthusiastically raised her hand you ducked thinking she might just clock you accidentally. You empathized with her in a deeper way because you were there, you experienced first-hand how drastically different her childhood was compared to yours, and yet, you were home in Phoenix every night to eat dinner with your own family. Real-time extended reality experiences are so… real.

Continue

What does Extended Reality mean for architecture?

We are now entering a virtual experience economy, where virtual experiences are becoming as meaningful to consumers as those happening in the real world. Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR) are revolutionizing how we interact, collaborate, and engage with our physical world. As higher value is placed on ever-changing, fleeting experiences, it is imperative that we evaluate, and understand the value that impermanence can bring to the historically permanent industry of architecture design.

Augmented Reality

Today, our workflows leverage AR in four ways: marker-based, superimposition, markerless, and projection-based.[20] The proliferation of mobile devices, and their relatively ease of use has launched Marker-Based, Superimposition, and markerless AR experiences, each leveraging the cameras, and screens of mobile devices, or in some cases, HMDs.

MARKER-BASED

Marker-based augmented reality (aka: Image Recognition) uses a camera, and a visual marker to view 3-dimensional objects. Think: viewing 3D models from your mobile device by scanning a QR code enabled 2-dimensional plan.

SUPERIMPOSITION

Similarly, Superimposition based augmented reality (aka: Location-Based AR) can position virtual objects into a choice location in a physical reality (Pokémon GO, anyone?).

Several retailers, such as IKEA, and Amazon, use this feature in their online purchase portals today.[21] For designers, it is a great way to show clients how different furniture, fixtures, or wayfinding choices will change the look, and feel of a space.

MARKERLESS

Markerless AR uses a GPS, digital compass, velocity meter, or accelerometer already embedded in a mobile device to provide data based on the user's specific location as it changes. For example, giving seamless step-by-step visual directions to specific outdoor/indoor locations, like to the supermarket two blocks away, then to a specific shelf for the product you are looking to buy.

PROJECTION-BASED

In contrast, Projection-Based AR does not leverage existing mobile devices or HMDs, but instead projects artificial light onto real world surfaces, senses human interaction or disruption (i.e. touch) of that projected light, and responds in real-time to that disruption. For example, Circlet[22], an evolution of the smart watch, projects the user's smartphone screen directly to their wrist, continuing to operate as if the user was touching the phone screen.

Whitney Houston will embark on a virtual tour this year as a projection hologram – changing how we think of space, time, and typology.[23]

AR is supplementing the real world with easy, and accessible data, changing our workflows by helping us make informed decisions, and altering our interactions with the surrounding environment, creating a new Assisted Reality. Here at Corgan, we are currently using DAQRI[24] to help us QA/QC in real-time at the construction site. By wearing the DAQRI HMD, architects can share on-site issues with off-site designers; simultaneously troubleshooting tasks, tagging priority items, scanning as-is equipment, and reviewing BIM models within the physical space for clash detection verification. DAQRI can also be used outside of the construction administration process for maintenance staff as a proactive maintenance tool, by educating use or repair of specific equipment through a step-by-step augmented visual.

AR is quickly becoming fully integrated into the construction process, with platforms such as Fologram[25], which transforms 3D models into full-scale construction instructions through an HMD, virtually superimposing construction documents on the construction site, or directing step-by-step guides during the construction process. Platforms like this help considerably in material placement for parametric designs – something that would have taken weeks or months, and very complex drawings, and measurements now can just take a day with AR. The direct comparison of the reality of the work with 3D models in real-time helps avoid errors, and can significantly reduce construction costs.

DID YOU KNOW...?

VR market volume is expected to reach

98.4M

sales by 2023, generating an installed base of

168M

units with a worldwide population penetration of 2%.

- Source: Forbes[26]

In the first two weeks of Oculus Quest headset sales, there were

$5M

worth of content sales.

- Source: Forbes[26]

Additionally, the end-user experience is changing with Assisted Reality. From voice, touch and gesture-activated Google Assistant Mirrors[27] that instantly project personal information, to virtual mirrors that provide step-by-step exercise routines[28] or specific advice when shopping unique to user preferences – a personalized digital infrastructure is growing, and it's just beginning. At the 2020 Consumer Electronics Show in January, IBM, Delta, and Misapplied Sciences together launched Parallel Reality[29]: a display that shows specific information, and images to multiple people at the same time, tailoring the information to each person viewing the single screen. In simpler terms, I can see my information, you can see yours, and we cannot see each other's, even when we are standing shoulder to shoulder, looking at the same display. This is a game changer for complex environments like airports, hospitals, and others where information transparency is key, timely navigation is imperative, and personal information security is of upmost concern. Hello Minority Report, we have finally caught up.

44%

of shoppers ages 17-49 prefer shopping with a virtual mirror.

- Source: PwC[30]

Proactive, and reactive AR methods are being leveraged in other complex industries such as healthcare to better execute lifesaving procedures with exact precision.

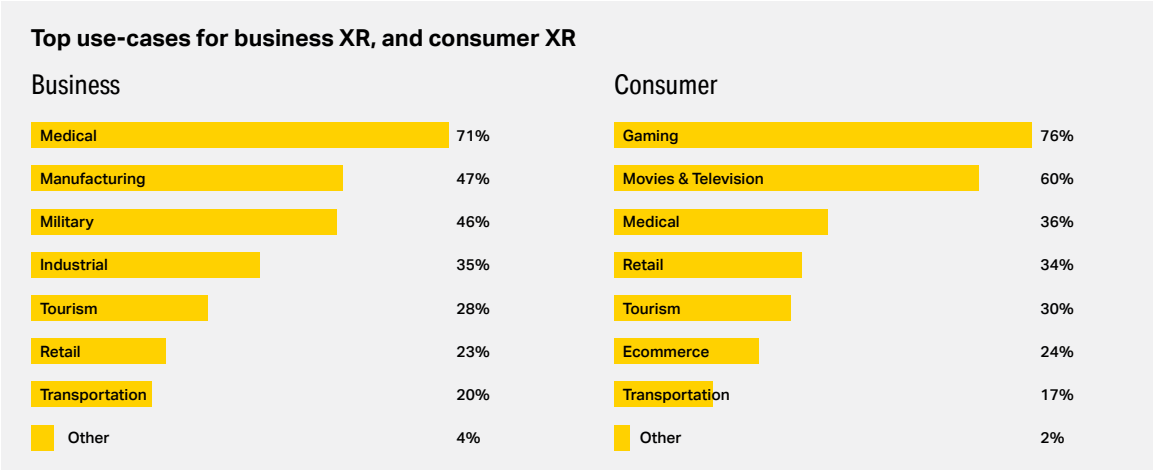
Combining the capabilities of machine learning, AI, and augmented reality, these platforms take two-dimensional MRI images or CAT scans, and converts them instantaneously into 3-dimensional holographic renderings. Physicians are not only using experience, and intuition, but can use AR to virtually dissect around cancerous tumors, and create plans for a more precise removal process.[31]

In cases like this, every single millisecond counts, with no room for error or delay. Here, we see a combination of DARQ technologies working together to make this scenario a reality: decentralized edge data centers integrated into our cities bring enhanced compute power directly to the source, enabling real-time rendering of the images with zero data latency; AI, and machine learning instantaneously provide an extensive global electronic database of past records, and similar experiences to increase the precision of the diagnosis; and AR allows the physician to view the tumor in 3-dimensions from a variety of views – all in one second.

Other democratized technologies that augment physical surroundings of mobile users are enhancing, and changing the interior environment of our buildings without the need for screens of any kind.

For example, the EMBR Wave[32] bracelet leverages software that gives each wearer direct control over their own temperature by producing pulses of heat or cold directly to the user's wrist – a personal thermostat in any environment.

While this can easily be dismissed as an insignificant change to our built environments, consider this: For every one-degree difference in the change of a thermostat, you save 10% of heating, and cooling costs in a building, and when you also consider that Wave has a



- Source: Visual Capitalist[33]

variable temperature change that can make an uncomfortably cool person perceive the room as 5°F warmer or vice versa, a warm person 5°F cooler, cost savings will skyrocket, and conversely, energy consumption will plummet.

Augmenting our physical environment is becoming commonplace, and will change the way we design experiences in the real world. But what about the virtual world?

Virtual Reality

We use virtual reality in four distinct ways today: Non-Immersive, Semi-Immersive, Fully Immersive, and Collaborative.[34]

NON-IMMERSIVE

Non-Immersive experiences are operated by using computer monitors, without headsets, such as viewing 3D models from Revit, Enscape, or fully rendered 360° views via computer monitor from a web-link. These are simple ways to view our the environments we design without much complexity.

SEMI-IMMERSIVE

Semi-Immersive experiences, however, are a step up from the monitor, where a headset is used to view the same type of scene, while surrounding the viewers peripheral, however no real physical movements are interpreted. Industries such as real-estate, hotels, universities, and others embrace this platform to provide virtual tours, the most popular semi-immersive VR experience today.[34]

FULLY IMMERSIVE

Fully Immersive environments ensure the user has a realistic experience in the virtual world. In some cases, this involves the use of haptic gloves, and body gear, with sensors that detect virtual movement, and react with a sensorial response. While Fully Immersive environments focus on the virtual world as perceived by a single user, Collaborative VR continues the use of full immersion for a group of different users from various locations, able to interact with each other in one virtual location.

For example, BlackBox VR[35], a gamified virtual gym experience, allows friends from different cities step into a virtual gym, and challenge each other as if they were together in the same location. In contrast to an actual video game, the user's actual fitness, and athleticism is used to play, while artificial intelligence progresses the user, and techniques learned "level-up" the user in real-time – giving

immediate satisfaction that real-world gym experiences cannot. Additionally, each workout room is a 10'x10' space, challenging the very notion of the gymnasium typology. This could have significant effects in education design, where we often have multiple gymnasiums, tennis courts, soccer fields, football fields, and other recreation spaces in one typology.

Alternatively, during the production of the live action animation version of The Lion King, Collaborative VR[36] was used as a way to let live-action directors from all over the world to work together to line up shots, rethink lighting, and adjust camera movements. The tools created for this process have completely changed the way we consider set design, filming locations, and on-site collaboration.

Disney is completely revolutionizing the way we use AR, VR, and MR to alter our physical world. In 2020, Disney opened a new park, Star Wars: Galaxy's Edge[37] – through an elaborate AR experience embroidered seamlessly into a physical space. This attraction allows each guest to experience the park as the character of their choice, and they haven't stopped there.

61%

of the 1,000 U.S. adults surveyed said that augmented reality has influenced where they shop.

- Source: Forbes[38]

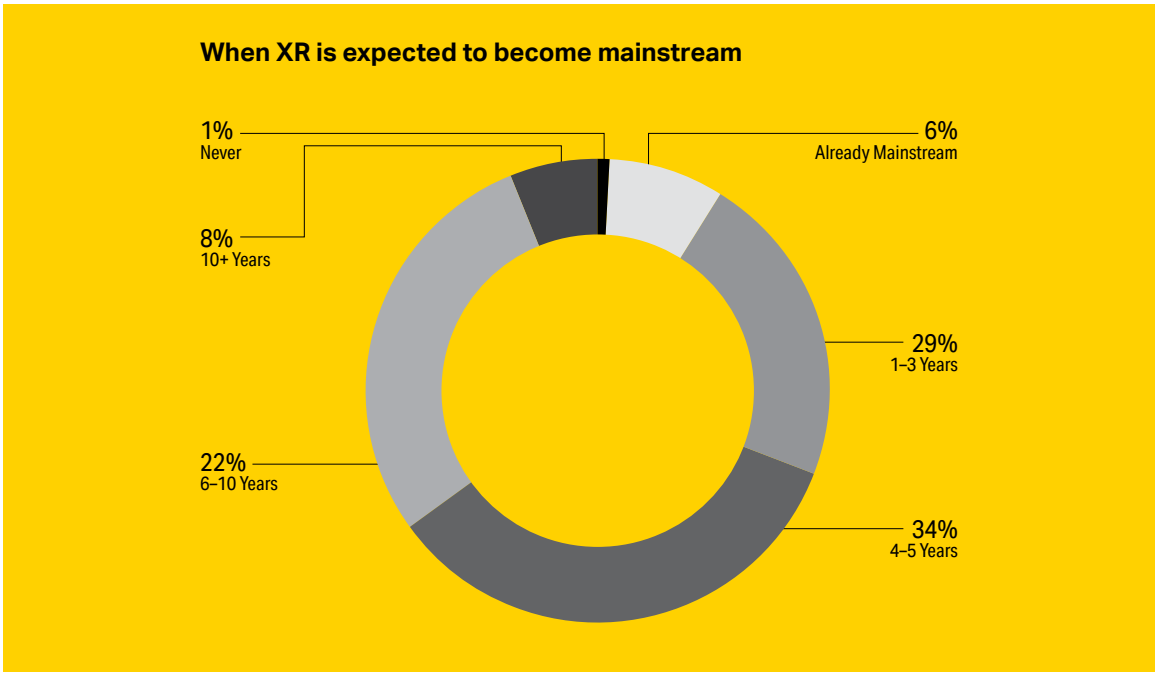
Disney has filed several patents[39] in 2020, as they move full force in the mixed reality industry. They are designing rides that use facial recognition to adapt to a person's emotive responses. They're using AR gesturally activated glass to engage users looking through windows, and they're even creating holographic benches that project interactive Disney character holograms. After a person has been sitting for 10 seconds. Even more exciting is their foray into stuntronics – robots that can recreate incredible aerial stunts, while repositioning themselves mid-air to avoid collisions with other stuntronics. Viewing them requires no headset; but one can only imagine the possibilities when combined with holograms, AR motion activated glasses, and other emerging MR technologies.

Extended Realities

Combining real world, and virtual reality environments with human-machine interactions are considered Extended Realities (XR)., and while they bring incredible imaginary worlds to life at Disney parks, they can also be an effective mechanism for experiential learning. Immersive learning is effective at emphasizing lessons through visualization, and providing environments that closely mimic real-world interactions. This form of engaged learning comes in a variety of forms. One way is to allow students to interact with their lessons rather than memorizing them. This is precisely how VR chemistry lessons are helping students.[40] Introducing them to chemistry on a molecular level, connects macro, and micro concepts in an experiential manner. Biology classes are also using VR as a method for dissection, giving students a safe space to experiment.

History classes, too, are becoming much more interactive, and memorable. Haptic VR experiences are bringing historical events to life. iNKStories[41] allows participants to witness the first hand effects of a bombing in a Syrian town through a haptic VR experience.

"After the smoke cleared, a voice cried out in the distance for help. I moved



- Source: Visual Capitalist[42]

towards the sound, and as I neared a pile of rubble, I reached out to lift a bar in an attempt to free a victim of the attack. As I grabbed the bar, I felt another hand grab back. I still remember the moment of surprise I felt, having completely forgotten I was in a virtual experience," one participant claimed.[43]

The experience is supplemented by improvisation actors, working with the user who does not know where the story is supposed to go. The actors must respond, and react in the virtual scene, keeping the student in a purely engaging learning experience. Immersive environments like this could offer new proficiencies in education, and high-proficiency training scenarios, suggest researchers at UMD. If this is the future of education, designing classrooms to host this kind of interaction is imperative.

The examples shared here barely scratch the surface. AR, VR, MR, and XR has begun to connect people to the digital world in a much more natural, and human way, allowing everyone to realize benefits in the virtual experience economy. It is changing the way we understand computer-literacy, travel, experience-driven environments, mental health and human-to-human interaction. We can now understand a pathway to adapting the computer to the way we naturally think, and work – the future of our work is just beginning.

Add this to your reading list.

The History of the Future

OCULUS, FACEBOOK, AND THE REVOLUTION THAT SWEPT VIRTUAL REALITY[44]

“Things are only impossible
until they’re not.”

CAPTAIN JEAN-LUC PICARD, STAR TREK

Quantum Computing

Imagine spinning a coin. When it falls, you get a head or a tail. This represents classical computing. It functions around the binary values of 1 or 0 (a head or a tail, if you will)., and its smallest unit of data is commonly referred to as a "bit," short for "binary digit."[1]

We experience the benefits of classical computing everyday. However, there are certain things classical computer systems will never be able to solve because they are limited by their computational power. Imagine having to flip a coin over, and over, and over again to generate outputs. This takes time, and energy. In fact, for problems above a certain size, and complexity, you could assign every computer on Earth to compute, and the progress bar would only move forward a percentage point in a million years.[2]

Now let's take the same coin, and spin it again, but this time the coin never stops spinning. It continues to explore every option in between. It is not restricted by the values of 1 or 0 because it represents a mixture of these two states — at the same time. That's quantum computing, and its smallest unit of data is referred to as a "qubit" (short for quantum bit).[3]

Understanding how this works "requires a significant philosophical leap: accepting the notion that a single object can behave like two separate objects at the same time."[4] What's the scientific explanation, you may ask? Quantum computers leverage the quantum mechanical phenomena of superposition, and entanglement to create states that can scale exponentially.

There are many things in this world that are naturally quantum mechanical, and will therefore require quantum computing if we want to study them in more detail. The human brain, for example, is a naturally quantum mechanical organism. Even simple molecules like caffeine maintain an enormous number of quantum states. Dr. Jerry Chow, Manager of Experimental Quantum Computing at IBM says, "The implications for this are huge with regards to designing new drugs, and designing new materials, understanding catalytic interactions, and different types of molecular interactions that are just too difficult, and too complex to brute force calculate today."[5]

We need a new kind of computing to help us tackle certain problems in the 21st century, and researchers are diligently making progress in this field every day. Imagine being able to sift through years worth of cancer data in minutes, facilitating the rapid development of drugs, and treatment? Or optimizing constantly changing supply chain routes by determining the shortest possible system Or continuously exploring, and fabricating new construction materials, and textiles?

That is the future quantum computing can provide.

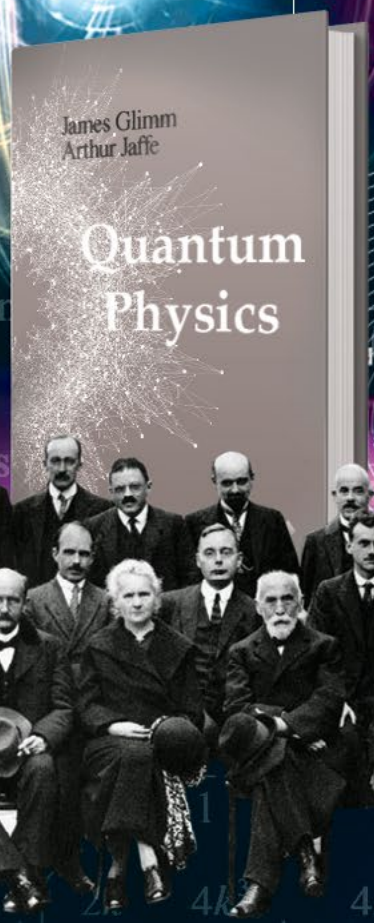
1800

1814
Joseph Fraunhofer, a German lens-maker and optical scientist, the world's finest craftsman in optical glass, tested an especially fine prism by shining sunlight through it, noticing that the spectrum of the sun is not continuous. It is divided by dozens of fine black lines. No one before has seen the lines because their prisms were not large enough nor well enough made.[6]

1887
Heinrich Hertz, who discovered radio waves, makes the first observation of the photoelectric effect.[6]

1911
Eighteen luminaries came together to discuss the subject of Radiation and the Quanta, as part of the invite-only conference in Brussels, Belgium known as the Solvay Council. Some attendees were Max Planck, father of quantum mechanics, Ernest Rutherford, discoverer of the proton, Heike Kamerlingh-Onnes, discoverer of superconductivity, chemist Marie Curie and the youngest member, a 32-year-old Albert Einstein.[6]

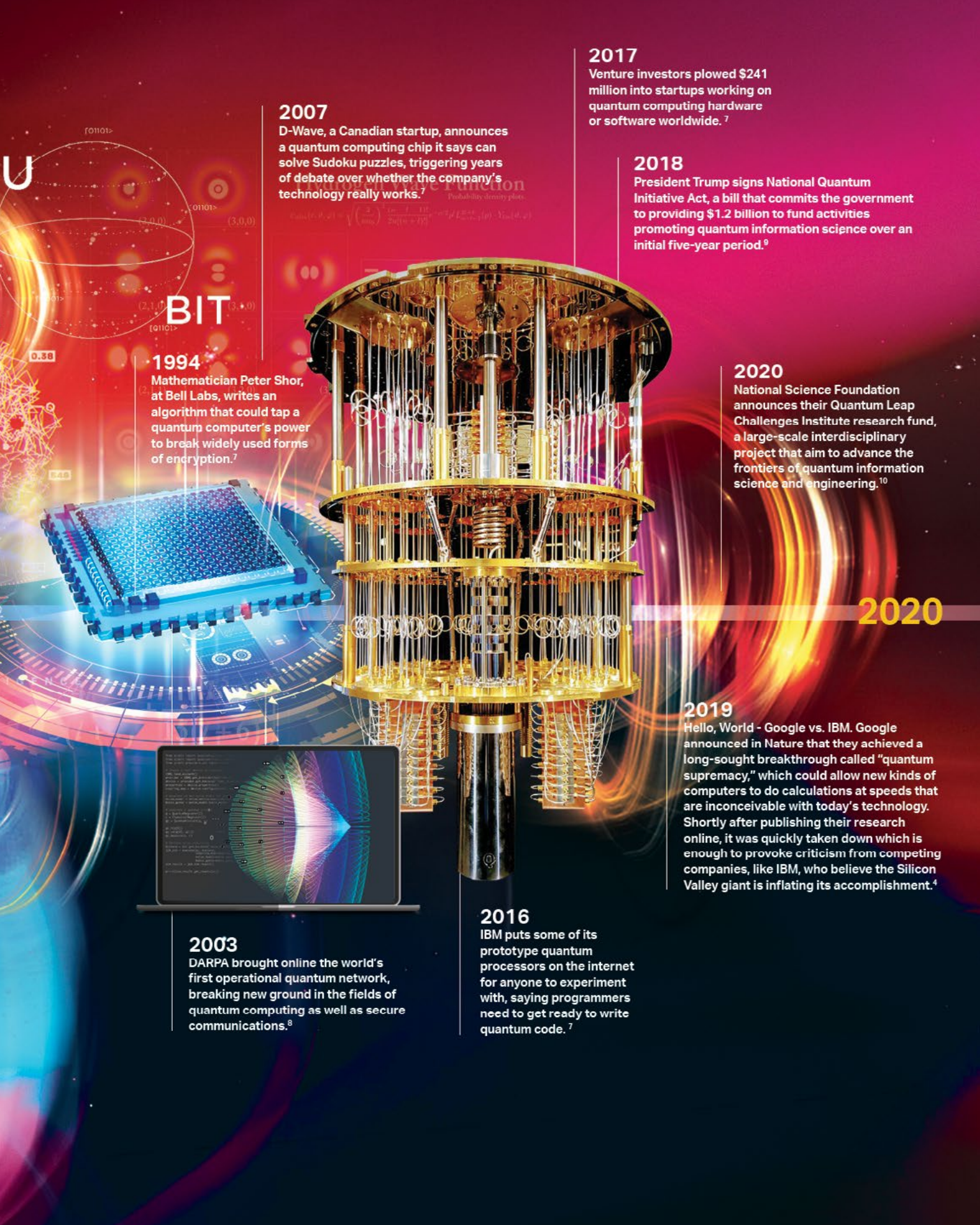
1927
Widely known as the most intelligent picture ever taken, participants of the 5th Solvay Conference on Quantum Mechanics meet. 17 of the 29 attendees were or became Nobel Prize winners.[7]



1980
Physicist Paul Benioff suggests quantum mechanics could be used for computation.[7]

1981
Nobel-winning physicist Richard Feynman, at Caltech, coins the term quantum computer.[7]

1985
Physicist David Deutsch, at Oxford, maps out how a quantum computer would operate, a blueprint that underpins the nascent industry of today.[7]



2017

Venture investors plowed $241 million into startups working on quantum computing hardware or software worldwide. [7]

2007

D-Wave, a Canadian startup, announces a quantum computing chip it says can solve Sudoku puzzles, triggering years of debate over whether the company's technology really works.[7]

2018

President Trump signs National Quantum Initiative Act, a bill that commits the government to providing $1.2 billion to fund activities promoting quantum information science over an initial five-year period.[9]

1994

Mathematician Peter Shor, at Bell Labs, writes an algorithm that could tap a quantum computer's power to break widely used forms of encryption.[7]

2020

National Science Foundation announces their Quantum Leap Challenges Institute research fund, a large-scale interdisciplinary project that aim to advance the frontiers of quantum information science and engineering.[10]

2020

2019

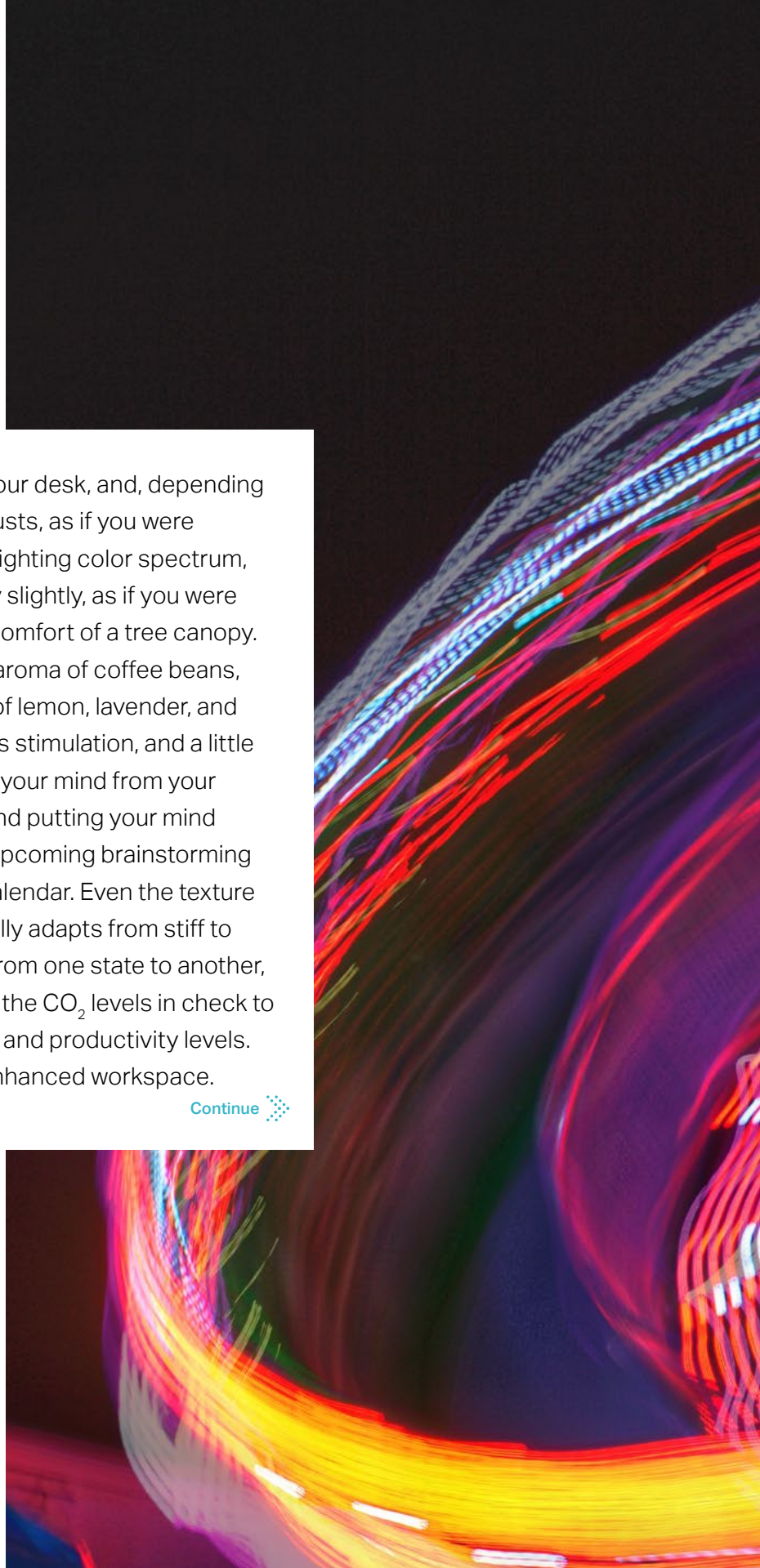
Hello, World - Google vs. IBM. Google announced in Nature that they achieved a long-sought breakthrough called "quantum supremacy," which could allow new kinds of computers to do calculations at speeds that are inconceivable with today's technology. Shortly after publishing their research online, it was quickly taken down which is enough to provoke criticism from competing companies, like IBM, who believe the Silicon Valley giant is inflating its accomplishment.[4]

2003

DARPA brought online the world's first operational quantum network, breaking new ground in the fields of quantum computing as well as secure communications.[8]

2016

IBM puts some of its prototype quantum processors on the internet for anyone to experiment with, saying programmers need to get ready to write quantum code. [7]



It's 10 AM, you are sitting at your desk, and, depending on your mood, the airflow adjusts, as if you were outside in a light breeze. The lighting color spectrum, and brightness begins to vary slightly, as if you were sitting under the shade, and comfort of a tree canopy. As you begin to wake up, the aroma of coffee beans, and rosemary shifts to a mix of lemon, lavender, and mint, as you require a little less stimulation, and a little more relaxation, transitioning your mind from your morning logic-based tasks, and putting your mind into a creative state for your upcoming brainstorming session scheduled on your calendar. Even the texture of your desk chair automatically adapts from stiff to plush, seamlessly morphing from one state to another, while simultaneously keeping the CO_2 levels in check to maintain your peak cognition, and productivity levels. Welcome to your quantum-enhanced workspace.

Continue

What does Quantum Computing mean for architecture?

In January 2020, IBM, and Delta Air Lines announced a multi-year collaborative effort to explore how quantum computing will transform the passenger, and employee experience in airports.[11] Delta's initial goals are to use the technology to "extend the warmth of its people to non-traditional airline touchpoints, and delivering innovative experiences that reduce stress across the travel day," explains Delta's CEO Ed Bastian.[12] This year, Detroit Metropolitan Airport will launch Delta's Parallel RealityTM display, with opt-in technology that allows multiple customers to see personalized content tailored to their unique journey on a single digital screen – at the exact same time, and in their own preferred language.[13] Anywhere between 10 to 1,000 people can look at the same display simultaneously, and only see their own information, no special glasses or augmentation necessary. Talk about a spinning penny!

Additionally, IBM researchers will be working in collaboration with Daimler AG (the parent company of Mercedes-Benz) to develop a solution for longer battery life, and faster charging electric vehicles. "Using a quantum computer to model the dipole moment of three lithium-containing molecules brings new insights into next-generation lithium sulfur (Li-S) batteries that would be more powerful, longer lasting, and cheaper than today's widely used lithium ion batteries," explains IBM.[14]

Most importantly, harnessing the power of quantum computing may be able to completely revolutionize our struggle with climate change. Imagine intelligent buildings that are incredibly aware, that produce energy rather than use energy, and can give back to our environments in ways that have not yet been possible.

Imagine buildings that simply remove carbon from the air. Quantum computing is poised to help us design such innovations for carbon capture; a challenge that could be realized as soon as 2030.

To date, we already concretely know how to use quantum computers to simulate molecules to determine their properties, and better understand their interactions with other molecules. This has led to finding more efficient processes to produce nitrogen-based fertilizers for agriculture, which begins to align with other our efforts to meet 2030 Sustainable Development Goals (SDG). In an article titled "How Quantum Computing Can Beat Climate Change," The World Economic Forum

DID YOU KNOW...?

The top quantum computing company, Strangeworks, is in Austin, Texas! Here is a list of the other top quantum computing companies:

Zapata Computing	**Bleximo**
Coldquanta	**Xanadu**
QC Ware	**Intel**
IBM	**Microsoft**
D-Wave Systems	**Atom Computing**

- Source: Builtin[16]

IBM Q Network

is a community of Fortune 500 companies, academic institutions, startups, and national research labs working with IBM to advance quantum computing."

- Source: IBM[17]

suggests that we use architectural design, and quantum computing together to reach more SDGs by creating a catalyst to remove carbon dioxide directly from the atmosphere.[15]

Currently, carbon dioxide (CO_2) production has exceeded the ability to capture CO_2 naturally through trees, and the ocean. While the world is already working towards reducing our emissions, capturing, and removing CO_2 that already exists may be a way to reverse the damage done., and while this may seem outlandish, known catalysts for carbon capture already exist, and are being tested, and tried today. However, current methods either rely on expensive precious metals, or are challenging to deploy. Scaling the amount needed to reverse climate change using these current methods would be nearly impossible. Using quantum computing to error correct, simulate various molecules, and discover new CO_2 catalysts, we might literally be able to save the planet.

Can you then imagine intelligent buildings that are incredibly aware, and leverage quantum computing, to give back to our environments in ways that have not been possible to date? Or a truly dynamic building that can respond on its own to changing conditions, with a biometrically enhanced structural, mechanical, and breathable building skin with no parts, and no assemblies. A simple system that gradually varies its functionality by varying elasticity.

This is how quantum computing will revolutionize architecture.

01

CURIOSITIES IN AVIATION

"It might be assumed that the flying machine might be evolved by the combined and continuous efforts of mathematicians and mechanics in one million to ten million years."

- NEW YORK TIMES (OCTOBER 9, 1903)[1]

The Wright brothers successfully fly at Kitty Hawk, North Carolina on December 17, 1903.[2]

What to expect

Welcome

We truly live in a phenomenal time.

A time when technology dissolves distance by connecting us face to face with loved ones across the world. A time where people have shifted from collecting things to collecting experiences. A time when our relationships are increasingly digital, business is consistently mobile, distance is irrelevant, time is negotiable, and the future is present.

Technologies are no longer developing linearly, but exponentially, and they are merging, triggering a transformation from physical, fixed assets to an information-based paradigm. These technologies are enabling a more connected nomadic population with instant access to valuable information. At the same time, user behaviors and preferences are constantly changing, as people are beginning to adapt more and more easily to new technologies. Startups are notorious for identifying gaps in user experiences, launching new digital and physical experiences that fill those gaps, iterating on the process, re-launching user experiences, and shifting to best support the needs of the user – and with just 100 years under our belt, the aviation industry has maintained that same startup mentality, innovating new processes daily, embracing change at every step, and leveraging insights to introduce breakthroughs in technologies and amenities that enhance the passenger experience.

Historically, disruptive breakthroughs arise when two desperate industries converge. Today, all innovative fields are converging, while completely dissolving the current paradigm of the airport. Take for example, mobile ticketing, biometrically enabled self-service bag drops, and city check-in

locations, all of which empower passengers to gain control of their traveling experience, while rendering the ticketing hall obsolete. Consider landside innovations, where autonomous shuttles bring passengers from parking lots to the terminal while autonomous robot valets park cars for others, fluctuating the capacity of parking garages daily. Passenger drones are beginning to verticalize transportation networks, creating novel traffic streams with increased efficiencies. Even more disruptive is the notion of a completely biometric terminal, seamlessly and securely identifying passengers without asking them to fumble for their wallet, phone, or ID to check-in. Airside innovations, too, are working in the passengers' favor – Boom's supersonic suborbital flights promise to save passengers time by converting 15-hour long hauls into a 7-hour sleep cycle. The sub-orbital industry will bring new requirements for vertical takeoff facilities such as Spaceports, further changing our transportation landscape.

Never before have we seen so many innovative technologies converging at such a pace. This is in addition to the evolution of passengers' travel habits and their behaviors, which are shifting significantly, altering the way we as designers see and conceive of each touchpoint within the airport environment.

We are living in a time of radical information transparency, thanks to iPhones, wearable devices, and all sorts of macro and micro datasets that can be leveraged and used to reveal trends, unseen patterns, hidden correlations, and new information about a passenger's experience. This is not just static information, it is dynamic information, always changing as the passenger demographic morphs and grows. Herein lies the undiscovered poetics of Big Data. Today's passengers are willing to freely give their data and information, expecting a more memorable and personalized experience in return. We are leveraging that information to better understand why our passengers are traveling, where gaps in the journey are occurring, and to create experiences that make traveling seamless, reducing stress and anxiety at every touchpoint. In essence, this new environment will inform airports how they should evolve through feedback from their passengers. This is experiential design, in its purest form. In some cases, we are introducing personalized dynamic wayfinding into the terminal, paired with sculptural wayfinding nodes to intuitively direct the passenger towards their destination. By analyzing movement and stasis of passengers, our designs are able to respond with variable air temperature and movement in gate lounges, mimicking a light breeze outdoors; and finally, using that data to respond to passengers specific needs by responding to passengers' environmental awareness and trends in wellness tourism as they ebb and flow.

This new paradigm of the information-enabled airport is not a building; it's an ecosystem. It feels like a city, performs like a computer, and enables people to travel spontaneously and hassle-free. Pretty soon, these technologies will dissolve the distinction between airside and landside, creating the opportunity for non-ticketed passengers to share an environment with ticketed passengers… everyday, at all times.

The airport typology is changing, and we will be the ones who lead that change.

- Corgan Aviation Leadership

CORGAN IS CURIOUS ABOUT

Welcome to the Biometrically Connected Airport

Imagine strolling through the airport with complete and unfettered ease at every touchpoint.

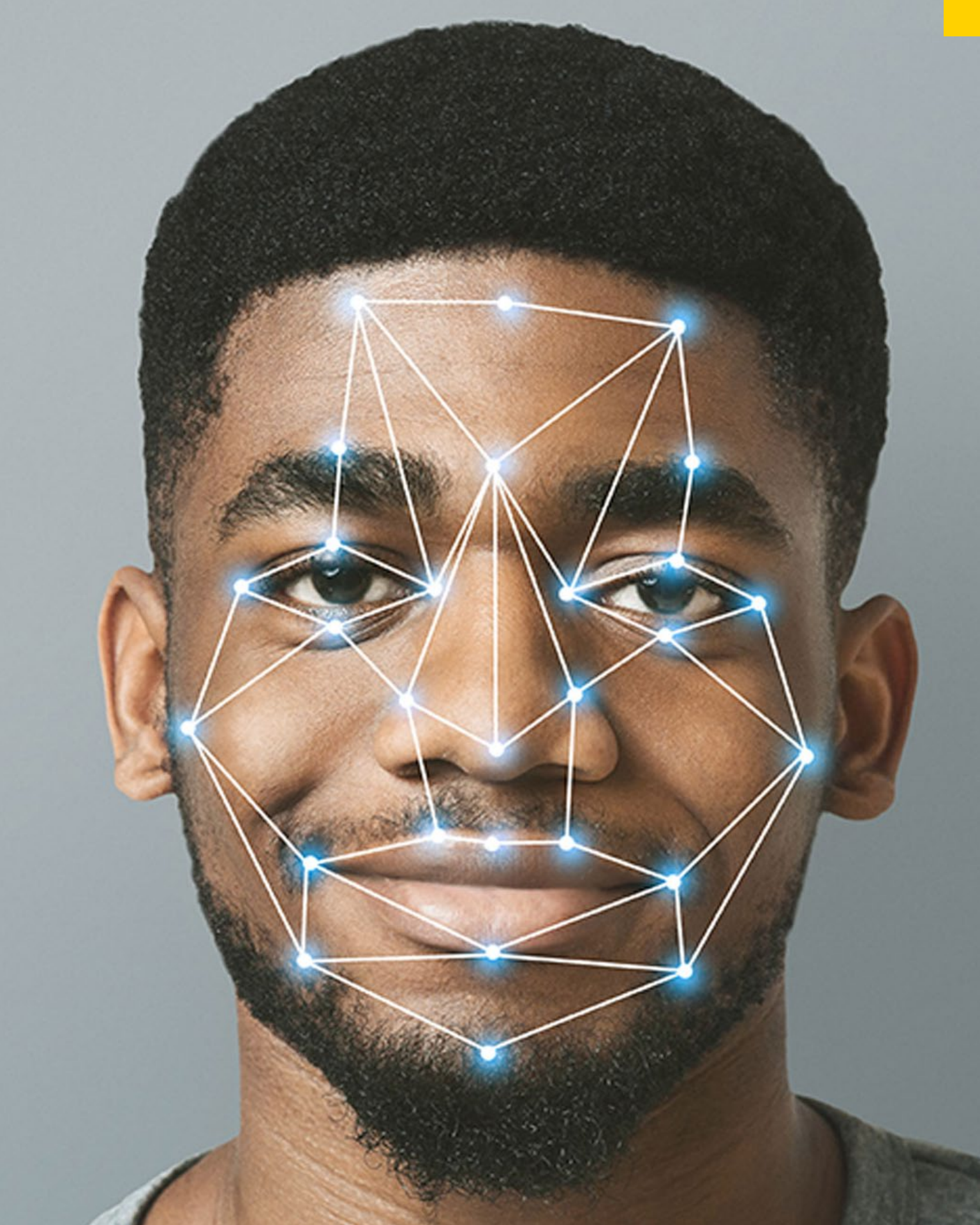
You drop your bag as soon as you get out of your car, without having to identify yourself to an agent, or even stand in line. You whisk through security, with absolutely no need show your ID, stop for a body scan, remove your shoes, laptops or liquids, or even put your bag through a scanner; and yet, you know the airport is even more secure than ever before. Need coffee before you go? No problem. With no lines and no need to pull out your wallet, you can simply order, grab, and go. Checking your reflection in the restroom mirror, it lets you know you have 10 minutes until your group is boarding at gate A9. Nice. With coffee in one hand, pulling your carryon with the other (if your airline didn't already place it above your seat, that is), you board with ease – no need to scan that outdated mobile ticket.

We have been conceptualizing and daydreaming about the ease and flexibility of the biometric terminal for years. Today, with increasing technological maturity, airports and airlines, in collaboration with the Department of Homeland Security (DHS), Transportation Security Administration (TSA) and Customs and Border Protection (CBP), are willing to incubate, test, trial and implement emerging solutions, and track growing adoption rates from passengers, finally bringing the Biometric Terminal to life.

But what is a Biometric Terminal? There are several factors working in symphony today to create the experience described above. Airports are integrating biometrics at varying levels, however there are 5 major processes being revolutionized to create the basics of the Biometric Terminal.

Biometric Entry/Exit at CBP

After 9/11, a commission recommended a full implementation of the biometric entry-exit scanning on both domestic and international passengers[3], but it wasn't until 2017 that the White House signed an executive order expediting the full roll out, with a 97% goal for biometrics in airports by 2021.[4] Even though in December 2019 the CBP removed the proposal requiring U.S. citizens to undergo mandatory face recognition at airports, following widespread protest, DHS, various airlines and several airports have already been putting successful biometric implementation plans into place across the country. International Entry/Exit at customs is common today in most airports and because of its efficiency in processing, it is a preferred practice by CBP and DHS. Today, over 2



million passengers on over 15,000 flights have used this technology to exit.[5] According to the CBP, their goal is to biometrically exit 16,300 flights per week by the end of 2021 with 100% of all international passengers using biometric recognition.[6]

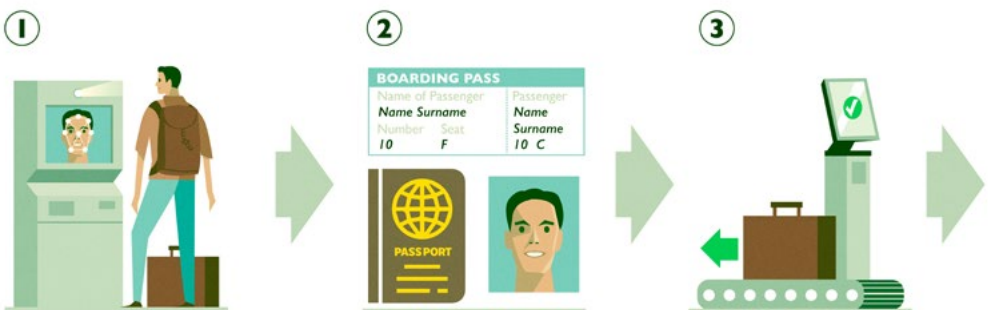
Biometric Boarding

With the exception of Southwest Airlines, most major airlines in the U.S. are taking steps to include the facial recognition technology for Biometric Boarding[3], a process which uses facial recognition at the boarding gate, removing the need for a passenger to pull out a paper or mobile ticket during the boarding process. In 2019, a study conducted by OAG found that biometrics-based self-boarding technology is preferred by 44% of passengers[7], and other reports are showing 90% adoption rates, with Delta Air Lines reporting only 2% of passengers opting out of the process[3]. And the passengers that are opting in?

Surprisingly, passengers across multiple demographics are seeing a benefit from Biometric Boarding processes, with the highest adoption rates in those between the ages of 25-34 (25.5%), and passengers between the ages 55-64 are 9.6% likely to adopt, citing that they would otherwise feel on display when fumbling for their paper ticket.[5] In addition to enhanced passenger experience, airlines are seeing a major improvement on turnaround times – the time an aircraft arrives at the gate to the time it leaves. In order to cut costs and increase performance and passenger satisfaction, airlines place a high priority on reducing turnaround times, using Biometric Boarding, automation of the ground crew, and other process innovations crucial for competitiveness. Using Biometric Boarding, Lufthansa recently boarded 350 passengers onto an A380 aircraft in 20 minutes, an improvement from the typical 45 minutes.[3] Biometric Boarding is becoming much more prevalent, and will be more widely adopted over the coming years.

Self-Service Baggage Drops (SSBDs)

Surprisingly, Self-Service Baggage-Drops (SSBDs) have gained more attention over the past year than any other process, a top preference by 49% of all passengers, according to a study conducted by OAG in 2019.[7] SSBDs are allowing passengers to seamlessly tag their checked bag, drop it on a belt, and go straight to security, completely hassle-free. In addition to being a preferred processing step by passengers, there are huge benefits to be seen for airports seeing growth that don't have either the resources or the space to expand; SSBDs can be easily installed onto existing check-in desks and conveyor belts offering up to 60% increase in terminal capacity, a 40% reduction in operational costs, as well as an improved passenger experience.[8]



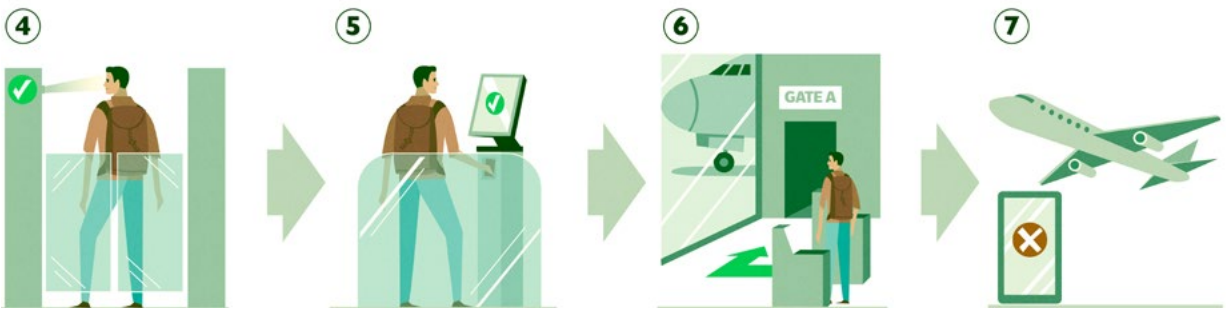
BIOMETRIC ENTRY **SELF-SERVICE BAGGAGE DROPS (SSBDS)**

Today, SSBDs can process twice as many passengers as compared to a full-service agent-assisted bag drop, with an average throughput of 51 seconds per person (as opposed to 90 seconds with a traditional counter), and one ticketing agent can monitor 12-14 machines at one time[9], transforming traditional ticketing agent roles into more hospitality-based roles. Biometrically enabled SSBDs are even quicker, and cater to a wider audience, as they use facial recognition to identify the user, rather than requiring a touchscreen input of flight information. While U.S. airports and airlines are starting to adopt SSBDs in some locations, luggage verification in the U.S. is currently still required by a human agent, therefore adding a step in the process, and reducing the efficiencies that SSBDs can gain. This requirement, however, will go away with the full adoption of Biometric Security Screening.

Biometric Security Screening

Over the past few years, airports have introduced expedited security clearance with Biometric ID managers like CLEAR, Vision Box, SITA, IDEMIA, and others. While some efficiencies are gained for the passengers, these methods are still checked against physical identification methods (driver's license or passport) by a TSA officer before moving through screening. In fall of 2019 however, TSA conducted a 30-day pilot at Las Vegas McCarren International Airport to test the 1:1 matching capabilities of the front-end CAT machine with a camera unit for facial recognition procedures in TSA Pre✓® lanes.[10] This gave the airport a deeper understanding of just how accurate biometric screening can be, and how much data storage capacity is needed to use biometric screening at scale. For each face that is scanned, 80 different points are analyzed. That information is stored for a maximum of 12 hours before being purged from the system. And while some passengers remain skeptical of the process, 42.6% passengers approve of the use of facial recognition technology to improve security and boarding speed.[11] 50% of passengers, however, believe that the security process will become more efficient with the help of computerized tomography (CT) scanners for bag screening, allowing passengers to keep electronics and liquids in their bags, according to study conducted by OAG.[7] Throughout 2020, TSA will be deploying 300 new CT scanners across U.S. airports, after seeing a 50% reduction in security screening time using CT scanners at Sydney Airport. In addition to baggage screening, passengers are interested in seeing mat-based shoe scanners that they can walk over without removing footwear, hoping this, too will reduce time spent at security screening.[7]

At DFW, trials are currently being held testing the Evolv Edge, which combines biometric screening, baggage screening and shoe scanning all in one



BIOMETRIC SECURITY SCREENING | BIOMETRIC BOARDING | BIOMETRIC EXIT

walk-through, zero-divestment experience. Evolv can process more than 800 people per hour, delivers facial recognition results in less than one second, and simultaneously detects metal and non-metal threats in real-time. Even better, Evolv is easy to deploy by one person, and takes less than 30 minutes to set up and begin scanning, creating complete flexibility for security screening spaces. With biometric identity match and no lines, it's not only a great system for efficient passenger flow, it also eliminates guard fatigue and potential passenger profiling. The success of the DFW trials could prove to be a revolutionary improvement for airports globally, as we continue to move forward in creating a more pleasant, seamless, hassle-free security screening experience.

The Biometric Airside

It's apparent that travelers crave simplicity, speed and efficiency. Information transparency plays just as important a role in speeding up processes and investing more in real-time information-sharing opportunities is key. Contrary to popular belief and healthy skepticism, 87% of consumers are willing to share data in exchange for a uniquely personalized experience.[12] When efficiencies are realized from universal biometric screening methods, it will only be a matter of time before we see a biometrically enabled airside infrastructure that caters to passengers in a more personalized way. A 2019 study reveals that 54% passengers would like to see universal in-airport-turn-by-turn GPS directions for navigating terminals and gates.[7] Additionally, self-service amenities are in high demand for younger generations, with 54% of millennials, 37% of business travelers and 35% of all travelers showing interest in self-assisted options at the airport.[7] Tapping into these desires will be key to creating great opportunities for an exceptional airside experience.

Whether providing gate information through destination glass or integrated tech bars, 37% of passengers will increase participation in concessions if Flight Information Displays (FIDs) are immediately visible within stores, increasing overall enjoyment. Likewise, 75% passengers want real time updates on expected boarding times, and 17% passengers prefer live video feeds showing what is happening at their gate sent to their mobile devices.[7] Knowing that information transparency may increase passenger enjoyment in concessions, where the majority of non-aeronautical revenue is gained, why not leverage an existing and emerging infrastructure of self-service touchpoints, using biometric data and facial recognition, throughout the concourse to inform passengers of their journey?

Imagine paying for your Starbucks order with your biometric wallet, and as you scan in, the screen reads "You have 30 minutes left until your flight boards, John. Would you like to enjoy a slice of pumpkin bread while you wait?" On your way to your gate, you stop to look at a digital advertisement, and in the corner you read "Good morning, John. You have 28 minutes until boarding at gate A8". You continue to see your personal flight information in the restroom mirror while washing your hands, however, no one else looking at the same mirror at the same time can see your information. This ecosystem of information is more than just a

pipe dream, it's a reality in the making. IBM, Delta Air Lines, and Misapplied Sciences recently launched Parallel Reality[13], a new display that lets many different people see completely different content on the same screen, simultaneously. When combined with location technology and sensors, content can be instantaneously updated and follow people throughout 3-dimensional space.[14]

The (very near) future of our airports has the capability to completely transform our traveling journey into a much more seamless and personalized experience, from curbside to boarding at the gate. And because terminals tend to be a good living laboratory to test future city-wide adoption, you can only imagine what comes next…

WHAT CORGAN IS CREATING

Parametric Design

When you google "parametric design," you might find yourself in the land of the abstract with more questions than answers. But, as the terminology might imply, this design method boils down to the rapid adjustment of design parameters in a short amount of time.

Studio Robazzo, a firm in Vancouver that specializes in parametric design, compares it to a spreadsheet. "Think of it like an Excel sheet you've set up to make calculations. You choose which math function will be performed, input the different numbers, and your result depends on what those variables are."[15]

Parametric design uses computer algorithms to allow you to plug in different variables and see the end result is each time you change something. This allows you to move much faster during the design process and envision the final installation as changes are still being made. This agile methodology is revolutionary for the industry for a number of reasons.

PHX - Terminal 3 Modernization designed by Corgan

1 You are able to rapidly make an infinite number of changes until the exact aesthetic intent of the design is achieved without losing the completed progress of previous iterations. The old adage, 'back to the drawing board,' is no longer relevant. Even if significant modifications occur, designers who utilize parametric software are not starting from scratch each time a new idea is studied, but rather making minor modifications to the overall script to implement ongoing changes. Numerous options can be studied in the same amount of time that a conventional designer would only be able to generate a single idea.

2 Thinking parametrically improves the traditional designer, manufacturer and contractor relationship. Changes can be rapidly incorporated into the evolving design right up until the final product has been fabricated. Adjustments in size and quantity that would conventionally cause headaches are painless to incorporate. This flexibility between designer and builder improves efficiency, reduces waste and allows for last-minute budgetary alterations.

Corgan recently used a parametric design to create a custom ceiling art installation for two new concourses at Phoenix Sky Harbor in Terminal 3. These pieces of artwork were requested by the owner to encourage passengers to venture further into the concourses and explore the concessions spaces they otherwise would not have discovered.

For the T3 installations, the design team utilized a parametric script to determine the mounting height, cable length, color and shape of each individual element. The script also assisted in optimizing the sheet to maximize the total quantity of elements while simultaneously minimizing waste material.

SOUTH CONCOURSE

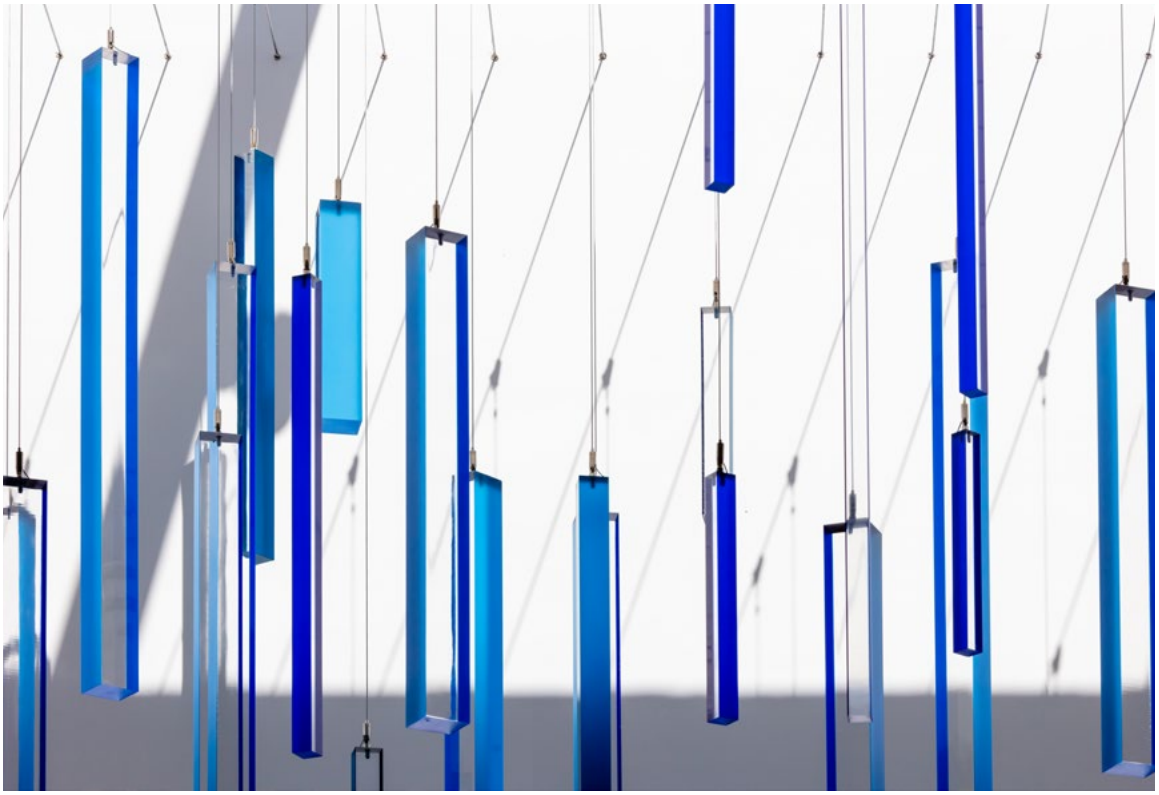
The south concourse installation consisted of 980 handmade blossoms. Initial blossom shapes were formed by heating 8x8 in x1/8 in 3form Varia Ecoresin pieces in an oven until malleable, then shaping the resin as it cooled, repeating the process until the desired forms were achieved. Of the initial prototypes, four basic shapes were selected to be included in the final design. The installation was reduced in budget four times and yet the end product was not negatively affected.

NORTH CONCOURSE

The north concourse is an adaptation of the south concourse script that uses vertical resin pegs in four differing shades of blue to emulate the desert rain. Similar to the south concourse, the desert rain featured three peg sizes and four lengths. A traditional design approach would have struggled to be able to handle the intricacy of the installation.

These elements provide memorable moments to help orient arriving passengers. Symbols and colors are universally understood. International travelers benefit from experiencing these installations just as much as native English speakers. These parametrically designed pieces have had a positive impact on passengers, providing an uplifting, stress relieving and calming respite during the typically stressful experience of airline travel.

PHX - Terminal 3 Modernization designed by Corgan



CORGAN IS CURIOUS ABOUT

The Wellness Effect – Through the Generations

From Genetic Profiling Journeys to Sleep Retreats. From Sound Healing Trips to Nature Immersion Explorations – each year, travelers take at least 586 million wellness trips.[16]

With millennials and Gen X travellers self-identifying as "workaholics", 91% of Gen Zers reportedly living with ongoing stress[17], and boomers looking to new ways of improving their health and quality of life, it's no wonder why Wellness Tourism is on the rise. In fact, the wellness tourism niche encompasses 15 percent of global travel, second only to cultural tourism.[18] And before you think this is just a fad, consider the fact that tourists focused equally on personal wellness and their own carbon footprint spend 130% more than the average traveler.[19] Wellness Tourism and sustainable air travel is growing rapidly and reshaping the expectations of passengers, forcing airlines and airports to offer more enhanced experiences and simultaneously be more transparent about the carbon footprint they create.

A large majority of global travelers – 87 percent – say that they want to travel sustainably,[20] with 40% global travelers are choosing options that reduce environmental impact[21], 44% focused on supporting local businesses[21], and another 34% desiring to have a locally relevant experience while traveling.[20] And in the spirit of fancy statistics, a whopping 78% of travelers consider themselves more ethically conscious than just a year ago.[22]

While millennials still log the most flights a year (on average 5.6)[23] compared to any other generation, Gen Z travelers are the demographic taking wellness tourism and conscious travelling to a whole new level, specifically booking trips that have a reduced carbon footprint or are carbon neutral. Gen Z travelers are completely changing the way the travel industry markets, books, and even thinks about air travel, our environment, and how we can play a role in creating an eco-friendlier tourism experience. So… who are they anyway?

Born after 1995, the oldest of the Gen Z travelers will be 25 in 2020. According to Bloomberg, in 2020, Generation Z will account for almost 2.5 billion people – that's 32% of the global population.[24] And with a collective buying power equal to $143 billion in the U.S. alone[25], they are already having a significant influence on how households are booking travel and spending their vacation money.[26] Travelers under the age of 25 also have a distinct sense of responsibility regarding the effect that their travel choices have on the environment, and are demonstrating a willingness to take less-polluting forms of transport, a preference for eco-friendly, ethical hotels, and a willingness to challenge travel norms for the sake of the planet.[27]

Most importantly, airports are taking notice of travelers' shift towards sustainable choices and are considerably evolving their concessions programs in favor of offering organic, locally sourced, seasonal, sustainable cuisine. Gen Z travelers prioritize food over anything else in their

itinerary, with 94% of them planning their locally relevant cuisine experiences before they travel, all while making a conscious effort to reduce their environmental impact.[26]

Some restaurateurs are leveraging these user preferences to improve their impact on the environment by combining data analytics, machine learning, and precision catering through robotic customer services.

Spyce, in Boston, MA is the first robotic restaurant in the world to cook complex meals.[28] Promising consistency, culinary creativeness with experienced chefs, and accessible, nutritious meals, Spyce focuses on only sustainable production (sorry kids, no beef on the menu) and locally sourced food to create delicious stir-fry bowls, always with an eye towards protecting the planet. Using 100% renewable energy, Spyce's Seven robotic heating woks deliver up a precisely made meal in three minutes – every time. "Our purpose is to increase access to wholesome and delicious food for people at all income levels," explains Grace Uvezian, Spyce's head of marketing and public relations.[29] "Too many people [are] being priced out of quality. Spyce is at the intersection of hospitality and technology; by combining appropriately sourced ingredients with our robotic kitchen, we're able to provide meals at $7.50".[29]

Precision cuisine at the airport doesn't stop with robotic concessions. To keep pace with population growth, more food will be needed in the next fifty years than has been produced in the past ten thousand years combined.[30]

Several airports and airlines, like Dubai International and Emirates Airlines for example, are beginning to use precision farming techniques on the airport campus to provide fresh food for travelers – more than 6,000 pounds of greens and herbs a day, using 99% less water than outdoor fields.[31] Singapore Airlines on the other hand, has partnered with a high-tech vertical farming company called Aerofarms in New Jersey to create the new "farm-to-plane" dining program, reducing shipping waste almost completely by sourcing greens from a few miles away, whereas previously greens had to be flown in from 3,000 miles away to cater flights.[32]

Other U.S. airports, like Denver International Airport, Dallas Love Field, San Francisco International Airport, and a whole host of others, are providing filtered water filling stations at the airport, in an effort to support the conscious traveler who wants to reduce plastic waste. Even drinking water companies like Oasis, manufacture hands-free

bottle-filling stations that are ergonomically fashioned to fit water bottles. San Francisco International Airport has been on this train for a while, and in 2019, they banned the sale of single-use plastic water bottles at restaurants, cafés, and vending machines throughout the airport – giving passengers the ability to fill up with filtered water for free. The move is also part of the airport's plan to reduce carbon emissions and landfill waste by 2021.[33] This is not a trend that is being forced on their passengers either; Consumers' inclination towards the use of lifestyle products in combination with a rising awareness of environmental threats is boosting the demand for reusable water bottles, becoming a status symbol among millennials and Gen Z travelers overnight.

In fact, the travel industry is estimated to account for the third-highest value and volume among other primary uses in the reusable water bottles market and the global market is estimated to reach a revenue of $11B by the end of 2027, and $12B by 2029.[34]

Also consider that almost half (48%) of U.S. travelers say they would change their consumption habits to benefit the environment.[35]

Airports like San Francisco International Airport and Dallas Love Field are not viewing this as a loss in non-aeronautical revenue; instead, they are shifting towards a hospitality mindset, catering to the shifting preferences of their customers. "There's this idea that having a purpose or doing good has to come at the expense of making a profit… Profits can and should help affect positive change on a global scale. The good news is, consumers want more sustainable and ethical products, so purpose is actually good for business too" remarks James Thornton, CEO, Intrepid Travel.[22] This is true, and is reflected in the fact that 66% of consumers will pay more for environmentally-friendly products, 73% of those millennials and 65% of those Gen Z.[22]

"Okay, but the travel market is not just Gen Z, right?" you may be asking.

You're right. Let me drop one more fact on you: Because millennials and Gen Xers are completely overwhelmed with their workload, skip-gen travel – where grandparents (boomers) travel alone with their grandchildren (Gen Zers)– is on the rise. Gen Z, you multi-generational travel influencer, we have our eyes on you.

It makes complete sense. Their entire lives, this population has been given information about global warming and eco-friendliness, creating a natural interest in eco-friendly trips, sustainable hotel practices and doing good in their destination's community.[27] Additionally, more travel is being planned that lets them experience life as a local, in search of truly authentic experiences. Why see gorillas in the zoo, when a 3-day trekking tour led by locals in Rwanda has you sourcing your own water for the hike, staying in a tent in the African mountains, and macheting your own path through the underbrush so you can view the gorillas in their natural habitat? In addition to creating minimal

impact on the land for accommodation, travel experiences like this provide a valuable source of employment for the locals. While a very small portion of the population will go to these extremes for an eco-friendly once-in-a-lifetime vacation, 60% of travelers note that natural sites that they have visited on past travels is their source of inspiration to travel more sustainably.[20]

Staying active while on vacation is a part of the more sustainable approach to travel, with travelers looking for more intrepid journeys and experiences now than their older generation counterparts who are looking for destinations focused on relaxation, health and wellness. Only 36% of Gen Z and 41% of millennials travelers describe themselves as "relaxers", while 50% of Gen Xers and 68% of baby boomers report booking travel focused on relaxation and mental wellness.[37]

From active, high-mountain trekking to napping on a beach, wellness journeys don't just happen at the destination; they begin at the airport. Airports are adapting to the wellness-focused traveler in a variety of ways, offering a wide spectrum of personalized and responsible amenities to all traveler generations.

Airports are known to be complex environments, asking passengers to multi-task at all times – recomposing themselves after security while deciding which café is closest for coffee with the time left to get to their gate before boarding. Did someone say stressful? A growing number of studies have shown that being exposed to natural environments can reduce psychological stress, lower cortisol levels, increase overall mood levels, and promote mental restoration from attention fatigue Levels of Nature and Stress Response. That's why getting in touch with nature on a variety of scales is a major element in wellness tourism, and some airports, like Chicago O'Hare, Amsterdam, and Singapore's Changi, have taken the hint by bringing the outside in.

From color and pattern choices in furniture to fully grown gardens and butterfly sanctuaries, these terminals are leveraging biophilic design to introduce rhythms of nature into the interior terminal environment in a variety of ways, including things like: airflow variation that mimics natural breezes, the ebb and flow of dynamic and diffuse light, diversity of spaces to provide both a vista and a sanctuary, and visual, auditory, and olfactory connections to nature.[38]

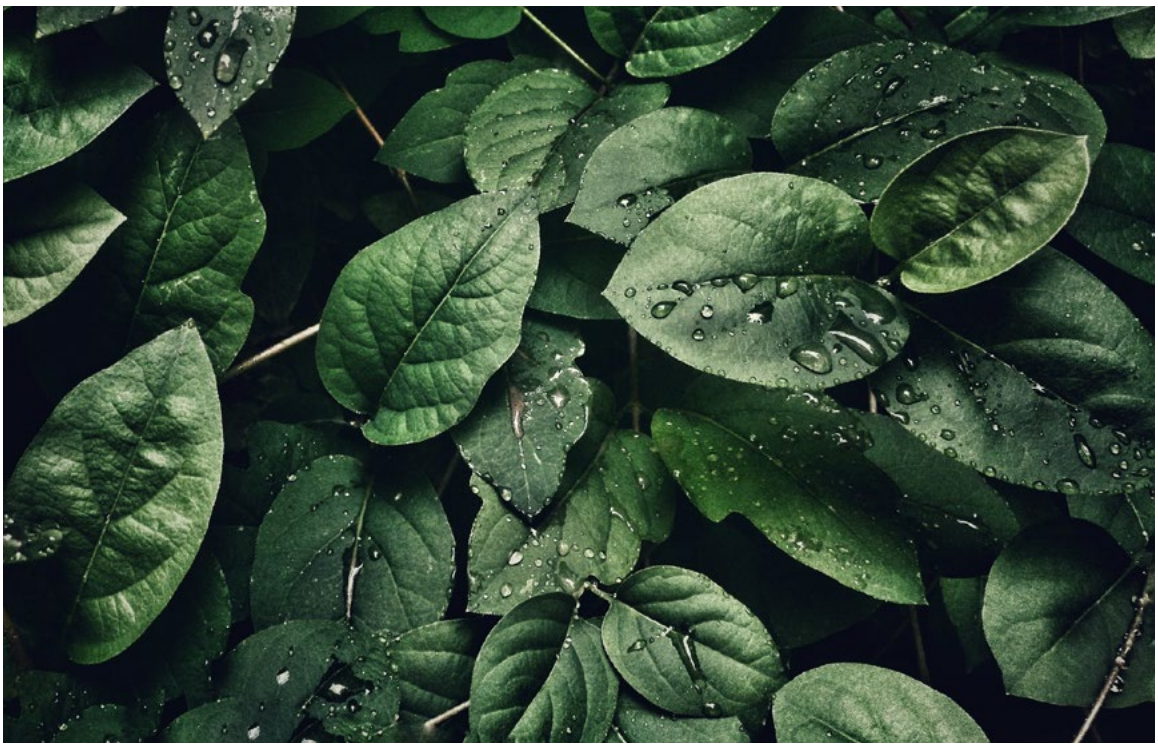
Design that reconnects us with nature – biophilic design – is essential for complex environments such as airports, as this method is proven to restore cognitive function which increases situational adaptability, attention, alertness, concentration, and emotion.

Stress management is also an added benefit of biophilic design, reducing tension, anxiety, anger, fear, fatigue, and confusion.[39] Biophilic design can also combat vertigo in older passengers, and can stabilize them if paired with vertical circulation, such as escalators and stairs.

Biophilic design is just one example airports are focusing on enhancing passengers' mental wellness. Some airports, like Phoenix, Minneapolis-St. Paul, and Cleveland, are promoting physical activity, offering indoor walking tracks to help more active travelers pass the time before flights, while various airports offer yoga rooms and work out facilities.[18]

However, with the various distractions to reduce the perception of time spent waiting and various activities that are being introduced into the airport environment, studies show that it's getting harder to get passengers to listen to—and comprehend—announcements in an airport setting. Additionally, airport noise is physically and mentally draining. In response, Silent Airport policies – where airports are removing terminal-wide PA announcements, noise pollution from adjacent concessions, and boarding gate calls (among others) and only announcing emergency or severe weather concerns – are now on the rise. Some airports that have adopted the silent airport initiative are filtering unique sound designs that highlight bird songs and the sound of rustling leaves – all in an effort to re-introduce our interior environment back to the mental wellness that nature supports.

Our passengers' preferences are changing, and it's important that our airports do too. Knowing traveling habits of passengers today will transform how we design airports for those same travelers in the future.



WHAT CORGAN IS CREATING

Viewing the World Through Data

The world is in constant movement as people, cargo and information continuously flow from one place to another. Data visualization and modeling has become a common and effective way to communicate these complex sets of information by allowing the human eye to see patterns and trends that might otherwise be lost in a spreadsheet. Giving life to information that might otherwise stay hidden can illuminate new ways of understanding the world around us.

Corgan's aviation sector recently investigated the power of data modeling and how it relates to our understanding of macroeconomic systems. Examining an array of data sets provided key insights about the airline industry, while providing intelligent data-driven design.

At the core of this project is spatiotemporal data visualization. Spatio refers to geospatial location and temporal refers to time. The intent of this project is to allow the user to interactively model and analyze data and its relationship to time and place with increasing levels of specificity.

With a focus on the aviation industry, this model seeks to understand global industry patterns and their impact on transportation infrastructure, architecture & user experience. Creating an interactive environment where users can isolate information by location and time for comparative analysis allows for intuitive data visualizations.

Scalability is a critical factor as the data sets available through entities such as the Federal Aviation Administration (FAA)[40], Bureau of Transportation (BOT)[41], and International Air Transportation Association (IATA)[42] consist of hundreds of thousands of data points for a single year.

Through a combination of Python scripting and Grasshopper, data sets can be parsed down into their atomic levels.

For example, a data set containing information about every airline's operational metrics for a given year can be parsed to isolate a specific aircraft type within a unique route belonging to a specific carrier during a specified time range.

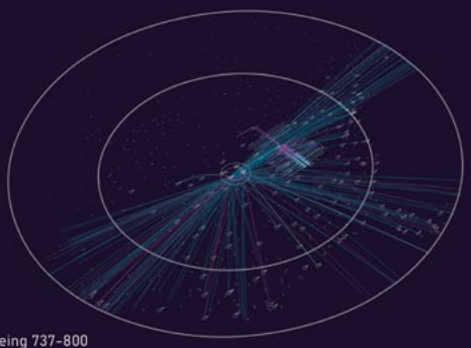
Looking at data through this interactive filter allows us to identify generalized trends at the macro level and filter down information to understand the driving factors behind it.

The project is currently hosted in a Rhino + Grasshopper environment. This allows the user to interact with the data via easy-to-use sliders as the data is modeled in a 3D environment. Hosting the environment in an object-oriented 3D environment also allows the user to interface with the data using extended reality tools like VR and AR.

The application for understanding data through visualization can take many forms as identifying areas of interest can narrow the scope for where in-depth statistical analysis can occur. From there, this information can provide a basis for data-driven design. This not only helps us to identify industry trends, but also the adoption of new technologies, and projected passenger and cargo load factors. It also expands our understanding of aviation's impact on public health, our environment and an increasingly globalized economy.

Spatiotemporal Data Visualization
01.14.2020

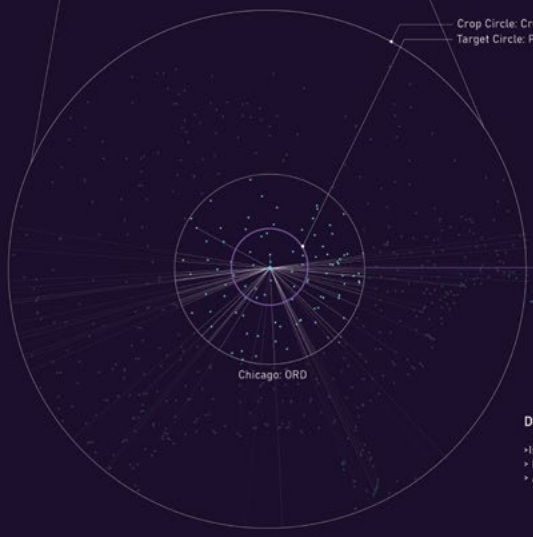
Example documentation isolated catagories
Time: January - 2019
Location: Chicago ORD
Carrier: American Airlines



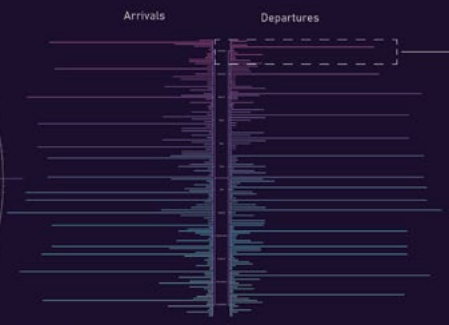
Boeing 737-800
Route Origin: Chicago ORD
January - 2018

Global Destinations of American Airlines - Chicago ORD - January 2019

Isometric View Of Brush Visualization With Data Tree Breakdown



Crop Circle: Crop map at circle extents
Target Circle: Pull data for cities within target circle boundary



Data tree - Breakdown:

›Isolated Origin (within taget boundary)
› Month
› Aircraft Type

Cycle Through Metric Data By Catagory
View By Metric
FREIGHT

Top 3 Aircraft At ORD
Ranked By Metric Sums
Jan - 2019
View By Aircraft
Boeing 737-800
Airbus A321
B787 Dreamliner

Data Breakdown

Brush Visualization - Arc Height = Metric Sum By Route

Visualization Interface : Rhino + Grasshopper

CAN YOU IMAGINE...

If your weekend getaway was to the moon?

Currently all around the globe, companies are competing in a privatized space race centered around constructing a vehicle to send passengers and goods into space as early as 2023. Now, sit and try to envision the spaceport, a building to house and launch these crafts. What iconic image comes to mind? … Nothing?

To date, no one has asserted themselves as the spaceport architect. Corgan will lead the industry to define spaceport architecture as the future of aviation. The United States has 24 licensed existing and proposed Spaceports and only one of them has been built to accommodate future passengers.[43]

Primarily, a spaceport is a facility where spacecraft launch into space on various types of missions. The overall campus includes concrete launch pads and landing strips along with facilities for maintenance, education/training and business commerce.

Much like Airports, no spaceport is the same. Today, the built environment for the spaceport is based on function and not the user experience. We are taking our aviation expertise and pushing the boundaries for the spaceport to expand and thrive alongside the escalating trends of technology and spacecraft.

Similar to the evolution of airports to present day standards, the spaceport will need to progress in stages. In the first phase of building, the spaceport will need to sustain growth with facilities for maintenance and business commerce along with the launch pads and landing strips. Taking cues from the motorsport industry, spaceports will have a higher return on investment if designed as a landmark or destination. We propose to include observation decks with a hotel. Watching rocket launches will inspire young and old minds alike with a life altering experience.

Rockets were initially designed with the goals of preserving the earth. The architecture of the spaceport will also provide sustainability. Utilizing the ignition overpressure and sound suppression system by NASA for the rocket launches, we could potentially replicate the process used in power plants to power a steam turbine. The turbine would turn from the water dispensed for the suppression system and then turn to steam once the water intersects with the rocket blasts. This would potentially create clean energy for the facilities at the spaceport.

Once the spaceport is established, passenger travel will emerge. Due to the nature of everyday civilians entering space, the passenger experience within the spaceport will be highly individualized. Each passenger will embark their journey in a lobby with an artificially intelligent virtual assistant. Here the assistant will perform a health screen to ensure safe travels into the universe. Then the passenger will be escorted into a private changing area to suit up. Passengers traveling via horizontal launching spacecraft will enter the concourse much like boarding a plane from the holdroom. The vertical launches are located away from the terminal and passengers will travel via spherical pods from the concourse to each vertical launching rocket. Then the spacecraft will launch to the Moon, Mars, or Beyond!

SPACEPORT LAUNCH SITE IN ALASKA DESIGNED BY CORGAN

HUGO

Spaceports: User Experience Research

As of today, there have been around 550 people who've left the Earth's orbit and flown into space[44]; only 12 of them have walked on the Moon.[45] Most of these spacefaring individuals come from highly specialized fields, like the military or mechanical engineering. But this technical expertise has enabled them to navigate extreme and complex environments such as zero-gravity, long-term isolation, and decision making in high stress situations.

The birth of a commercial space industry introduces average people, with no technical training, into this harsh environment — people like you and me. This presents a ripe opportunity to consider the user experience of guest arrivals and departures as they prepare to fly into orbit.

With this in mind, Hugo set out to learn everything we could about space travel. We read astronaut diaries and NASA research papers. We developed journey maps for future space travelers and tried to imagine what their expectations might be. We quickly learned that there are a variety of human states and behaviors that need to be considered when designing this architectural typology. But for our purposes, it boiled down to three factors:

1. **The Overview Effect**
   While examining astronaut journal entries, NASA anthropologist Jack Stuster and his research team identified adjustment as one of the most common and pressing behavioral issues of space travel.[46] Journal statements assigned to the adjustment category were either positive, negative or neutral, and ranged from physical and cognitive adjustments, to fatigue, and reflections on both high and low morale.

"I'm learning how to put things 'down' in space. But now, without thinking about it, I've found that I place things in the air beside me so they're easily available right away." - Astronaut Diary Entry[46]

2. **The Overview Effect**

Coined by Frank White while interviewing numerous astronauts,[47] he found that many of them had undergone "truly transformative experiences involving senses of wonder and awe, unity with nature, transcendence and universal brotherhood".[48] The intense and singular states of awareness triggered by viewing the wholeness of the Earth from space is a symbol of almost all that is meaningful in human life. Some individuals reported intensely self-transcendent experiences that have historically been associated with practices such as prayer, meditation, and religious rituals as well as the use of psychedelic drugs.[47] While this view of the earth might be temporary, astronaut experiences' may sometimes settle into long-term changes in personal outlook and attitude involving their relationship to the planet and its inhabitants. Astronauts often reported no longer seeing the importance of geopolitical boundaries, denouncing war and becoming stewards of environmental conservation.

It's worth noting the neurological implications of the Overview Effect. These feelings of unity and awe seem to include temporary reductions in activity in regions of the brain associated with spatial awareness, perhaps contributing to reduced awareness of one's physical self and of their separation from objects in their environment.[49] This can also happen here on Earth when we view things, like the Grand Canyon, from a high vantage point; our brains are not used to seeing such colossal structures on a smaller scale.

"If somebody'd said before the flight, 'Are you going to get carried away looking at the Earth from the moon?' I would have said, 'No way.' But yet, when I first looked back at the earth, standing on the moon, I cried." - Astronaut Diary Entry[47]

3. **The Space Fogs**

Many astronauts reported having a "slow mind" and required a more concerted effort to concentrate.[46] This is sometimes referred to as the "Space Stupids" or "Space Fog." The cause is unknown but nearly all astronauts report taking about a ten-point hit to their IQ when they reach low-Earth orbit.[46] For many astronauts, these sensations tend to stop after a couple of days in space, but others suffer discombobulating feelings throughout their trip and after their return.

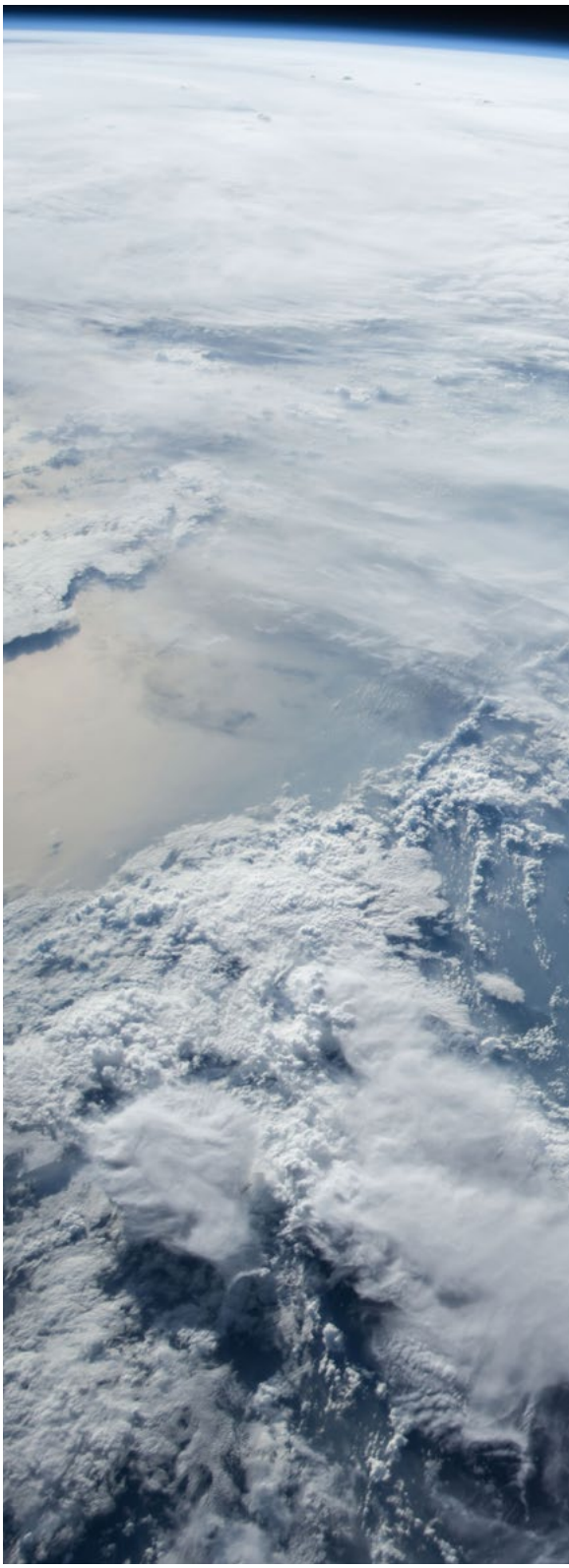
Many of these strangle illusions and disorientations are caused by the simple lack of gravity. Without the weight of the body to give it cues, the brain becomes easily confused about its orientation, causing, for instance, the uncanny feeling that you are permanently upside down.

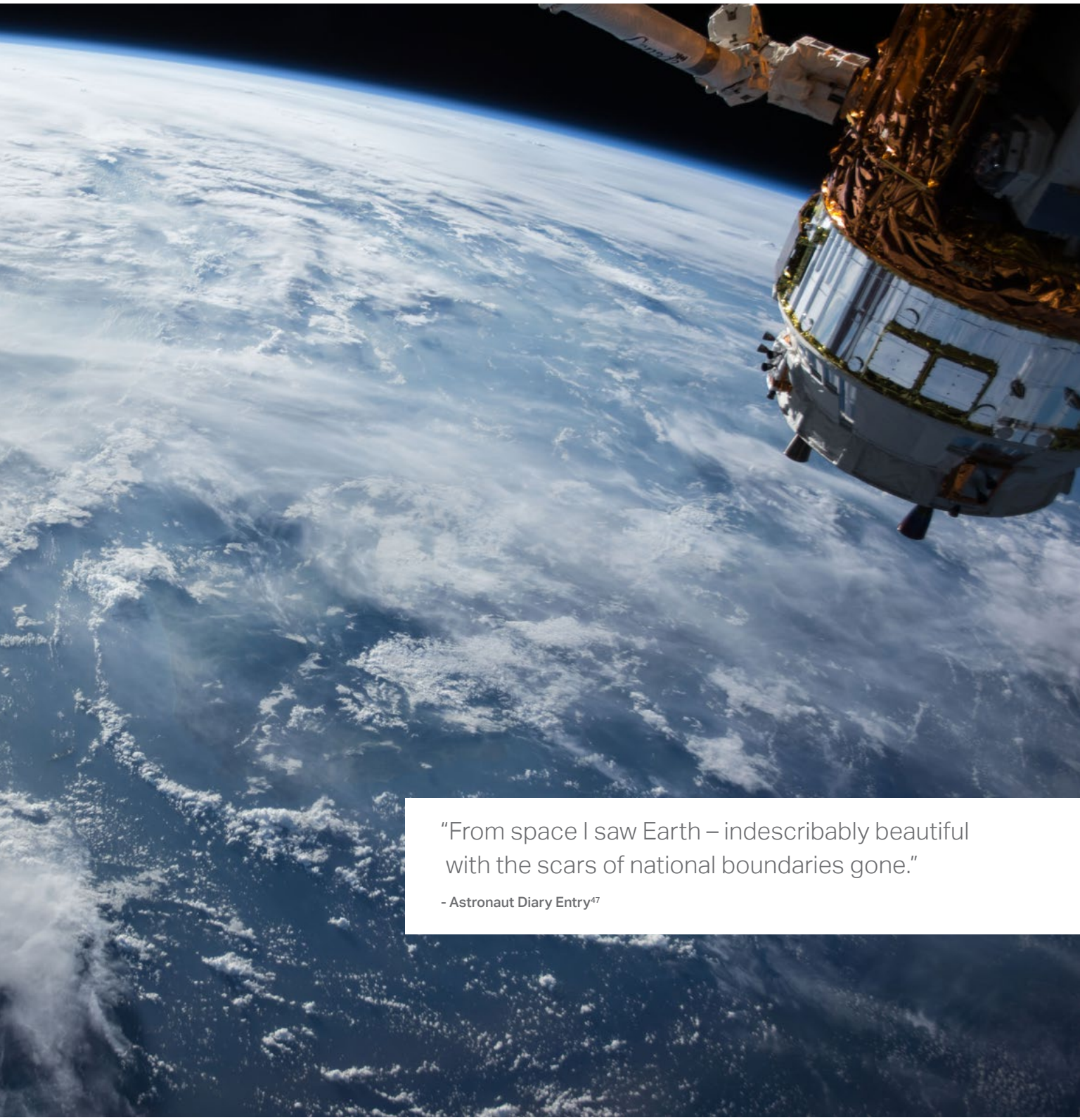
HUGO

So, what does this mean for spaceport architecture? It means the facility needs to reflect the deep physiological and psychological shifts that can take place before and after space flight.

If travelers experience a change in their sense of spatial awareness after space flight, their return to Earth via a spaceport needs to incorporate this understanding into the final design. This can impact things like wayfinding, branded environments, optimal ceiling heights, and designated rooms to recalibrate spatial perception. Maybe someone's spiritual faith has been severely impacted after seeing the Earth suspended in outer space and they need a moment to reflect. Or maybe a passenger comes down with a bad case of the Space Fogs. We wouldn't recommend someone to drive home after a couple of drinks and we, similarly, wouldn't recommend someone to drive home immediately after being in space.

This means a spaceport might want to provide accommodations like hotels, reflection spaces and medical facilities that allow guests time to re-acclimate their minds and bodies to their routine back on planet Earth.





"From space I saw Earth – indescribably beautiful with the scars of national boundaries gone."

- Astronaut Diary Entry[47]

02

CURIOSITIES IN COMMERCIAL

"Attention salesmen, sales managers: *location, location, location*, close to Rogers Park."

- REAL ESTATE AD IN THE CHICAGO TRIBUNE (1926); FIRST RECORDED APPEARANCE OF POPULAR REAL ESTATE PHRASE, "LOCATION, LOCATION, LOCATION."[1]

What to expect

Welcome

The key element of any commercial architecture project is its proximity to consumers. Think of historic markets and bazaars in famous world port cities like Istanbul, or the Silk Road, an important network of trade routes that connected the East to the West. These famous commercial routes functioned off proximity, connectivity and nodes; full of energy, and highly concentrated, each vendor had their own small quadrant of the world, so to speak, and each business was outward facing, accessible, and in proximity to other businesses

Moving into the 21st century, what does commercial architecture look like? Since the introduction of the office building typology, not much has changed. Office towers, for instance, while continuing to break boundaries in regard to height and unique structural systems, have essentially remained the same. An office tower built in the 2000's still looks generally like an office tower built in the '60s. The biggest advancement to office design has been research regarding the health benefits and increased productivity that come with access to natural daylight. This has changed the way commercial office buildings have been laid out spatially, especially in Europe, creating narrower structures and providing floor to ceiling curtain wall.

So then, what is changing? And how are these DARQ technologies affecting the way society will view commercial architecture in the future?

We can begin to answer this question by understanding the nature of work and how we occupy commercial spaces. Work, for the majority of companies, combines the tasks and innovations of the individual with those of the group. These collaborations require spaces to meet,

be that virtual or physical, an entrance or lobby with access to individual desks or work zones, restrooms, etc. Not only should these spaces offer function, it's important for them to consider the health and wellbeing of people occupying those spaces. Access to natural daylight, as mentioned before, has proven to have positive benefits to mental health as well as productivity benefits for individuals. Improved indoor air quality has been proven to increase cognitive functions in workers, resulting in better decision making.

While these examples provide benefits for all people, we are learning that technological revolutions are influencing how individual generations prefer to work.

Advances in computing have enabled remote work capabilities like never before, enabling people to perform their jobs from almost anywhere through a decentralized workforce. The ability to work and collaborate remotely is being powered by digital commerce and extended reality platforms that allow us to be closer and more connected to people across the world. These virtual spaces allow us to recreate these commercial hubs across the globe, making their remote offices feel connected and wholly integrated. In this scenario, workers have much more autonomy over their careers and their work-life balance than they did before as they are not burdened by the repetition of "8 to 5" (which we think might make the next generation of workers cringe but more on that later).

What does this mean for companies? It means they no longer have to construct gigantic monuments dedicated to the "8 to 5." Their spaces can become much smaller since they do not have to account for 100% of workers occupying their office 100% of the time. Programmatic elements can be shared amongst companies in new ways, like ground level retail and restaurants, or shared autonomous vehicle parking spaces. These areas can even be turned over for completely new functions that are yet to come, like top story "air lobbies" for urban air mobility vehicle drop-offs.

A Forbes article recently addressed a question commonly asked of Steve Jobs — did Apple conduct market research or survey the public for ideas during the development of their then-revolutionary iTunes product? His answer was no. Jobs quickly explained himself by referencing a humorous, yet insightful, quote by Henry Ford, inventor of the Model-T: "If I'd have asked my customers what they wanted, they would have told me "a faster horse." What we can draw from Ford's and Apple's mindset is that with our profession comes the exciting privilege of invention. Rather than merely reacting to DARQ's cultural phenomena, by becoming constant curious observers of cities, people and processes, we have the ability to anticipate and form conclusions unseen to the rest of the world through our commercial architecture.[2]

These emerging technologies introduce a new way to think about work. What would a building look like that only housed professionals using their creative right brains, with DARQ technologies in place to cover for the rest? How can unique architecture enhance creativity needed in the modern workplace? Walk into any cathedral, like Le Corbusier's Notre Dame du Haut Ronchamp, and see first hand how that space can influence creativity. Or MVRDV's Tianjin Binhai Public Library, or Tadao Ando's Modern Art Museum in Fort Worth, or even intimate spaces like the nook at your local coffee shop. We can design the future work spaces that enhance and cultivate our best, creative qualities as a human race.

- Corgan Commercial Leadership

CORGAN IS CURIOUS ABOUT

Virtual Spaces and Digital Placemaking

Spaces are only as inspiring and attractive as the designers create them to be. Why stop at just the physical?

Companies like Rumii[3] and Dataview VR[4] have designed virtual workspaces where people can meet in virtual office environments, eliminating commutes to and from work, and removing collaboration barriers associated with global and remote working. Virtual reality conference rooms create a space where people can actually interact in 3D (unlike online conference call platforms), increasing employee engagement and productivity.

Rumii's platform has its users create custom avatars to represent themselves once inside the virtual environment, although there are companies trying to use facial scanning software so that their avatars actually resemble employees. The virtual workspace also provides customizable interfaces and room design, that can be changed per meeting and can allow for interaction with 3D models, charts, screensharing, etc. Dataview VR's platform for viewing data as a 3D dynamic component, versus 2D static charts, can revolutionize how businesses can interpret data in the future.

As commercial architects, the limitations within which we design spaces (land, material properties, code etc.) can be removed when we think in 3D virtual spaces, expanding our design services and repertoire into the digital world. Digital meeting places can be customizable per team, client, employee, etc. based on their firm's brand guidelines or aesthetic preferences.

Additionally, with these virtual conference rooms and workspaces comes the reality that people will need physical spaces with which to enter these virtual environments. "Commercial architecture" begins to encompass a wide array of spaces; basically any space (coffee shop, living room, office, etc.) that people use to engage with VR. How can architects design these spaces to promote long term physiological health, or "digital wellness", for people who are in VR environments for long periods of time, and will this be the next programmatic need for corporations who continue to need physical offices?

rumii

Rumii has designed virtual workspaces, allowing employees to meet in a digital office environment, eliminating commute times, and removing collaboration barriers typically associated with global and remote working.

CORGAN IS CURIOUS ABOUT

Decentraland

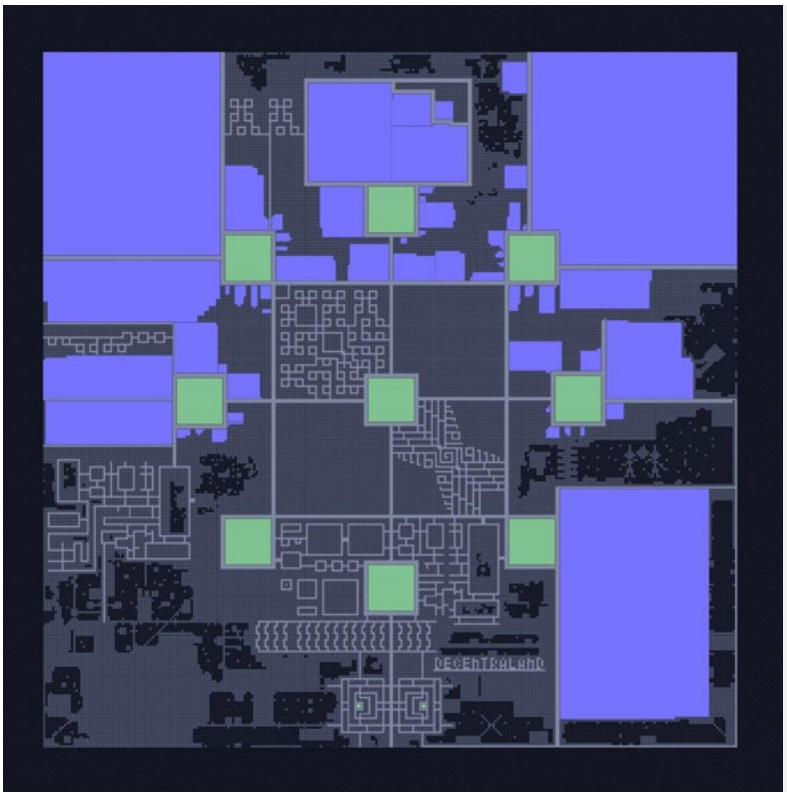
Permitting, building codes, and Pro-Formas got you down? No need to fear; build your dream building and design your perfect masterplan in Decentraland!

Decentraland[5], the first ever blockchain-based world, is a booming virtual real estate market that allows you to auction and purchase virtual plots of land. This innovative platform is taking advantage of the fact that workplaces are moving more and more to virtual versus physical workspaces. Users can interact with their friends within the platform, run a business, and build whatever they wish without the threat of online governments or corporate entities (like Facebook) regulating their spaces and the content they consume. Just like our real estate market, the value of the land in Decentraland changes based on supply and demand but is purchased using cryptocurrency.

"The ownership of items is cryptographically established on a smart contract, which prevents anyone from stealing or altering users' property," according to the project lead at Decentraland, Ariel Meilich.[6] This means that power is given to the users, not regulating forces, resulting in the allure of one's ultimate autonomy. The platform uses blockchain technology and smart contracts to conduct all purchases and payments within the platform, so money and goods are transferred directly from user to user without corporate entities or brokers receiving profits from the transaction. To sign up, users must enroll in a "Crypto Wallet," that helps them manage transactions such as: earning rewards, purchasing items, claiming your name, and more.

At the moment, Decentraland has many components of a typical gaming platform like Minecraft or Second Life, but many are curious as to how it will evolve. Real estate firms can build out virtual portfolios of leasable spaces for remote workers that want places to conduct virtual meetings. Retail companies can let users visit in their virtual shops, trying on digital clothes for real-world purchase. Developers could also test out innovative master planning concepts, garnering data from how users may use the space in the real world. The creative work of architects and interior designers can also extend into this virtual market, helping users of the platform beautify their worlds as digital designers.

On February 20, 2020, Decentraland went live to the public. They hosted a treasure hunt throughout their virtual metaverse, with over 12,000 live participants.[7] Architects and artists have been submitting their virtual creations and users have started building our their own plots of land using tools and various metaverse features.



Images Courtesy of Decentraland

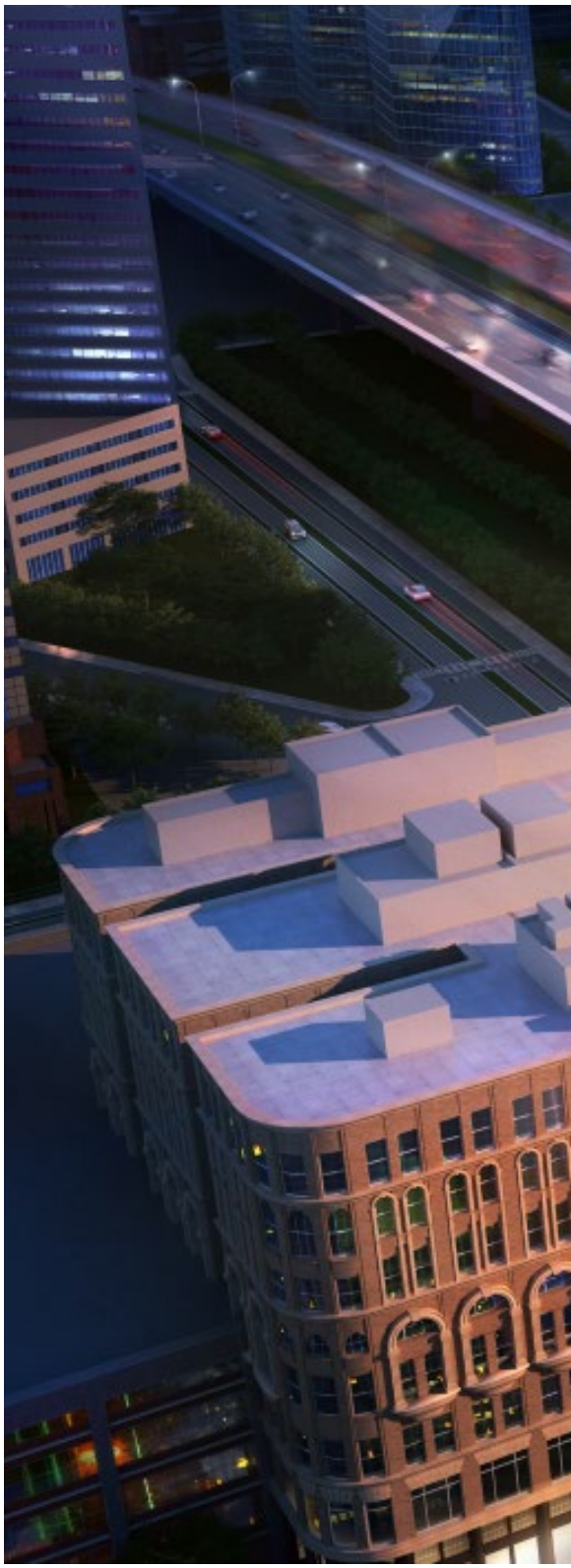
WHAT CORGAN IS CREATING

Urban Air Mobility Architecture

Whenever we evaluate the success of architectural projects, we think not only about form and function, but also its larger context. We are constantly researching ways for our buildings to tie into the existing urban fabric, while respecting historical contexts, and encouraging pedestrian friendly models.

Not only are buildings drivers of city culture, they are also designed to integrate within a system of transit and movement: pedestrians, cars, subways, bikes, etc., and all the public life that comes with it. Buildings do not live in isolation, but are rooted into the city ecosystem, being conductors of life and energy at the street level, while also having the serious potential to be obstructors of public life.

Think of areas in Dallas like Lower Greenville or Bishop Arts. Why are they so popular and loved as they are? It's because their buildings have been designed with the human scale in mind. The built environment is engaging in the zone of public life as much as the people themselves. These buildings are designed to shape spaces for pedestrians, and to be inviting and enticing, giving character to the city.



Uber Air Evolved

But what changes, then, when Uber Air becomes an integral part of our way of life in the future? And how should architecture respond?

Uber Air and mass eVTOL ridesharing adoption will dramatically shift how architects and urban planners design in city spaces, as the public begins to experience cities from a new perspective: the air.

It's no longer just about curb-appeal. Design perspectives will shift upward from the street to the sky, and these changes will raise questions driving innovation around urban design.

Air travel opens an entirely new zone through which to view Architecture. No longer limiting a building's urban impact to the first 30 feet above street level (which has been the story for much of our history). The Highline in New York City[8] is a good example of an elevated public life (off the street level), and how buildings around it have responded: increased tourist and local traffic, higher desirability for developers, not to mention the global attention it has received. The Highline has done a good job of making this area accessible to the everyday person, although the buildings around them are generally not.

What if we take this "zone" concept 200 feet higher in the air, utilizing that space with eVTOLs? What does that new zone look like for architecture and city life?

1 These elevated buildings could start having their own landing zones, whether in the middle of high rises, or on rooftops. The "roof", as we know it, would no longer be relegated to serving as a mechanical equipment graveyard but would become as vital to the overall function and programming of a building as its main lobby. Imagine how many millions of square feet of roofs that could regain an entirely new purpose as a response to air travel?

2 Buildings at these higher zones could be required to take part in air traffic guidance for eVTOLs. Will signage, signals, sensors, or lighting need to be mounted on the buildings, or incorporated into the architecture of this new "air zone"? Considering the fact that air transportation doesn't rely on physical streets to build its infrastructure upon, what will future building codes ask of our buildings?

In this scenario, the building becomes infrastructure. The "building as infrastructure" is a different than "buildings as sculptural objects" or "building as a hospital, office, or school." They are no longer purely about functions based on a market need, such as an office, but rather part of a larger transportation system and offering. At this air zone, buildings could have a greater responsibility which means they will be tasked with seamlessly connecting the two realms, air and ground.

A successful city will be one that can leverage all of their zones to their fullest potential while providing opportunities for all of its citizens. Architecture at the air level must strive to be one of inclusivity, transparency and approachability, so that we prevent the air level from becoming a "separate world" only enjoyed by a few.


Uber

CORGAN IS CURIOUS ABOUT

Gen Z: The Emerging Generation

For the first time in modern history, five generations are coexisting side-by-side in the workplace.[9] This presents a unique opportunity for architects to engage a wide group of users in the workspace.

While the last decade focused predominantly on the Millennial generation (as they entered the workforce), we are now looking towards Generation Z. How we adapt to and understand their preferences is crucial if we want to develop real estate and workplaces that match the needs of future users.

Gen Z'ers were born between 1997 and the early 2010's. The majority of them grew up during the 2008 recession and were likely to see their family directly and negatively impacted as a result. This global event left a deep imprint on many Gen Z'ers, as they are much more practical and fiscally responsible than their older millennial counterparts. They are the first generation to be born in a fully mobile and connected world, and as a result, tend to stray the opposite direction from technology. When it comes to collaboration they prefer more face to face interactions than previous generations. Will Gen Z and future generations of the post-digital era convince us to re-prioritize designing spaces for human connection, instead of designing our spaces around technology? How will they feel about virtual conference rooms? Is remote working the ideal setting for a Gen Zer that desires face-to-face interaction? Gen Z might be the generation that reminds us, as designers, that our spaces need to accommodate both tech-focused and tech-free spaces.

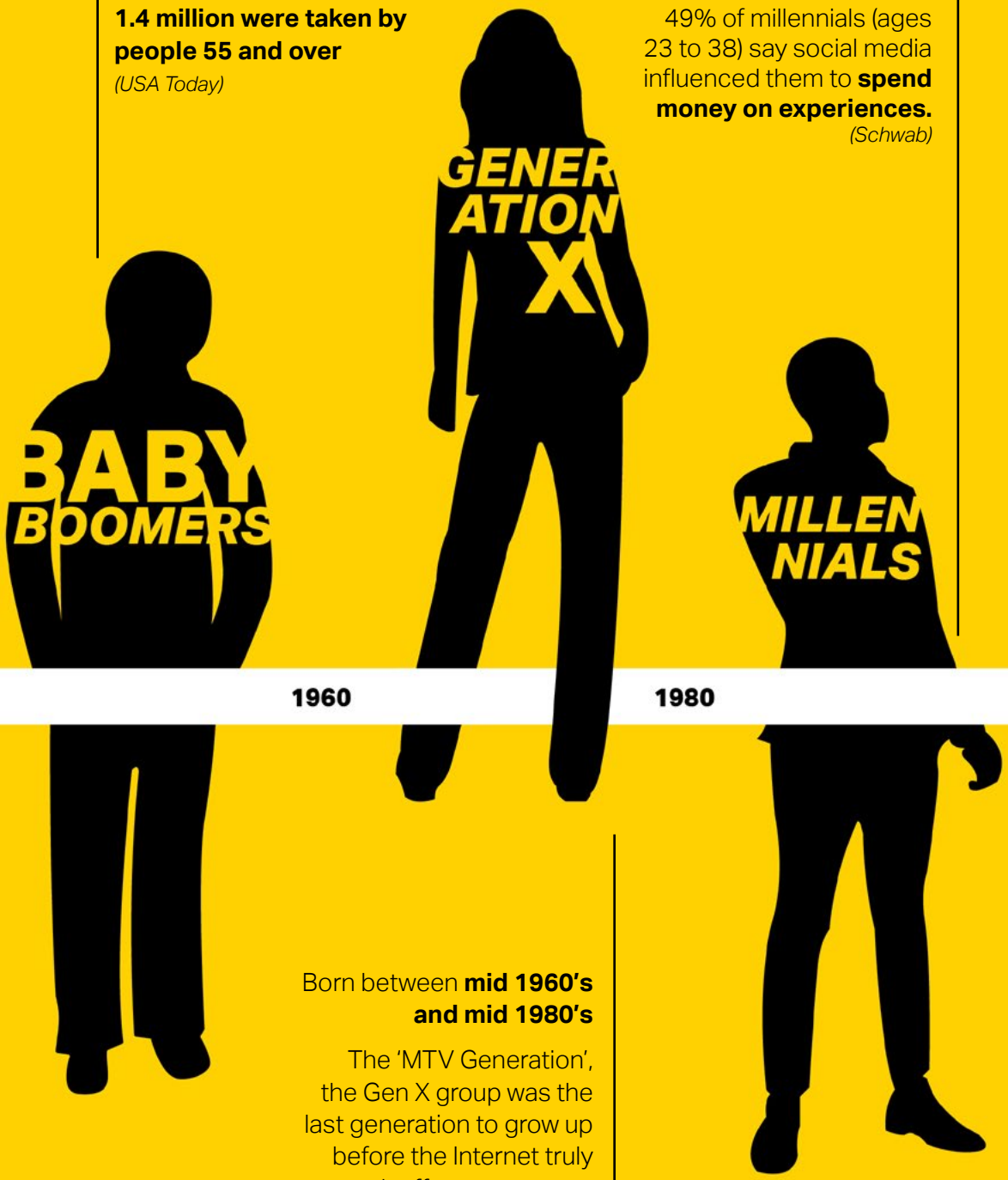
Gen Z's value for pragmatism, authenticity and customization have some pretty significant architectural implications. Companies are told to choose office buildings and locations that are "authentic" if they want to retain Gen Z talent. That means, architecture with historic components (think adaptive re-use, repositioning, etc.) or buildings that are rooted in the local regionalism and culture of the area. Offices that are close to a variety of live-work-play components are preferred by this generation, as work-life separation tends to be ever blurred by our constant connectivity to our devices; meaning, this generation is conditioned to expect availability just outside their front door and at their fingertips.[10]

Born between **mid 1940's and mid 1960's**

Of the 2.9 million new jobs recorded by Labor's survey of households last year, **1.4 million were taken by people 55 and over** *(USA Today)*

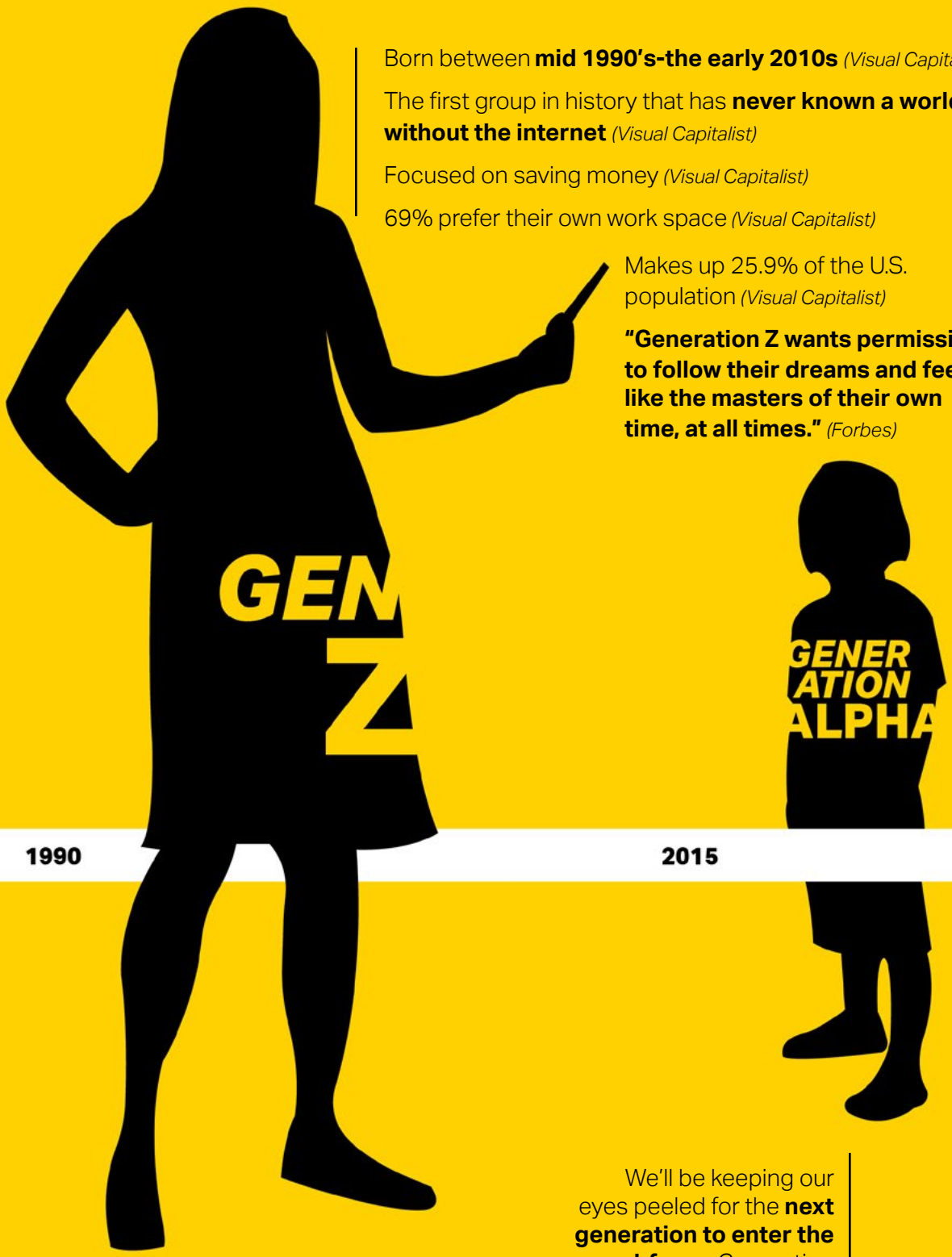
Born between **1981-mid 1990's**

49% of millennials (ages 23 to 38) say social media influenced them to **spend money on experiences.** *(Schwab)*



Born between **mid 1960's and mid 1980's**

The 'MTV Generation', the Gen X group was the last generation to grow up before the Internet truly took off. *(Visual Capitalist)*



Born between **mid 1990's-the early 2010s** *(Visual Capitalist)*

The first group in history that has **never known a world without the internet** *(Visual Capitalist)*

Focused on saving money *(Visual Capitalist)*

69% prefer their own work space *(Visual Capitalist)*

Makes up 25.9% of the U.S. population *(Visual Capitalist)*

"Generation Z wants permission to follow their dreams and feel like the masters of their own time, at all times." *(Forbes)*

We'll be keeping our eyes peeled for the **next generation to enter the workforce**: Generation Alpha (born 2015-2025) *(Forbes)*

CORGAN IS CURIOUS ABOUT

Commercial AI Software

Technological advances over the past two decades have propelled the architectural industry into a whole new form and process through which buildings are conceived and built. From hand drafting, to CAD (Computer Aided Drafting), to BIM (Building Information Modeling), computer software has leveraged unknown potential for the betterment of our cities. What is next in the development of software to further these endeavors?

Artificial Intelligence (AI) has become the next step in championing the digital development for architecture. The life blood of this operation is driven by data, and since we're in the post-digital era, we're in no short supply. What is key is how this data is used and implemented.

Originally, designers embraced the trend known as "data-driven" or "data-centered" design. This phenomenon leveraged the information boom through collection and interpretation of data by the designer. This is a one to one ratio, in that what results is directly equal to the user and their analysis of the collected data. Outcomes are affected by data, but at the pace and rate of which the designer can filter and implement.

The next step in the technology evolution was data recognition software. These platforms are programmed to perform a certain task and respond based upon the data sets it is given. This alters the ratio to one to ten or one to one hundred, which dramatically increases the resultant design. Bypassing user analysis speeds, data recognition capabilities aid the user by processing data for them and delivers faster outcomes. The designer can change and modify the software based upon the data, problem or set program at hand, like flipping switches to test various options and design-based outcomes.

What the Commercial Studio envisions for the future is true AI technology, moving beyond user analysis or data recognition to machine learning for design outcomes. AI can partner with existing technologies like BIM to perform simple yet repetitive tasks that take extensive user time and energy. Programs, like Dynamo[11], can complete various documentation actions with the simple click of a button (i.e. tag rooms / doors / windows in a model) that are typically user heavy and prone to input error.

Continuing further, machine learning can be achieved through training the computer to understand key architectural factors that affect and govern the design. This can be realized through a catalogue of past design solutions. By computer processing, each architectural design is tagged as 'true' or 'false' in an effort to train the machine and teach it the aesthetic of the designer. The machine learns through each design input.

Equipped with these inputs as training sets, the machine can now achieve the next output: creation of a new design.

With a specific site, the building footprint, orientation and program of a design can be established through instant machine generation that references the input design catalogue and discriminates between real and fake solutions.

Building upon the previous designs, the machine can place elements in similar fashion as the designer would and make assumptions for connectivity and circulation. New designs are a shadow of past designs, as the machine is trained to learn from and replicate solutions that allude to the designer inputs.

A key benefit to AI technology is that the machine can see and test all the possibilities, generating a vast amount of design outcomes, instantly. The ability to see full spectrum through the computer, opens the perspective we have as designers into realms we could not have imagined. Yet, the designer brings the human touch. Unlike the computer, the designer can break the rules and innovate. When working together, this duo can achieve more sophisticated and complex solutions to difficult design solutions.

Our industry stands to benefit greatly from this endeavor due to the nature of the high-volume market. True machine learning will assist with speed of initial design and efficiency of building layout. Using this tool, we envision agility to perform design solutions, sustainability analysis, cost projects and aid in shortened construction timeframes. The future is AI technology.

WHAT CORGAN IS CREATING

eVolo Competition

Established in 2006, the eVolo Competition challenges designers to reimagine the formal definition of a skyscraper. This annual design competition examines the relationships between architecture, the natural world, our communities and the cities we inhabit.

In 2020, Corgan's commercial design team will be submitting two strategic design solutions for consideration:

Oceana

The ocean is vastly uncharted, strung with garbage and largely uninhabited. How can we advance ocean research, clean our planet and expand our existence into the ocean?

Nearly 10% of the world's annual plastic production ends up in the ocean.[12] Ocean currents create whirlpool systems called gyres that, due to strong wind-driven, circular currents, trap plastic pollution in their path. With five main gyres in the earth's oceans, most of the ocean debris resides in one of these systems.

The largest is the North Pacific Gyre in the Pacific Ocean between North America and Asia. Although

2020 eVolo Submission: Oceana

the size of the garbage patch is unknown, scientists estimate the size to be 0.41% to 8.1% of the Pacific Ocean (or twice the size of Texas).[13]

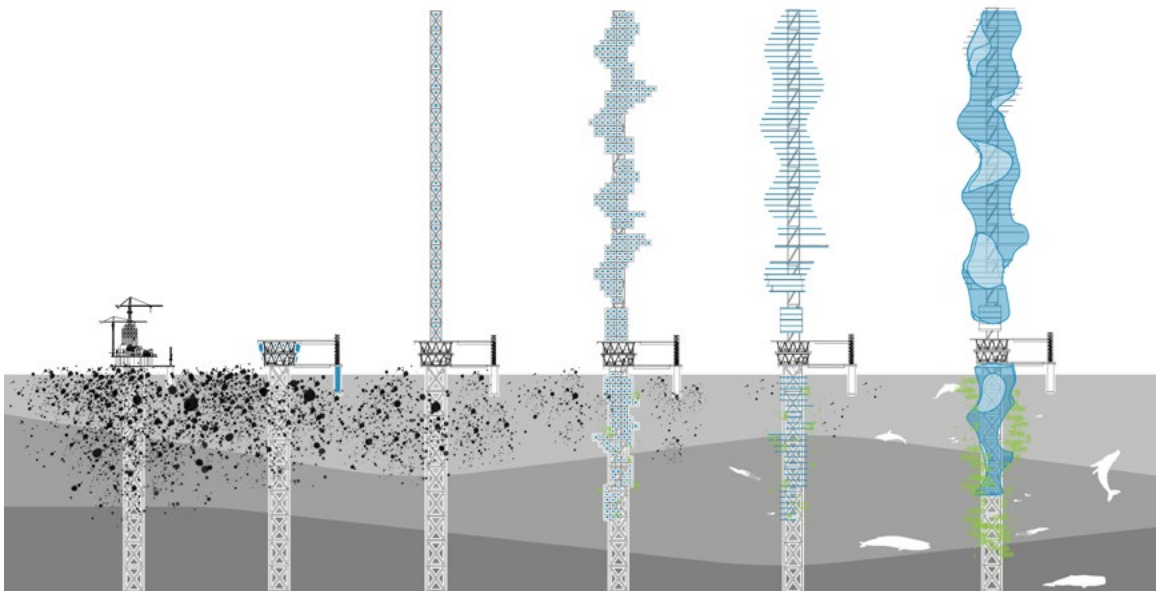
The Ocean Cleanup Project has been the leader in marine pollution for the last decade. The organization has developed two prototype systems that were engineered to remove 50% of the debris within the Great Pacific Gyre in 5 years.[13]

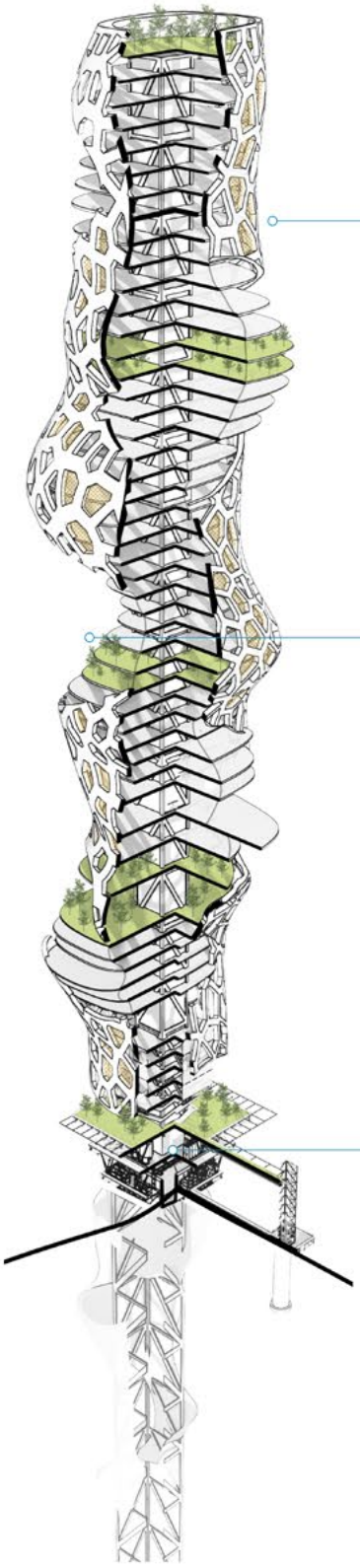
In order to assist these efforts and build upon the need for larger collection zones, a team of designers at Corgan created the *Trash Scraper* to collect, refine and generate energy from marine pollution. Utilizing the backbone of abandoned oil rigs, they are repurposed into waste-to-energy power plants. After collection, filtration and burning of plastic, Oceana creates a sustainable energy source for future use, while removing vast amounts of toxic, threatening ocean garbage.

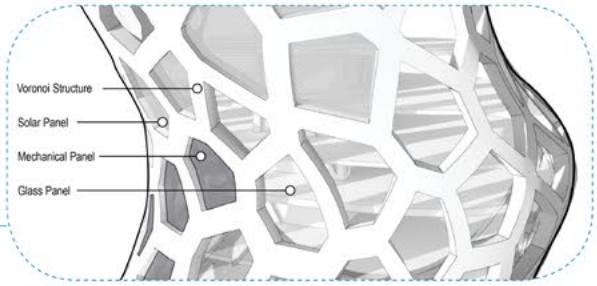
Oceana is the new hub for ocean collection. These vertical towers serve as collection nodes; their successful clean up increases exponentially and affirms the system network. Efforts like the Ocean Cleanup Project can utilize the tower as a dump site and reduce extraneous travel distances to and from the mainland. As the host for all efforts, collection can occur deeper in the ocean as required ties to land are reduced.

As a self-sufficient tower, this new rig is a platform for research and learning deep within the Pacific Ocean. With space for marine labs, visiting scientists and universities can now be closer than ever to uncharted parts of our oceans. Rebuilding of coral reefs connected to the existing oil rig structure will restore aquatic life and generate areas of observation and research.

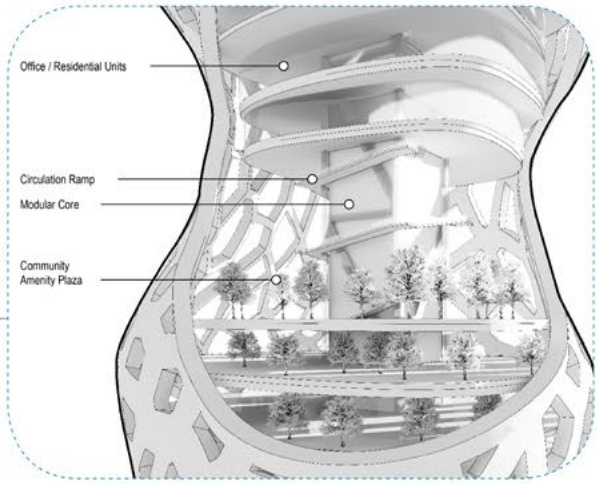
Commerce, agriculture, residential and entertainment will all be possible on this new structure. With vitality springing from Oceana, a community emerges from production and research to establish a new form of colonization on Earth.



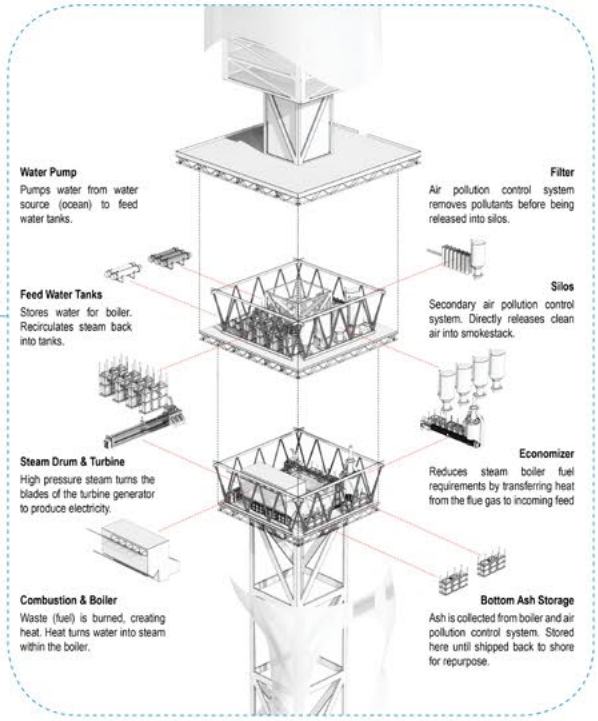




SKIN FUNCTIONAL DETAIL



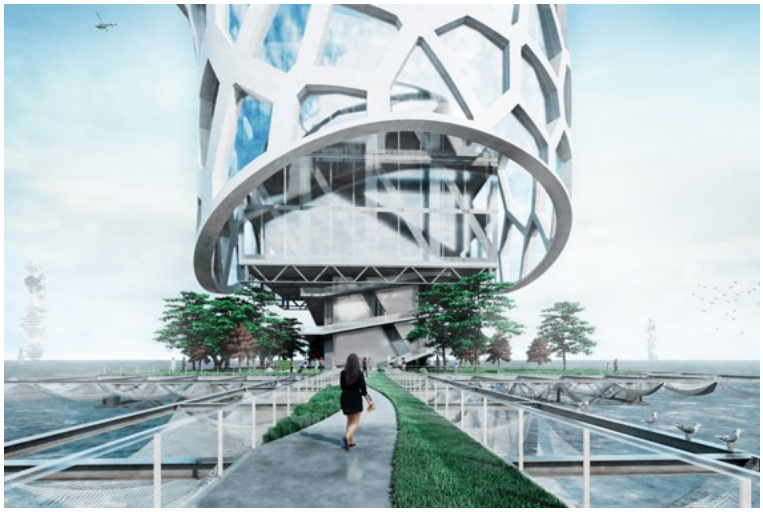
GARDEN PARK LEVEL



WASTE-TO-ENGERY PLATFORM

FLIGHT AMENITY DECK

Guests arriving by air will be welcomed at the flight deck amenity lounge. The architectural Voronoi form of the tower allows for unique views that change at each floor.

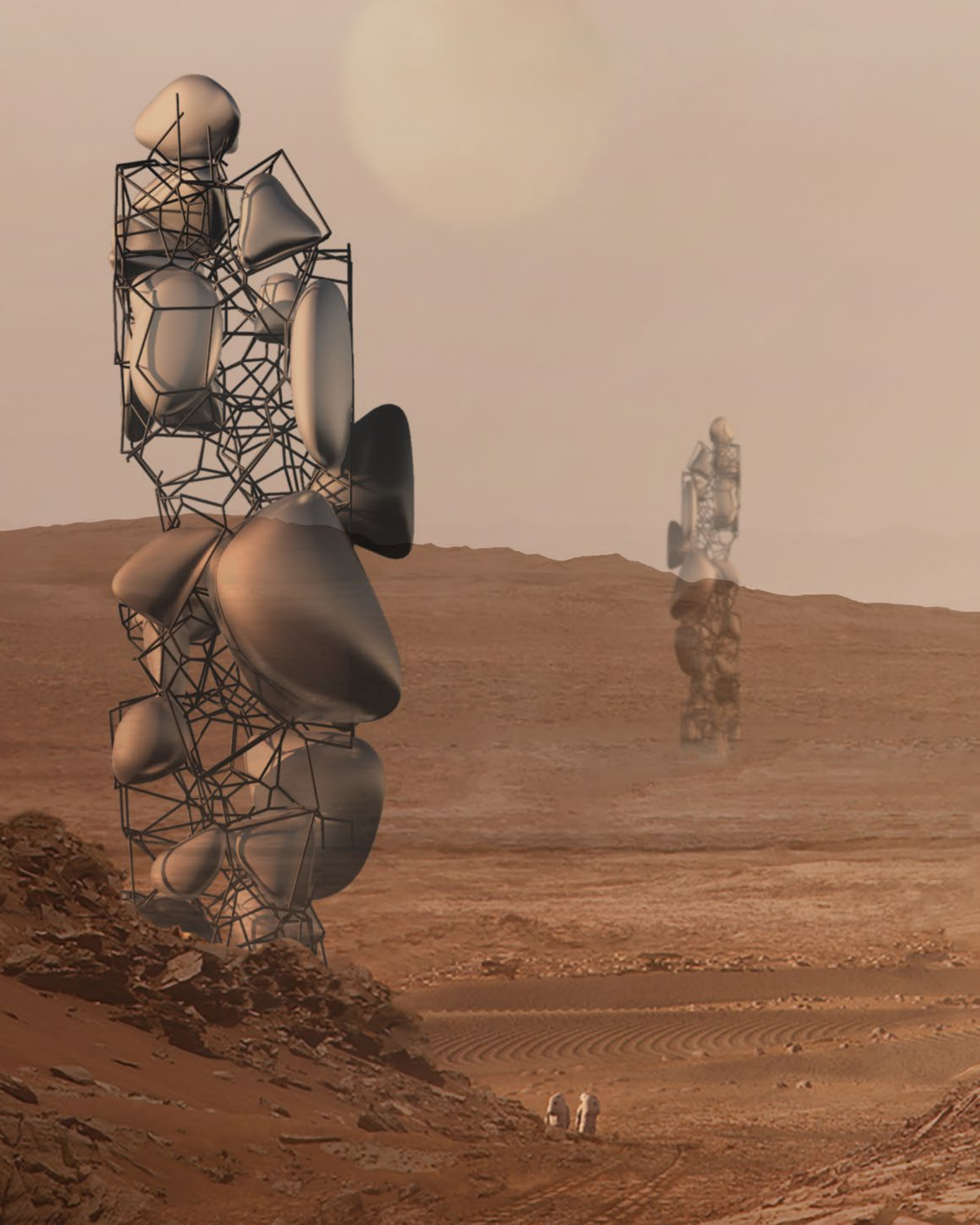


ENTRY PLATFORM

Entry from boats places the user directly on our first amenity deck, creating a welcoming park and connection to both sea and tower. One's first views is of the research labs dedicated to plastics research.

EXPLORITORIUM

The underwater platform is for all to use, however directly connected to the research of underwater habitat creation. The focus of this level is the study of coral reef rehabilitation.



NOAH

After decades of neglect, the earth can no longer support human life. Interplanetary travel is now a necessity to continue life as we know it and for earth to begin to repair itself. But, how are the masses trained to survive space travel and space living? How are buildings designed on other planets to ensure the preservation of human life?

NOAH, The Necessary Orbital Academy of Humans, is an educational system implemented to provide the inhabitants of earth for their relocation to other planets. Another structure, located on Mars, operates in conjunction with the one on Earth - a pair that shares information of the conditions and experiences of their respective locations. This building typology serves the human population by facilitating initial travels from earth to other planets, then provides the experiences of Earth and training for the eventual return home. Each structure utilizes NOAH's Digital Twin Technology to grow humanity's understanding of the universe and repair their current home while linking those two experiences through a mirrored structure.

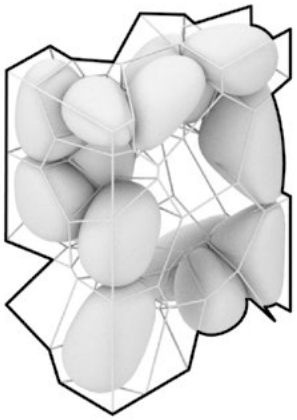
That goal of growth and repair is at the heart of NOAH's mission and of their Digital Twin Technologies (DTT). DTT allows any structure in the NOAH network to record environmental needs and interpret those needs through programming. Through use of Voronoi script-based structure and an array of sensors, each tower can respond critically to changing environments and its own adaptive programming. Using this data, each Tower can grow itself based on conditions in their respective environments. The Tower on Earth is erected first, with its twin on Mars following shortly afterwards. Once online, data from Mars is transmitted to Earth and its Tower begins to use that data to adapt itself to the Martian conditions. Once the necessary adaptions have occurred, the training period begins, and inhabitants of Tower will soon be ready for departure.

As the structure grows, it expands to accept a series of pods that serve as spaces for residence, recreation, and research. These pods are flexible in physical nature allowing each type of pod to resize, relocate, or redistribute as required by the inhabitants and environmental data transmitted from the Towers. For example, one Terrain pod typology allows users to experience mars gravity as read by the DTT, or it may replicate the ideal conditions for a greenhouse for agriculture that will occur on Mars. Simultaneously, the Mars Tower also utilizes data picked up by the Earth Tower. As Martian landscapes are harsh and inhospitable, the pods may offer experiences of gravity on earth, or landscapes from around our current globe. Each pod dynamically programs itself to replicate the experiences of its counterpart.

As inhabitants move from Earth to Mars, the roles of the binary towers eventually reverse. Without human interference Earth can heal and replenish its resources. The Earth Tower will monitor environmental conditions and its own building state to provide direct feedback to the Martian tower. Eventually, signaling to NOAH inhabitants when it is safe for humans to return home. Through the entire process, NOAH works to preserve humanity in the training for extraterrestrial inhabitation and the eventual, triumphant return to Earth.

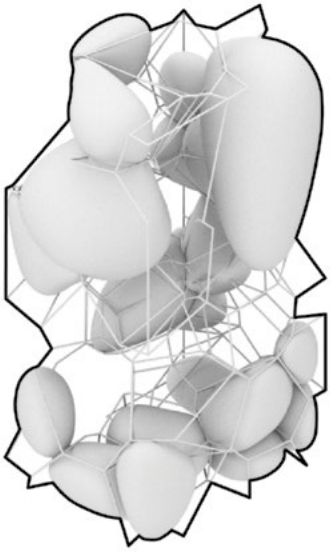
INITIAL INFRASTRUCTURE

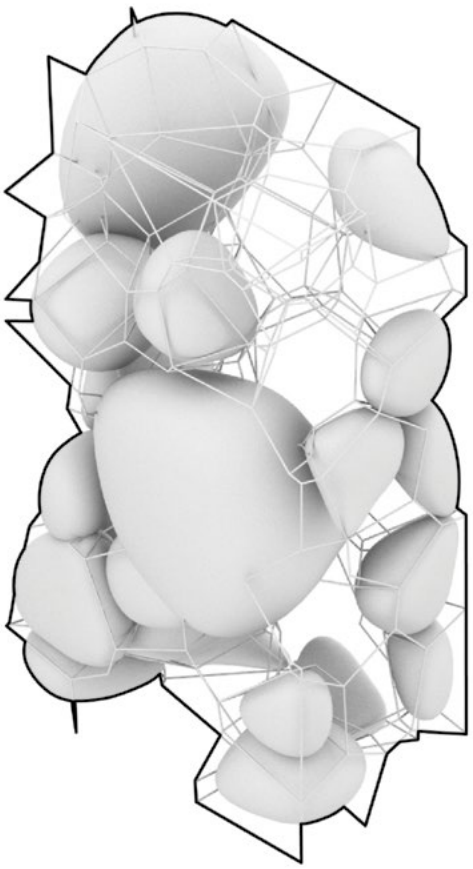
A binary pair of structures are erected both on Earth and Mars. Inhabitants and the building will prepare for new conditions as the binary structures work as a whole composed of two.



ADAPTING INFRASTRUCTURE

The needs of inhabitants are accommodated through larger or new pods as required by their interior program. Information collected from the binary structures data gathering system informs the necessary configuration to maintain life.



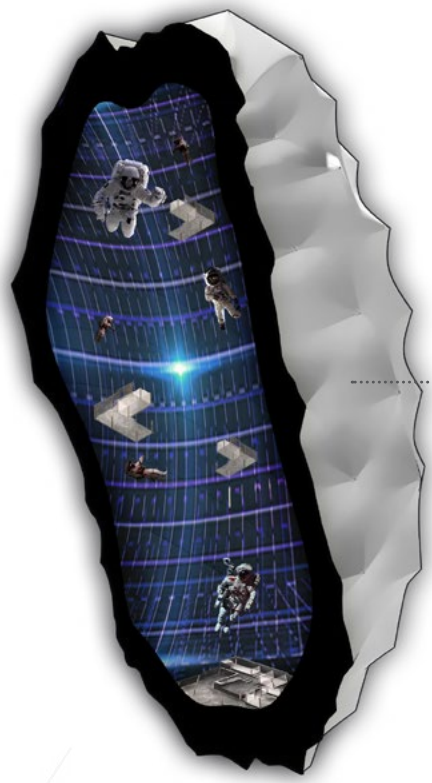


EXPANDING INFRASTRUCTURE

As life expands within the tower, so to does the physical volume of the tower. Refinements and adjustments are occurring to relocate life to the binary tower.

FINAL INFRASTRUCTURE

The building is shaped to best support life on our new planet based on gathered data. Sensors on the binary towers relay when it is safe to return.



AGRICULTURE

The Agricultural Pod allows for crops to be planted and harvested from within by gathering sunlight from the portholes. The porthole's aperture are dynamic depending on how much sunlight is require for the specific cropping zone. This pod is crucial for the survival of the tower's inhabitants.

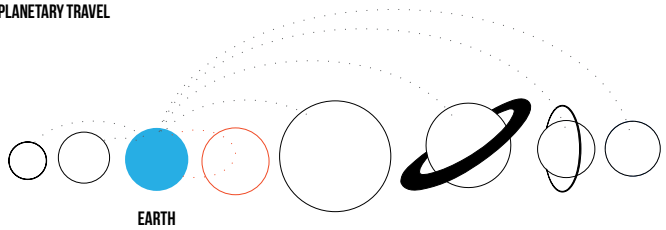
GRAVITY

The Gravity Pod mimics the conditions of both Mars and Earths gravity respectively. This allows for the inhabitants to work and train in the conditions in which they will be residing.

TERRAIN

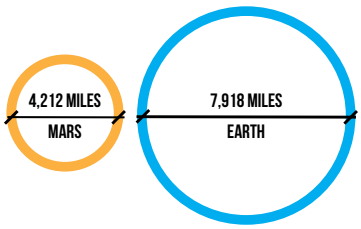
The Terrain Pod uses the digital twin technology and reacts to the weather, topography and climate on Mars. Inhabitants utilize this pod to both research and explore Mars expansive topography.

INTERPLANETARY TRAVEL



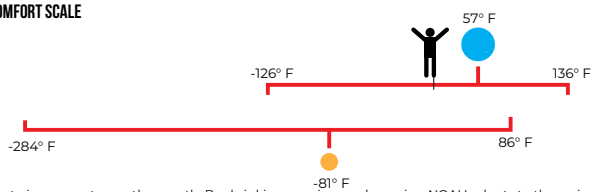
The distance from Earth to Mars is 173.54 million miles making it a viable option for interplanetary travel. Mars could be used to station the first of many interplanetary NOAH units. These stations could then begin to be placed on other planets allowing for a network of interplanetary inhabitable facilities.

PLANETARY DIAMETER STUDY



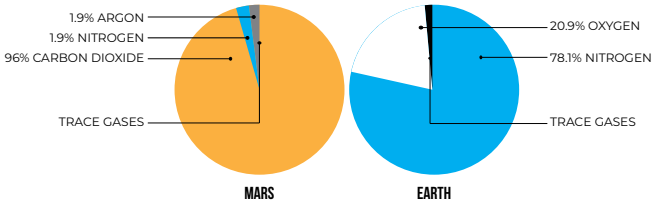
Mars in particular is significantly smaller than earth. Having 53% less In order to avoid the same misuse of resources on mars the design for NOAH towers seek to keep as small of a footprint and slim of a profile as possible.

HUMAN COMFORT SCALE



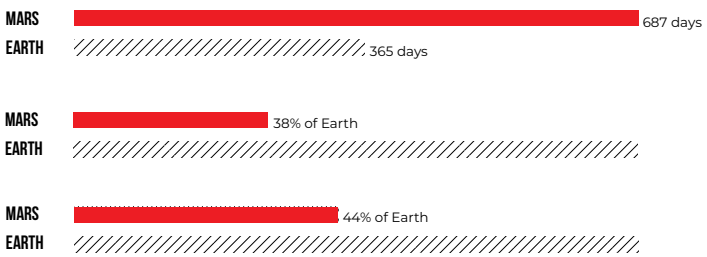
Mars climate is more extreme than earth. By shrinking, moving, and growing NOAH adapts to the various conditions on mars to support life. The binary half on mars informs how the building needs to react - before humans arrive.

ATMOSPHERIC CONDITIONS



Atmospheric conditions on mars will not support human life as we know it. The mars tower studies the atmosphere and ensures that the exterior skin is air tight. Humans are wired to be outside and in sunlight, so NOAH provides pods that simulate the necessary needs of humans, without having to be exposed to dangerous outside gases.

LIGHT & GRAVITY



To support human life on mars, farming pods are integrated into the design. The portholes on the farming pods allow for light to concentrate to compensate for the significantly reduced sunlight. Gravity pods are also utilized to simulate conditions on earth and anti-gravity pods on the earth tower to simulate conditions on mars.

CAN YOU IMAGINE...

If you could explore 100's of design options in minutes?

AI's ability to automate certain processes is ushering in a new type of organization – one that is built on the backbone of an "AI factory."[14] An AI factory treats decision-making like a science, "running millions of scenarios and processes, converting data into predictions, insights and choices."[14]

Let's take a company like Amazon or Uber. They haven't necessarily created "new" industries; retail and transportation services have existing for a long time. Instead, their AI platforms help them gain efficiencies and market competition against the existing model. Amazon uses AI algorithms to scan its competitors' prices. Uber uses their algorithms to determine which cars can offer rides.[14] As we've observed, their AI models stand in fierce competition with traditional retail shopping and taxi services.

So, what does the Amazon or Uber of architectural design look like?

Our commercial architecture team imagined what this could be. Their envisioned Instanalysis software enables rapid scenario planning and prediction modeling. What if you could explore hundreds of design options in minutes with your client? What if could predict (in real-time) how traffic and circulation would be impacted, based on how we lay out the parking and main building entrance? Or what if AI's predictive policing could help prove that certain design and lighting layouts would dramatically reduce crime rates in the area?

This complex piece of software allows you to quickly toggle back and forth between different design options, while forecasting what impacts certain design decisions could have on the surrounding area. What might usually take hours or even days, could be boiled down to minutes, with the assistance of our very own AI factory.

Predictive Design Analysis

SELECT PROGRAM

ADD A NEW PROGRAM TYPE +

Select any combination of progammatic elements to analyze viability.

- ✓ OFFICE
  - SQ FT. 180,000
  - LEVELS 6
- ✓ RETAIL
- RESIDENTIAL
- ✓ PARKING
  - UNDERGROUND GARAGE
  - PODIUM GARAGE
  - SURFACE PARKING
  - STAND ALONE GARAGE

✓ *YOU'VE SELECTED: "OFFICE" "RETAIL" "PARKING : PODIUM GARAGE"*

ANALYZE COMBINATION!

YOU SELECTED COMBINATION: 2B

"OFFICE" "RETAIL" "PARKING : PODIUM GARAGE"

SEE CITY IMPACTS ON NEXT PAGE >

PROJECT SPECIFIC DATA:

The following outputs are a result of your selected option, data inputs, and imported model.

BUILDING FORM

- MAIN VIEWS: NW, SE
- PERCENTAGE GLASS: 87%*
- GLASS REFLECTIVITY: 35%**
- PEDESTRIAN ENTRY: NORTH
- VEHICULAR ENTRY: SOUTH

* Percentage exceeds City of Dallas allowances. Energy model required to prove compliance.

** Percentage exceeds City of Dallas allowances. Select new glass performance criteria.

MORE..

BUILDING PROGRAM

- OFFICE SQ. FT: 180,000
- RENT RATE: $50/SF*
- RETAIL SQ FT: 10,000
- PARKING REQ'D: 540 (3:1000)
- GARAGE SQ. FT. REQ'D: 178,000 SF

* You better hurry! 3 other developers are looking at this property right now!

MORE..

CARBON FOOTPRINT

MORE..

PROJECT TITLE: *CORGAN EAST QUARTER | BOUTIQUE CREATIVE OFFICE | OPTION 2B*

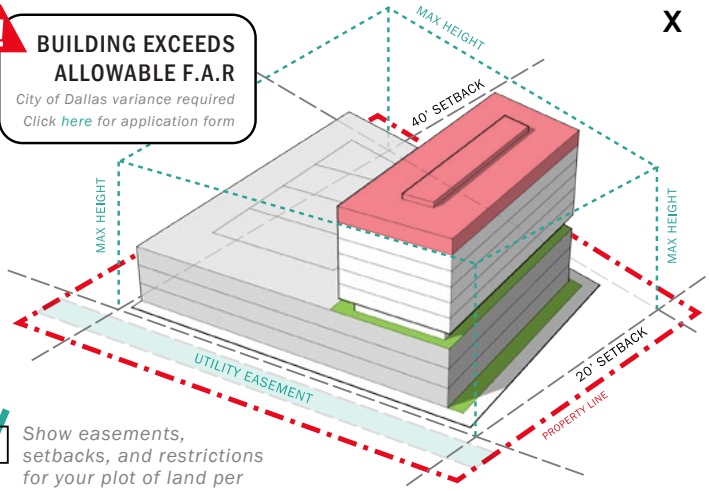
Analyze View Window Help Dallas, TX

BUILDING EXCEEDS ALLOWABLE F.A.R

City of Dallas variance required

Click here for application form

X



Show easements, setbacks, and restrictions for your plot of land per City of Dallas zoning

HWY TOGGLE

ON

345 HWY

INSTANT ANAYSIS PORTAL

Toggle Building OFF to see current conditions (before development)

Toggle Building ON to see how the city is impacted by your design (after)

BUILDING TOGGLE ON

Toggle categories ON/OFF to test how various factors are impacted by your design option.

URBAN HEAT ISLAND EFFECT OFF

NEIGHBORING PROPERTY VALUES ON

TRAFFIC FLOWS ON

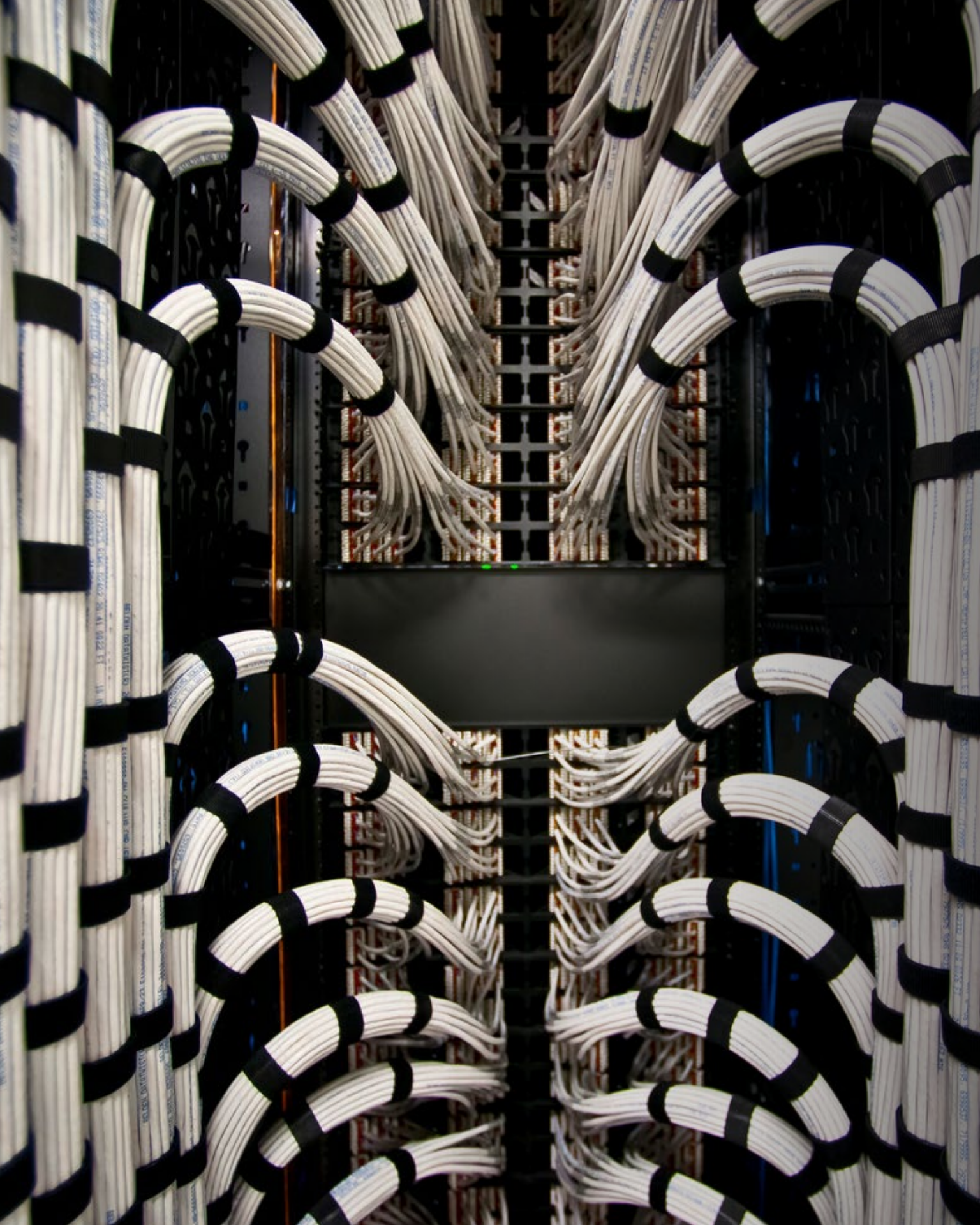
WALKABILITY SCORE OFF

CRIME RATES OFF

RETAIL VIABILITY (BASED ON DENSITIES) ON

MORE...

Camera: 535 m 32°47'0



03

CURIOSITIES IN DATA CENTERS

"From a distance, everyone will be able to read text, enlarged and limited to the desired subject, projected on an individual screen. In this way, everyone from his armchair will be able to contemplate creation, as a whole or in certain of its parts."

- PAUL OTLET, INFORMATION SCIENTIST (1935)[1]

What to expect

Welcome

When we say, "Designing the World's Next Generation Infrastructure," we are not just speaking inspirationally. As we become more connected, plugged in, wireless, international, global, immersed and less constrained, Corgan is designing the data center infrastructure that make this all possible.

The industry is rapidly changing. Data Center facilities look nothing like what was considered state of the art only a couple years ago. Today, we are learning about new battery technology, more efficient cooling concepts, and the idea of submerging the entire compute. The horizon for what's next is getting closer every day and it's pretty exciting. So, what is next?

Imagine better internet, everywhere. With this in mind, it's easy to consider things like unmanned autonomous travel, drones delivering packages, and a free nationwide 5G network. Increased access to data would give us the ability to instantly share health care records, finances, and communications, while improving the quality of streaming services for gaming and entertainment.

This distributed compute cloud (as compared to a web) would provide greater resiliency and smaller, more secure, compute footprints. These networks could be distributed all over and powered by faster communications with more dense compute capabilities. All of this would be supported by newer technologies that would together effectively eliminate lag time and compute as the limitation to "what if we could…?" scenarios. Imagine unmanned autonomous travel, drones delivering packages, 5G provided free WiFi nationwide. This is all eminent and will be enables by the kinds of technologies we are playing with today. However, there are a few hurdles we will need to overcome in the meantime.

Space

As the demand for more compute power increases, it will become more and more difficult to locate large parcels of land that can host a data center site. An emerging technology that is hoping to be one of the solutions to this problem is immersion cooling, or the concept of submerging servers and other compute needs, in a dielectric (nonconductive) fluid.[2] The advantage to this approach is grounded in the fact that these fluids offer up to 10 times the cooling capability of air.[3] This cooling method has the potential to reduce the footprint required to a fraction of what a traditional data center would require which would represent significant financial savings, as well as reduced carbon emissions.

Storage

Energy storage (energy generated at one time for future use) is also spurring new technologies in the field. With the increased push toward renewable energy sources, such as solar and wind power, comes the need for storing the energy produced. Since the demand for energy is not constant and varies depending on the time of day and temperature, we need a means to storage energy produced when the sun is shining, and the wind is blowing. Currently, the most viable method of energy storage is through the use of lithium-ion batteries. We have seen a trend in Battery Energy Storage Systems (BESS) becoming more and more common throughout the U.S. and internationally. We believe within the next decade, most if not all public and private power generating utilities will have some sort of BESS helping them to lower the cost of power and deliver it more reliably.

Cooling

The data center industry has long struggled to achieve better energy performance in hot, humid climates where opportunities for economization are limited; global warming is making this even more of a priority. When the temperature is just right, and the air is dry, it only makes sense to turn off the air conditioning and open a window, if for no other reason than to reduce your electricity bill. Data centers have a similar, albeit mechanically sophisticated, approach to this through the use of economization. This provides 'Free Cooling' part of the year, depending on local temperature and weather conditions. For this reason, sites in temperate or northern locations have been traditionally been favored for large scale data centers. But what happens when you need to locate a large data center in a warmer, less optimal climate?

As acceptable operating temperature ratings for integrated circuitry have continued to increase, the conditions inside the data center have begun to approach the ambient temperatures of warmer climates. We've noticed firms deploying novel solutions for cooling data centers in these locations, including the embrace of direct air solutions and indirect air solutions. One recently announced, unique approach is the use of a new kind of water-cooling technology called State Point Liquid Cooling, or SPLC.[4] Via a special heat exchanger and cooling system design, SPLC units can cool water from ambient temperatures, helping to close the gap between the higher server inlet temperatures and the warmer temperatures outside, all in a very energy efficient manner. This promising technology may allow future facilities to achieve energy performance closer to the Best-In-Class data centers of today.

Data powers our world. As the field advances, it will become the backbone infrastructure that enables 21st century technologies like machine learning, autonomous travel and space exploration, but most importantly, the ability to serve humanity in a way we have never seen before.

- Corgan's Data Centers Leadership


Search property
FLOOR
DISCIPLINE
RESPONSIBILITY
ASSETS
57
Level 21
Mechanical
Variable Air
CURTAIN PANEL CORNER GLAZING UNIT LEFT_027
Curtain Panel Corner Glazing Unit Left
Overview
Discipline
Mechanical
Expected Replacement Cost
$1,500
Expected Replacement Date
01/06/2035
Category
Variable Air Volume
Type
Variable Air Volume
Description
Variable Air Volume
Manufacturer
Celmec
Model No
AE 12
Inlet Size
500 x 200
Name
Variable Air Volume
Asset Id
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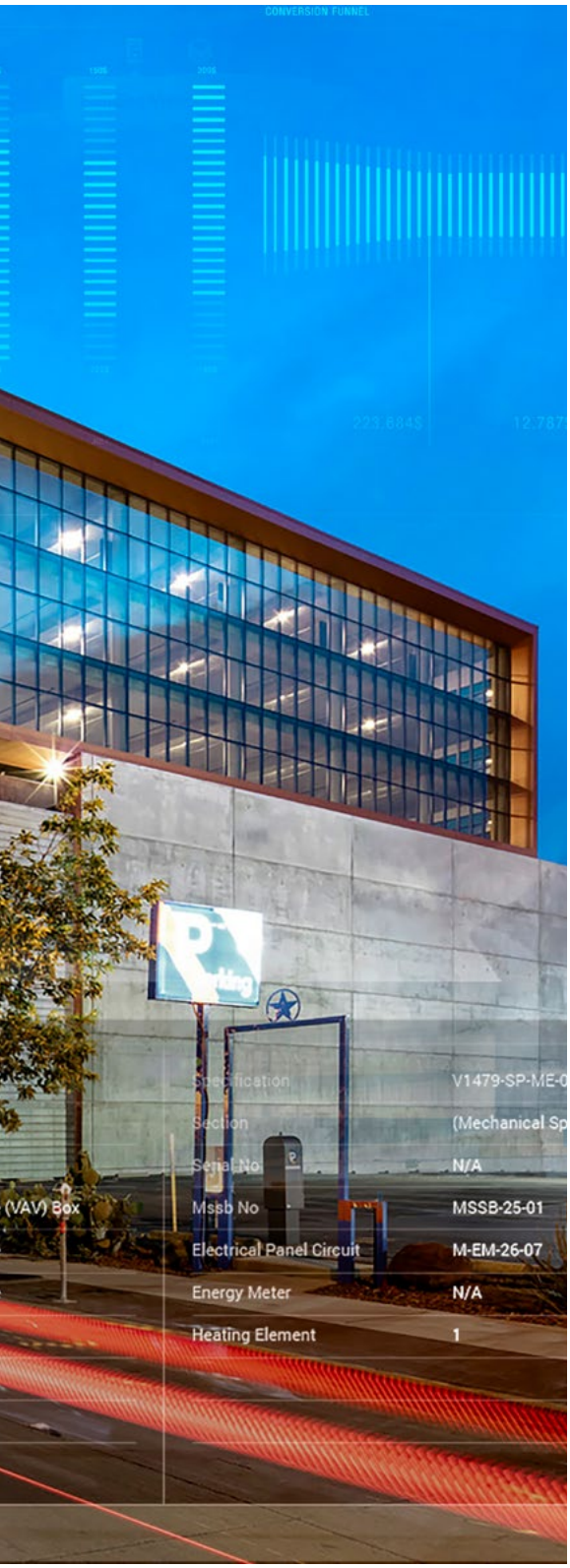
Location
L-25
Maintenance Resp
Landlord
OVERVIEW
TREND LOGS
LIVE DATA
CHANGE HISTORY
DOCUMENTS (O&M)



CORGAN IS CURIOUS ABOUT

Digital Twins

Digital twin integrations and interface solutions are becoming more robust for data center facility groups & operations teams. This live data visualization helps organizations effectively operate their fleets of data centers across a campus and across the globe. Having live robust data feedback, to intelligently and nimbly make quick decisions for capacity planning asset management, is paramount.

According to IBM, a Digital Twin is defined as a "highly complex virtual model that is the exact counterpart (or twin) of a physical thing. The 'thing' could be a car, a tunnel, a bridge, or even a jet engine. Connected sensors on the physical asset collect data that can be mapped onto the virtual model. Anyone looking at the digital twin can now see crucial information about how the physical thing is doing out there in the real world."[5]

1. **WillowTwin™ – A Digital Twin Software**
   The WillowTwin™ is a "ground-breaking software solution that deploys digital twins for the built world to collect, organise, and analyze data."[6] This smart building platform creates high-res, digital maps of the physical world. These maps, called "digital twins," let users visualize and contextualize every element of a building, from the temperature of a certain story to the operational capacity of the building's air quality system.[7]

2. **Microsoft Azure – A Platform to Host Digital Twin Outputs**
   The WillowTwin™ solution uses Azure Digital Twins's cloud, AI, and IoT capabilities to model a building, track real-time data, and connect devices.

   According to Microsoft's initial press release, "most IoT projects today start from a things-centric approach, but we've flipped that around. We've found that customers realize huge benefits by first modeling the physical environment and then connecting (existing or new) devices to that model. Customers gain new spatial intelligence capabilities and new insights into how spaces and infrastructure are really used."[8]

With Azure's Digital Twin's cloud, users can:

- Predict maintenance needs for a factory.
- Optimize the use of available space for an office.
- Track daily temperature across several states.
- Monitor busy drone paths.
- Identify autonomous vehicles.
- Analyze occupancy levels for a building.
- Find the busiest cash register in your store.
- Analyze real-time energy requirements for an electrical grid.

Digital twin concept


120M AUTO-SWAP
TMGCORE
powered by
TMGCORE

WHAT CORGAN IS CREATING

High-Performance Computing in a Box

As we probably all know by now, our world runs on the internet. We use it to power our social networks, to communicate at work, and even shop for groceries.

Our internet service is generated by data centers that, as of now, are often found in remote, secure locations because they typically require a large amount of land (think 100,000 square feet and beyond…). Because of their remote locations, this means our data is "traveling" long distances before it arrives in the palms of our hands. But distance introduces complications. It can slow down your network, or even create lag times (referred to as latency).

In order to bring our internet closer to us, TMGcore has developed OTTO, a fully commercial Two-Phase Liquid Immersion Cooled (2PLIC) high performance computing data center platform. TMGcore is a U.S.-based provider of data center solutions and manufacturer of data center hardware committed to building innovative solutions that solve and mitigate the industry's most pressing challenges.

OTTO is essentially a data center in a box. This product has balanced the demands of data processing while reducing operating costs and environmental impact. This data center platform is a tenth of the size of a traditional data center, uses zero water and reduces operational costs by 80 percent while providing 10 times more processing power per square foot.[9]

OTTO provides companies with a solution that is scalable, quick to market, secure and extremely energy efficient while remaining cost effective. Clients can select from four different OTTO platforms. The largest model, OTTO 600kw, is only 160 square feet.

- OTTO 600kw
- OTTO Edge 120M
- OTTO Edge 60XS
- OTTO O.T.E. 60XS

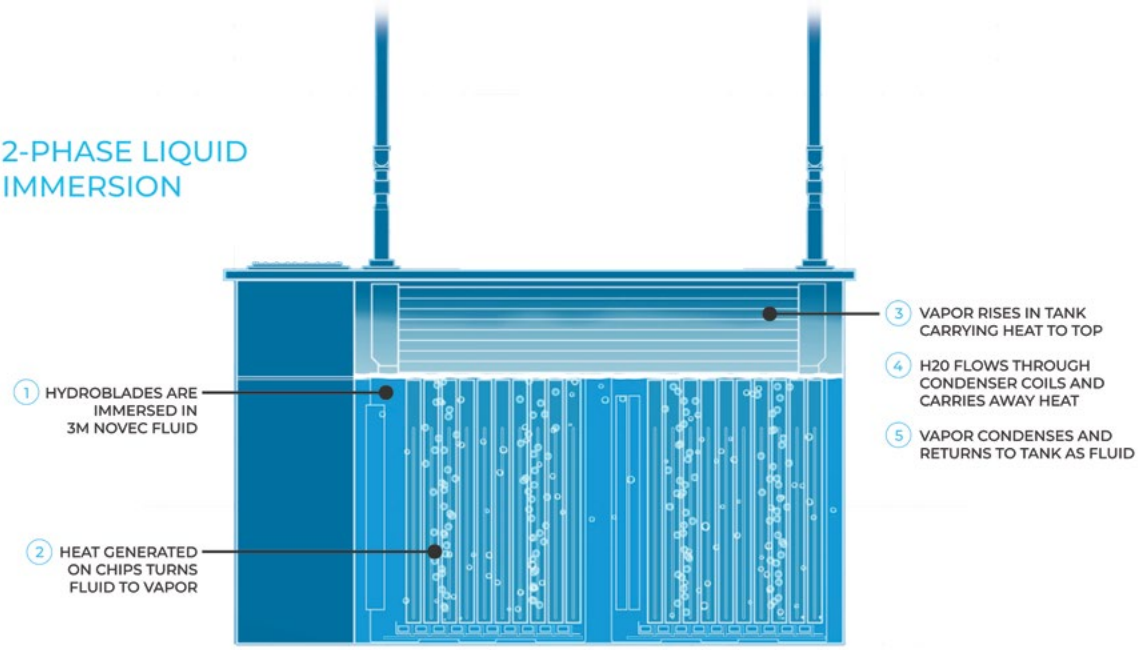
As a result of these space and energy savings, OTTO has the ability to become part of a distributed network of smaller "data centers," that are dispersed throughout urban dense locations. They can also be deployed to more remote areas that have a hard time accessing quality internet services.

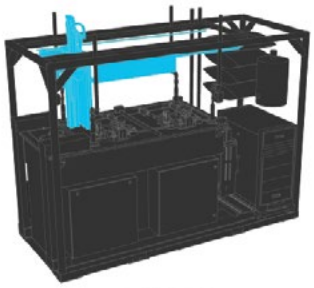
The OTTO 120M

OTTO is a Two Phase Liquid Immersion Cooled (2PLIC) data center.

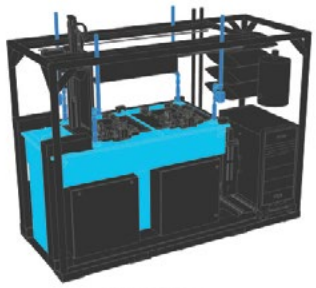
SYSTEMS OVERVIEW

2-PHASE LIQUID IMMERSION

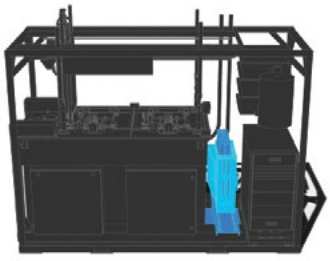




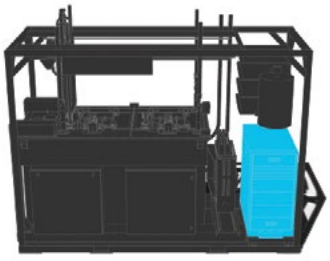
OTTO-BOT
Automated hot-swap system



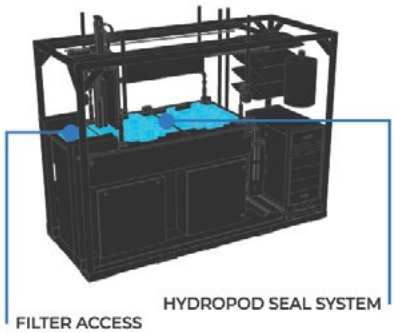
HYDROPOD
2-phase liquid immersion tank

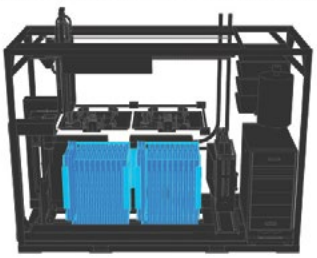


HOT-SWAP
Standby hydroblades for Otto-Bot hot swap

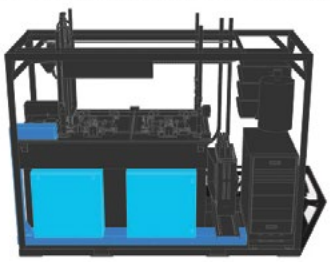


24U RACK
Customer standards with integrated DCIM system

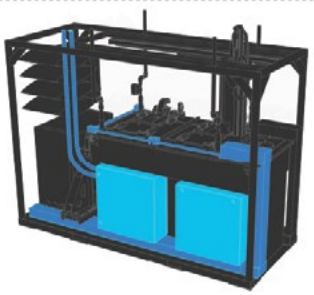




HYDROBLADES
6W x 20 hydroblades + powerblades



PLC
Localized HMI and API for remote ops + config



POWER
Primary connection: 480V or 415V 3-phase AC

HUGO

TMG Booth Design

In August of 2019, TMGcore approached Hugo and MediaLab with a special request: design a product launch experience at the Super Computing Conference that people will walk away remembering… and want to come back and experience again.

The first thing we had to do was learn about their product, OTTO — a data centers platform that uses liquid immersion cooling technology and has the ability to reduce the size of a traditional data center by 90%. We quickly realized that this is a disruptive technology that might be met with doubt and skepticism which meant we needed to educate the audience and create a curious learning environment.

We wanted to achieve this on multiple levels: How does OTTO disrupt the data center architectural typology? What impact does OTTO have on other industry? How does OTTO revolutionize the world? Introducing this very innovative new piece of technology would require a very personal and educational approach.

In this booth, we decided to take the viewer on an experience that would allow them to understand the world enabled by OTTO. The final design represents a diverse array of design disciplines, including graphic design, video production, motion graphics, experiential storytelling, sound landscaping, architectural design, interior design, lighting design, and olfactory design.

The exterior of the booth had to intrigue the passing audience, enticing them in to learn more. The exterior of the booth was designed to represent the product in motion; visually calling to the speed and efficiency that the product brings to the data center industry. Along the exterior, multiple touchscreens were employed to grab the attention of passersby. These interactive touchscreens encouraged people to engage with a custom app, developed to intuitively show a real-time 3D comparison between the OTTO and a traditional data center; additional information about the operational costs and physical footprint auto-populated simultaneously.

As viewers walk into the booth, they enter the first zone of the booth: the Operations Stage. This space was designed for two purposes. First, we wanted to give visitors the first-hand experience of sitting at an OTTO operating desk, educating them on how each OTTO can be operated from remote facilities anywhere in the world. We did this through a custom interface design that allowed people to play and interact with the product dashboard. Behind the desk, video content was projected, educating the viewer on the 2-phase liquid cooling process.

Graphics to the side of the desk also explained this process.

Launching the product in an open exhibition hall meant it would be difficult to control the environment. So, we created a new one. After viewers walked through the Operations Stage, they entered the dark room – a museum-like experience that leveraged all senses and created a sensorial environment to capture the viewers focus. This is where the audience is first introduced to OTTO in a fully immersive experience. We custom-designed the scent of fresh water which was released through the air duct system. This olfactory sense captured the user as they entered the fully enclosed room. Upon entry, the viewer feels the chill of conditioned air, the smell heightens, and digital bubbles projected onto the walls. We also incorporated the sound of bubbling water which subtly reinforced OTTO's liquid immersion cooling technology – a process where servers are fully immersed in water, a paradox to those of us who have always known that technology and water do not mix.

Past the entrance, viewers could peek into the OTTO, as its internal robot arm repositioned servers one at a time. Above the OTTO, the eye catches a scene of deep outer space, dark skies and ethereal lights; a 42' long backlit fabric graphic that transitions in both graphic design and in physical form through sky, mountains and cities, deep into the depths of our oceans, anchoring the interior experience of the booth. This "Sea to Space" graphic describes a world enabled by OTTO: A world where artificial intelligence is democratized, personalized medicine is commonplace, discovering oil is faster and safer than ever before, and all students around the world have access to unlimited resources and next generation technology.

While the Sea to Space educates the viewer on the incredible world that OTTO will enable, the touchscreens on either side of the graphic educate the viewer through 6 different industry specific videos. These vignettes were created to describe how OTTO will impact your personal world, and the industry you work within. Each video could be accessed through an interactive version of the Sea to Space graphic. Above the touchscreens, sound domes were employed to direct the sound towards the user.

To keep the OTTO Launch Experience a purely immersive event, we designed a dedicated a smaller space for our network of partners to discuss in detail with interested viewers and potential clients. This area was outside of the booth in the Corgan Design Center.

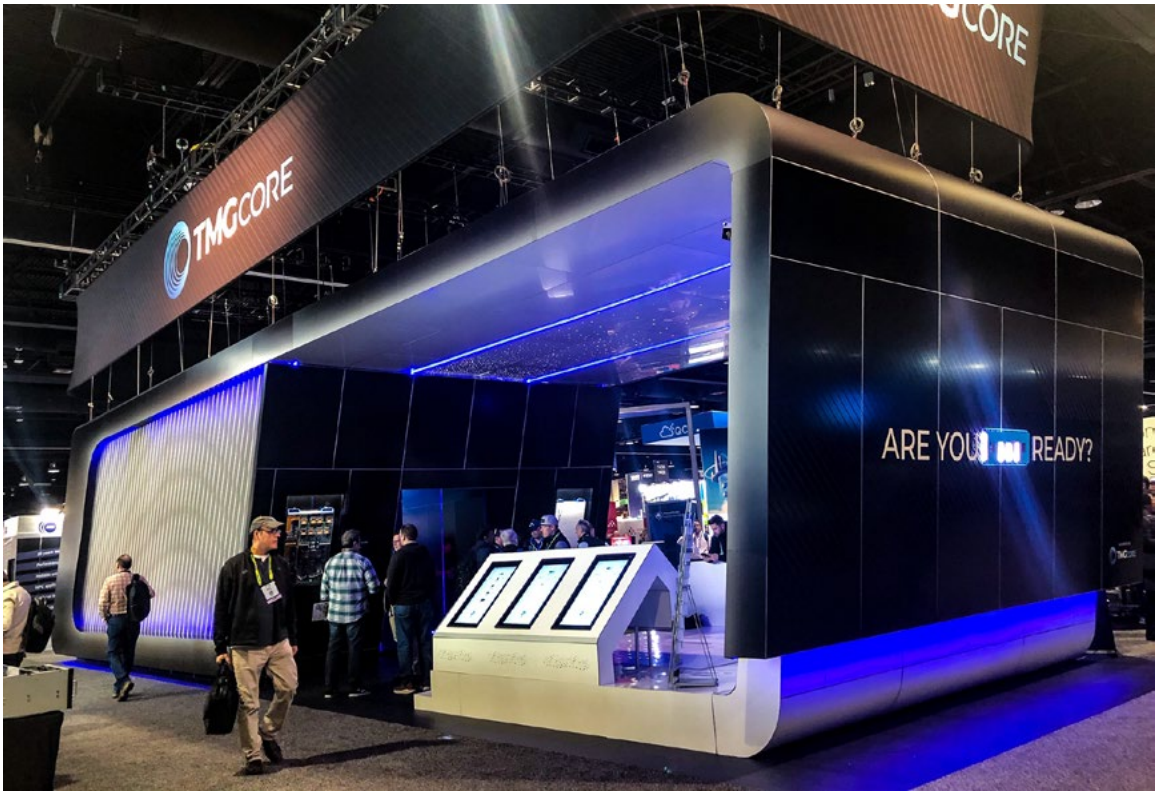
The experiential booth design at Super Computing conference provided an opportunity for TMGcore to interact with clients in an engaging environment. The integration of the Sea to Space mural and the interactive app encouraged the asking of questions and general curiosity. TMGcore acquired almost $150M in new business during their time at the conference.

Hugo and MediaLab are currently working on a new design for TMGcore's traveling booth concept that they plan to use for their 2020 conference circuit.

HUGO


OTTO
Imagine a world with zero latency.
A world that leverages distributed networks and thrives on edge computing.
A world where artificial intelligence is democratized, e-sports lives in the cloud, personalized medicine is commonplace, national defense intelligence and disaster relief efforts save more lives via real-time situational awareness, discovering oil is faster and safer than ever before, and all students around the world have access to unlimited resources and next generation technology.
Imagine a world where novel compute power is at your fingertips.
We are making the impossible, possible.
Are you OTTO ready?


HUGO


TMGCORE
ARE YOU READY?

CORGAN IS CURIOUS ABOUT

Sustainably Smart Buildings

The Dutch refer to this as: het nieuwe werken ("a new way of working").[10] It combines environmental efficiency with technological integration, but most importantly, a seamless user experience.

The Edge, commissioned by PLP Architecture firm, was designed to answer the demand of new working patterns and collaborative spaces while addressing environmental standards. This office building is flexible and *social*. Its design is centered around the need for a central hub within the building. This takes the form of a large indoor atrium that is filled with nodes of spaces and circulation paths that represent different social environments that reinforce Deloitte's work culture.

The building also has been awarded one of the highest ratings in sustainability by the Building Research Establishment Environmental Assessment Method (BREEAM)[11] with an attributed sustainability score of 98.4%[12]. In addition to daylighting optimization and natural ventilation, the building uses 70% less electricity than a traditional office building[13].

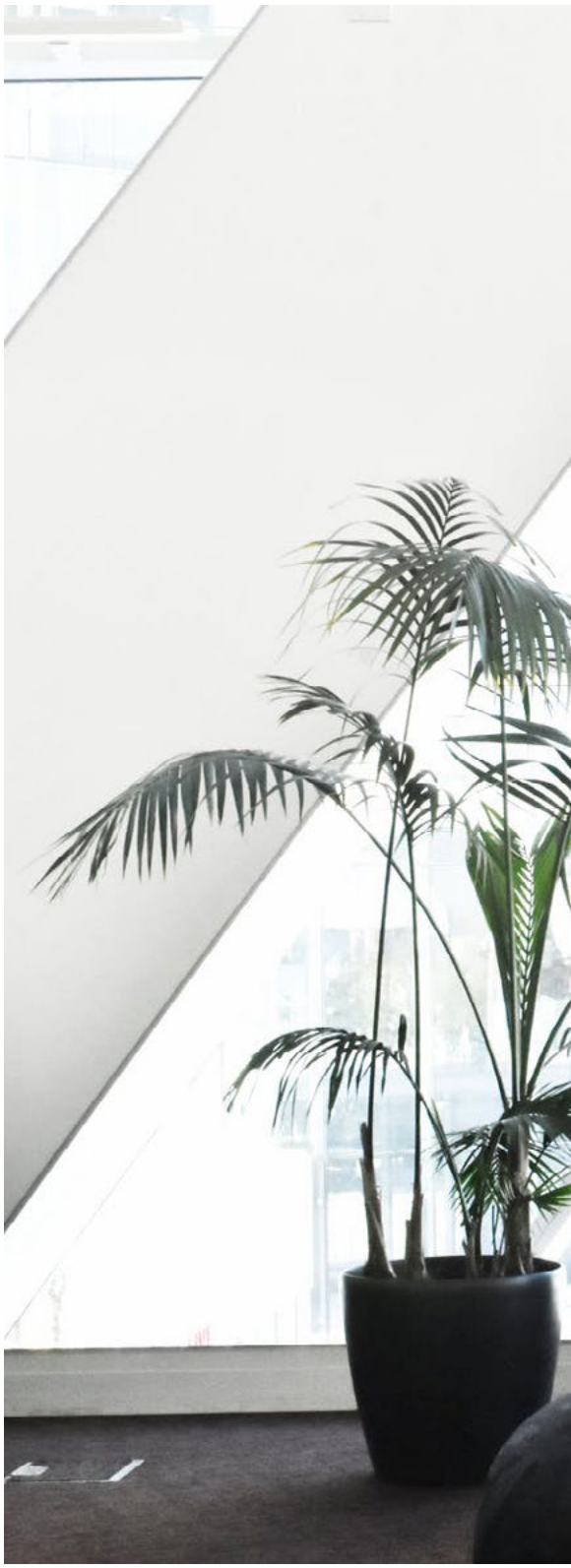
It achieves this through an array of solar panels along the building façade and roof; harnessing enough power for the building installation systems, laptops, phones, and electric cars. The fifteen-story volume cut from the building not only allows more surface area for natural sunlight but helps air between floors rise to the roof and create a loop of natural ventilation.

Digitally speaking, the building has also been crowned one of the most "connected" buildings in the world. Every Deloitte employee is connected through a smartphone app that tracks meeting schedules and workflows. Employees no longer come to the office and work at an assigned desk. Instead, workspaces are assigned to each employee based on their respective schedule for the day. Known as "hot desking,"[14] this new environment means everyone needs to stay connected.

The building also integrates the app to intelligently control the HVAC system. The active lighting is

just as intelligent and efficient. LED light panels harness power using the same internet data cables, are installed with an inter-connectivity of motion, temperature, humidity and infrared sensors. So essentially wherever someone goes, the app knows your preferences for light and temperature, and it tweaks the environment accordingly. By collecting data on how employees interact within the building, central dashboards monitor every category of energy usage. On the days fewer employees are expected, an entire section might even be shut down, cutting the heating, cooling, and lighting costs.

The Edge knows yours schedule and accommodates accordingly: "sitting desk, standing desk, work booth, meeting room, balcony seat, or "concentration room." Wherever you go, the app knows your preferences for light and temperature, and tweaks the environment accordingly."[10]



CAN YOU IMAGINE...

A quantum data center?

Quantum computing has the ability to disrupt most, if not all, industries. While it is still relatively theoretical (and might even read like a science fiction comic book at times), we can begin to imagine the ways it will impact the world. Imagine – what would take a classical computer 10 years to process, might only take 30 seconds for a quantum computer.

What could we do with all of that computational speed and power? Medical researchers could accelerate breakthroughs by processing multiple-variable problems that often make medical research so challenging. Astronomers, trying to find exoplanets, could quickly process mountains and mountains of data in order to make any sense of it all. Governments could understand the spread of a global pandemic like COVID-19 in real time.

Quantum computing allows us to solve these kinds of problems exponentially faster.

However, the data being processed in this quantum scenario is a different kind of data. It no longer processes in classical 1's or 0's. It's now crunching qubits (quantum bits) of information and with that a new type of data center could emerge. This Quantum Data Center, while speculative and theoretical, still needs to consider some of the fundamental building blocks of quantum computing that we know today. Let's take a look.

1. Emerging Technology

The quantum computing field is advancing each and every day, with some of the world's largest technology companies, like IBM, Google and Microsoft, leading the way. While this initial investment is required to spur development, it also means that what we know today could be drastically different from what we know in 10 years. Some might say this is always the case with technology; we never know entirely what it will look like in the future. But with an extremely powerful technology, that represents a potential quantum leap forward, we really have no idea what its future composition might look like. Designing a Quantum Data Center could therefore prove to be challenging as we explore this unknown territory.

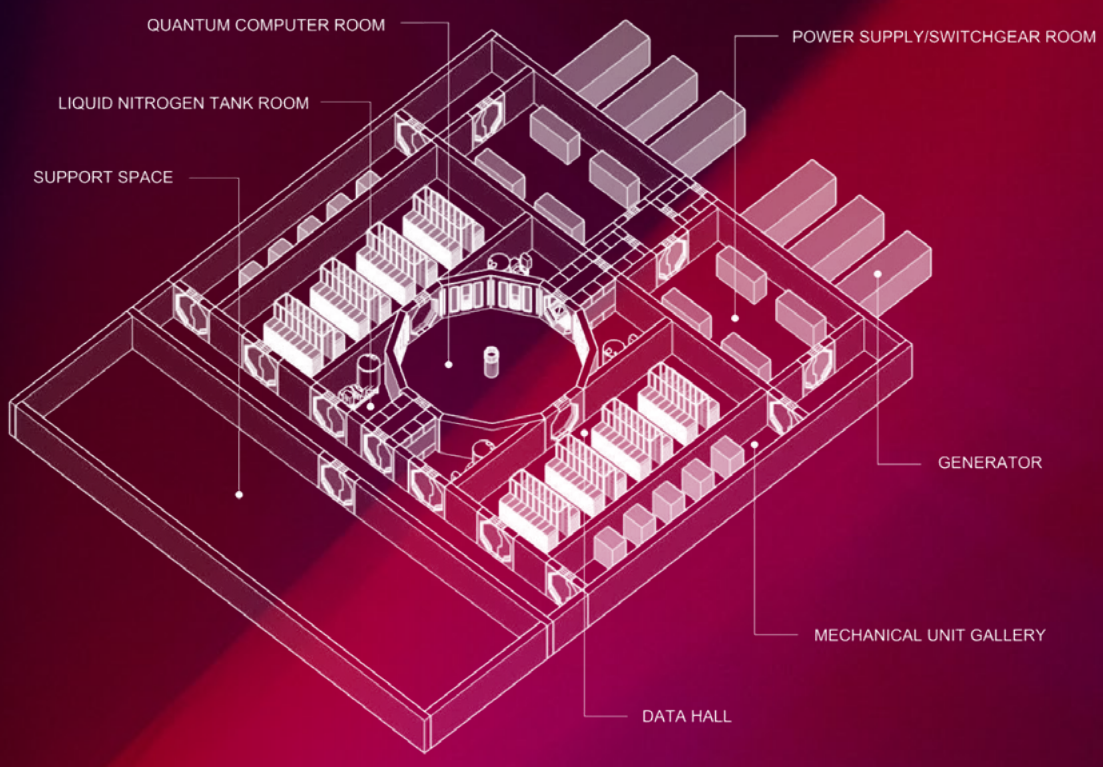
2. Error Prone

One of the major challenges facing quantum data processing is that their output measurements are more error prone. [15] This is due to inherent quantum properties. Unlike the binary values of classical computing, qubits can represent both a 1 and a 0 at the same time. [16] This means the

possibility you'll get back a 1 or a 0 is neither 0 nor 100 percent. There is even the possibility of measuring identical qubits but resulting in different answers, making it very difficult to distinguish if the answer is the correct one or not. Additionally, qubits are universally instable and fragile which means they do not exist for long periods of time and are affected by nearly any disturbance around the quantum processor. This leads to the expectation that classical computers will more than likely still be needed and that data centers will house a quantum computer at its center with traditional computers serving a complimentary role. [15]

3. Energy Efficiency

Power consumption for computational power is a serious consideration as the world becomes more connected and data-driven. Highly specialized coprocessors such, as D-Wave's quantum processing units (QPUs), show promise in significantly increasing the power efficiency of computing. In a recent study, D-Wave's 2000-qubit system was shown to be up to 100 times more energy efficient than highly specialized algorithms on state-of-the-art classical computing servers.[17]



A QUANTUM DATA CENTER THAT IS SUPPORTED BY TRADITIONAL SERVERS. DESIGNED BY CORGAN

04

CURIOSITIES IN EDUCATION

"Every great wizard in history has started out as nothing more than what we are now: **students**. If they can do it, why not us?"

- HARRY POTTER, *HARRY POTTER AND THE ORDER OF THE PHOENIX*[1]

What to expect

Welcome

It's an exciting time to design schools....

The fundamental purpose of education is to prepare students for their future. To build knowledge, inspire compassion, and instill a spirit of curiosity and innovation so that learners become doers who contribute their energy, their insight, and their creativity towards the forward progress of humankind. And in an ever-changing world with rapidly advancing technology and evolving social and ideological trends, the learning environment must respond and adapt in order to support the learning that needs to take place. While the vision of education and learning environments of the future may not always be known, there are some essential truths that endure: we are designing for minds, in bodies, in places. Ours is an embodied cognition, and this represents an incredible opportunity for architectural space to meaningfully contribute to the mental, emotional, and physical health of students as they learn and grow.

While higher education institutions have always understood that their enrollment is directly tied to how effectively they improve student outcomes and market to future students, public K-12 school administrators could once think of enrollment as a predictable function of growth, demographics, and testing performance within their municipal boundaries. As some school districts have opened their borders, and public charter schools have multiplied, enrollment numbers are no longer so predictable. Between fall 2000 and fall 2016, overall public charter school enrollment has increased from 0.4 million to 3.0 million, according to the National Center for Education Statistics.[2] Where parents once had a choice only between the neighborhood elementary or a private school, now they have a wide array of options.

As a result, public schools have had to become more responsive to the specific opportunities parents want for their kids. They also have to support those

opportunities through facility improvements, and curriculum changes, while communicating them effectively to the public. Career training, PK-8 campuses, all-girls and all-boys schools, specialized academies with a curriculum focus like STEM or Fine Arts, or an educational approach such as Montessori; for the most part these options were once limited to those who could afford private education. Now they are common in public schools, and all have implications for the architects and interior designers that design these active learning spaces. Even in traditional comprehensive schools, the double-loaded corridor lined with lecture-style classrooms is no longer ubiquitous. Parents and teachers expect more.

Embedded in this conversation of opportunity and methodology is the role of technology; specifically, how to give students access to new tools that enrich their learning experience, without letting these tools become the focus above interaction with peers and place. Ten years ago, there seemed to be a race to be the most high-tech district by offering the most connected experience with the most devices per student. Some schools are now responding to a perceived overreliance on technology by banning personal devices altogether. There's a broad recognition that balance is needed; that both access to and respite from technology is a necessary part of the school day, for both teachers and students.

For decades, the prevailing institutional mindset limited a student's access to nature to a short window of recess, to avoid distraction during lectures. As designers we are now challenged not only to create energizing spaces for kids to engage and learn, but calming spaces to retreat and reflect. We're challenged to connect teachers and students with nature throughout their day, with outdoor learning and respite spaces, views and daylighting throughout the building.

This push for more personalized and active learning experiences comes with the realities of budget. Construction costs have outdistanced projected inflation for many projects, which has been felt acutely in bond-funded public projects that are budgeted several years before bidding. Funding limitations are forcing administrators and architects to look for creative ways to renovate existing facilities and repurpose under-utilized space. For example, rather than acquire a greenfield site and build a new Career and Technology Center, a client may look at an overlooked and abandoned retail and distribution facility and ask an architect, "what can you do with that?" It's a different kind of design challenge but requires no less creativity than a ground-up project. To take an overlooked and outdated eyesore and revive it as a vibrant learning environment makes a huge impact on a community.

The upshot of all this is that when we sit down with a client to discuss the design of their project, we are talking about more than the number of students, square footage, budget and maintenance standards. Of course, all these parameters remain, but the conversations have elevated to center more on user experience, outcomes, health and wellness. The essential shift is that these are now the client's priorities as much as our own. They- and their teachers, students and parents- want learning environments that are not only adaptable to different modes of teaching but allow kids to intuitively find a personalized way to engage and learn. This can only be done with greater understanding and consideration of their cognitive and emotional needs. This, and our ability to speak in these terms fluently and show our work with real data, is what will differentiate our work and our reputation as education architects and interior designers in the years ahead.

- Corgan's Education Leadership

85%

of teachers say they want more flexibility in their learning environment

WHAT CORGAN IS CREATING

Lessons from Teachers–How Classroom Design Impacts Teachers

Pressure from parents, rapidly changing pedagogies, and tight budgets only begin to outline the daily pressures teachers face as they educate future leaders and develop the talent of tomorrow.

Not unlike counterparts in other industries, a teacher's workplace can take a toll on well-being, job satisfaction, and most importantly their performance. Schools, designed to promote learning and caring for the development of students, could often increase attention toward the holistic wellness and productivity of teachers.

In fact, according to a recent Corgan survey, one in four teachers cite poor classroom design as a main source of stress—similar to the percentages that point to pressure from administration and lack of support from leadership.

In order to better understand the unique challenges and needs of teachers as it relates to the design of educational environments, Corgan's survey collected responses from 1,000 Kindergarten through twelfth grade teachers from across the country. Reinforcing many of the best practices from workplace design and from visioning sessions with educators, the exploration also offered new insight into the relationship between school design and teacher satisfaction while providing practical ways to ease stress, drive recruitment and retention, and, ultimately, improve teacher and student outcomes.

Flexibility

Flexibility is a non-negotiable. Different teaching and learning styles combined with a marked shift toward individualized, self-paced curriculums and personalized learning models, the role of the modern educator is more facilitatory—requiring flexible resources and environments that are responsive to their quickly changing needs. Effective classrooms must also be agile and mirror the agility of the professionals that occupy them. From technology-ready spaces to modular furniture that intuitively accommodates collaboration and open discussion, flexible classrooms need

Rodriguez Elementary School designed by Corgan. Each classroom wing includes a "learning stair" that connects the first and second floors and can be used for small group collaboration, lecture seating or a study area.

to be able to adapt to both long- and short-term changes—embracing multiple learning styles within a singular class while welcoming the major shifts in future technologies.

Professional Settings

Surrounded by bright colors and themed bulletin boards, teachers spend a majority of their day in environments tailored to meet the preferences and aesthetics of children and youth. Intentionally integrating spaces that respect teachers as professionals, empowers teachers with a workplace that works as hard as they do and supports them throughout their day. While a ping-pong table or eclectic perks might be popular amenities in an evolved office setting, school design and budgets require less obvious, and more practical, seamless interventions to respond to common teacher pain points. Wellness rooms, phone booths, and refreshment areas, for instance, add a positive and functional space that are dedicated to the real needs of teachers and offer quick break out spaces to regroup, while residentially inspired finishes speak to an innate affinity for quality design.

Collaboration

A hot topic, collaboration is often a key design principle for schools but is often focused on bringing students together for collective learning and exploration. Providing spaces geared toward collaboration between teachers, however, offers opportunities for professional development, social bonds, mentorship, and creative problem solving. In addition to increasing communication between instructors, these spaces provide casual and intentional opportunities to share insights on student performance, create a sense of belonging between faculty, and to share ideas with and learn from more other educators across departments.

Middle School West, Coppell ISD designed by Corgan

Personalization

A teacher's work is never done. From answering questions between classes and grading papers to monitoring the health and emotional wellbeing of their student body and preparing for parent-teacher meetings, the workday for teachers extends well beyond teaching hours. Their day is varied—changing every week, day, and even every hour. With a spectrum of work styles and tasks, today's educator needs the same level of personalization that the corporate workplace has recognized as a core driver of productivity, engagement, and satisfaction. The power of choice and the ability to tailor their lighting and temperature, or select the appropriate technology or desk height, allows teachers to choose the most appropriate setting for the job at hand.

Perhaps most importantly, Corgan's survey found that teachers are paying attention and that the implications of design are essential to the school and student body performance. The classroom is to a teacher what the office is to a corporate employee—profoundly shaping their work experience, talent acquisition, and school outcomes. Passionate about educating our youth, teachers want to work where they can be at their best, and as design proves to play an important part in their ability to be effective, more and more educators are weighing school design when choosing where to work. While competition heats up between districts to recruit and retain top talent, well-designed schools that consider the needs of teachers will continue to stand out as key differentiators. Though the challenge remains of salaries, teacher-student ratios, and family engagement, better school design offers realistic, practical solutions to reimagining the school experience for our students, teachers, and communities.

98%

of teachers say that having a well-designed learning environment makes teaching more enjoyable

CORGAN IS CURIOUS ABOUT

Empathetic Design

The world we live in is fueled by data and quantitative reasoning. But, often times, the way people feel is just as (if not more) important. This is particularly important for students who are learning about the world around them and building a deep sense of curiosity.

As architects, we can recognize and adapt to the emotional needs of students through empathetic sensory design. The strategic implementation of color, light, sound, and material choice can provide comfort and emotional support for students with special learning styles or mental health conditions such as depression and anxiety. These spaces are powerful tools that can support overall wellbeing in schools and other educational environments.

Social Sensory Architectures is an on-going research project led by Sean Ahlquist at the University of Michigan to design technology-embedded multi-sensory environments for children with Autism Spectrum Disorder (ASD).[3] Ahlquist's research integrates the fields of architecture, structural engineering, computer vision, human-computer interaction, psychiatry and kinesiology, in an attempt to encourage and positively reinforce moments of social interaction through architectural design.

One of the prototypes developed from this research, *sensoryPLAYSCAPE*[4], is an interactive structure made with tensile fabric to create an immersive environment that responds to touch and sound. This environment demonstrates a connection between motor skills, auditory and visual feedback thereby helping children with autism understand social interactions through reactive touch and sound.

Spaces such as sensory rooms, sensory courtyards, wellness rooms and environments that generally respond to individual needs can provide students with a sense of comfort and security. Changes to the scale, shape, light level, color, and sound of a space can provide a sense of security, comfort, and reprieve within the larger school environment. It should be noted that it's critically important to consider differentiated student needs when designing these types of spaces. A space designed to support a child who needs strong sensory stimulation would be distressing for a child who needs minimal stimulation and vice versa.

Snoezelen applies these concepts at a larger scale to develop fully immersive sensory rooms, creating multi-sensory environments that support relaxation, development, stimulation, and therapy for people of all ages and needs. Through the interaction of integrated technologies, lighting, tactile elements, and sensory stimulation, Snoezelen curates spaces that can help reduce agitation and anxiety through restorative interaction.[5]

Similarly, the work of creative technologist, Behnaz Farahi, integrates reactive, spatially-focused technologies that transform in response to immaterial forces like movement, emotion, and spoken words.[6] Farahi's work includes: art installations, wearable sensors, and responsive spatial elements that react and transform in response to movement, emotion, gaze, and spoken words. These responsive designs create a transactional relationship between the environment and the body interacting with the technology.

WHAT CORGAN IS CREATING

Tinkering with Transition

As adults, we take for granted how we transition with relative ease and comfort throughout our daily routines. We know what time we must leave for work in the mornings; our average commute times; the location of entrances and exits in our buildings. However, this is not the case for young students who are still learning how to adjust and adapt to their environments.

The cognitive development that occurs between the ages of 5 and 12 represents substantial change in a child's relationship to the world around them, as well as their needs and abilities in an educational setting.[7] To support students throughout their daily transitions, an elementary school campus should replicate the safe place of home while still providing opportunities to grow, explore, and own new territory. This human-centered approach for the proposed design of Round Rock Elementary conceptualized the classroom as a parallel of home, focusing on the core concepts of exploration, responsiveness, and wellness.

Round Rock Elementary School Entrance designed by Corgan


ROUND ROCK
ELEMENTARY

At Round Rock, flexible, modular furniture can be moved and rearranged as needed. Their individual spaces can open up to a larger "neighborhood" that provides more opportunities for hands-on exploration and social interaction. The central feature, the Tinker Space, is designed to support specific tasks in specialized zones such as knowledge sharing, focused study and project work. These fixed and adjustable features enable students to customize their learning experience, creating a sense of ownership and ease.

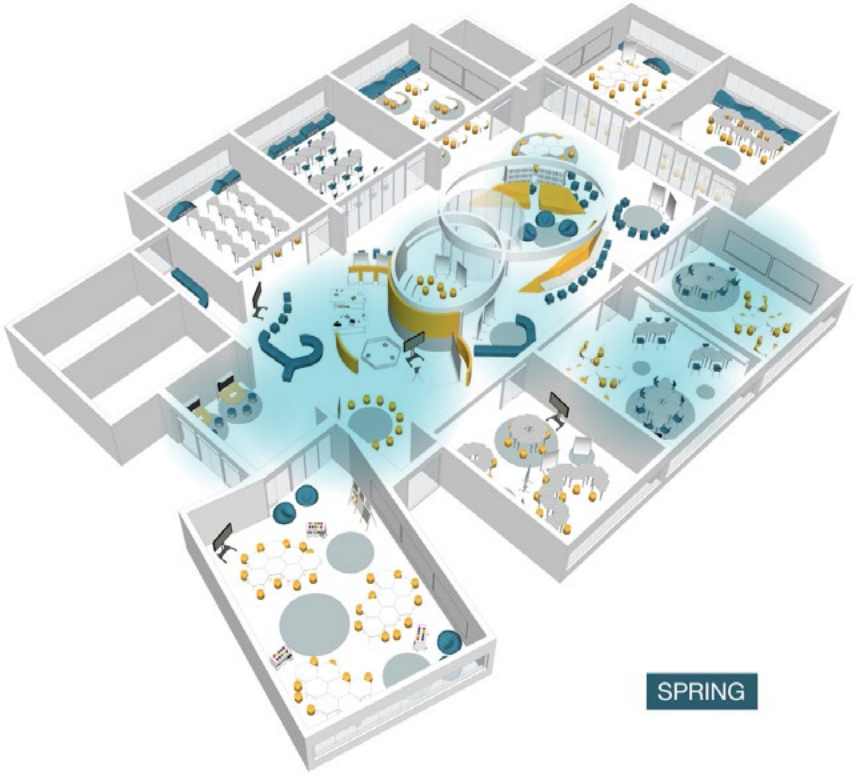
The Tinker Space can not only be reconfigured as students engage with it throughout the day; it may also look different at various phases throughout the year.

At the beginning of the year, when students are getting acquainted with their learning environment, the space may be organized into groupings of furniture and displays of resources that they will be using throughout the year to familiarize students with their new "home." As students begin to dive into specific curriculum in the coming months, the space changes to accommodate groups of students with a degree of acoustic and visual privacy for focused study. Markerboards, smartboards and mobile book and VR carts can roll out to help craft the spaces and provide ready resources. In the spring, students are in project mode, which means they are brainstorming and creating in the Tinker Space- transforming it into a lively laboratory brimming with ideation and collaboration. And finally, at the end of the year, presentation or gallery mode can be implemented to facilitate student presentations that show off their work and the knowledge they've acquired over the last year.

This spirit of community, exploration, and engagement extends beyond the classroom pod and out into the rest of the campus. Students share learning experiences and resources with their older and younger peers in outdoor classrooms, learning labs, makerspaces, sensory courtyards, and a 21st century library. The campus, as a whole, encourages growth and exploration, by responding to the needs of every student, in a welcoming, natural environment designed to create seamless transitions for young students adjusting to new environments.

Fall and Spring configurations for The Tinker Space


FALL


SPRING

CORGAN IS CURIOUS ABOUT

Place-Based Learning

Learning does not happen in a vacuum— it is a multisensory experience that takes place within the larger context of our physical environment.

This means that how and where we learn is an integral part of the learning process.[8] The physical environment presents a powerful opportunity for architects to develop thoughtful and intentional designs that can positively contribute to a students' experiences and outcomes.[9] Emphasizing "place" in education can help us, as designers, connect students to their world, their community, and to their peers.

An example of this integrated approach to learning is the "Nature School" typology, in which students spend the majority of their day learning outside in natural environments. In these settings, children gain new perspective through experiential learning practices, environmental stewardship, sensory engagement, physical activity, and improvement in psychological health.[10] This less directive and more open-ended learning environment supports creative thinking and problem solving through play and experimentation.[11]

Durham ISD's HUB Farm is another example of using the outdoor environment to enhance the learning process. The HUB Farm was developed through a collaborative partnership between the school district, landscape architects, scientists, and educators. Like the Nature School model, the HUB Farm encourages students to learn from nature and to co-create an outdoor "learning landscape" that also serves as a resource for the broader community.[11] Scientists and subject-matter experts work with teachers to reimagine their curriculum and classroom activities in a way that will emphasize learning through multisensory experience in the physical environment. These ongoing collaborations contribute to a constantly evolving, exploratory learning landscape where students are encouraged to be inquisitive, take risks, solve problems, and build meaningful, translatable knowledge through open-ended nature-based learning.[11]

This trend of reincorporating nature into learning environments is not new. However, the integration of technological tools, like AI and Extended Reality, can add a layer of depth to a model that traditionally does not rely on technology assistance. Imagine the possibilities for guided exploration, health and safety monitoring, geospatial mapping, environmental sensors, data collection, and autonomous drones — these tools represent opportunities to enhance place-based learning through the strategic use of technology.

Reconnecting students with nature and the history and culture of the place where they are is a powerful way to strike a balance between the "real" and the "virtual" by embracing the benefits of technology as a tool to enhance learning, while also recognizing the value of the tactile learning opportunities offered by the "here and now".[12]


Eagle Mountain
High School

WHAT CORGAN IS CREATING

Learning in a Restorative Landscape

Our concentration often becomes depleted after extended periods of time; our brains weren't designed for 24/7 uninterrupted focus. Attention Restoration Theory, however, suggests that a remedy for this may be exposure to natural environments. This mental "reset" with nature can help us regain cognitive performance through intentional periods of restoration.[13]

A school site can similarly impact a student's ability to learn and concentrate. It's, therefore, important that education architects develop a deep sense of place that connects students with their surrounding environment in restorative ways. A new high school designed for the recent pursuit of Eagle Mountain-Saginaw ISD was developed with this exact principle in mind.

At Eagle Mountain, courtyards nestle into the hill to create unique student-owned spaces for respite, social development, and varied educational experiences. The courtyard adjacent to the

New high school for Eagle Mountain-Saginaw ISD designed by Corgan

athletics programs allows for unstructured free-play activities for team building and stress-relief. A flexible maker courtyard provides resources and space for large, messy projects, giving students the freedom to manipulate the area as needed. The restorative central courtyard, bounded by academic programs on three sides, is reserved for individuals and groups of students to use as needed for respite, group activities and socialization.

Native trees and a river rock stream fed by collected rainwater allow for learning opportunities and a connection to nature. A natural amphitheater with limestone seat walls slopes with the site.

The restorative concept transitions into the interior of the student union where flexible seating areas for personalized learning feature large windows that overlook the shaded courtyard. While these adjacencies intuitively make sense to designers, they also align with research in cognitive neuroscience and environmental psychology.

Attention Restoration Theory shows that exposure to nature and interaction with natural elements can mitigate the negative effects of stress and cognitive fatigue by activating an effortless form of attention called fascination - effectively taking effortful, focused attention offline to recharge.[13] This restorative experience provides students and staff with cognitive and psychological benefits, allowing them to learn effectively and perform at their best.

Freedom of choice, a key facilitator of personalized learning, was the driver of the interior space planning and design decisions. Rather than separate single-use spaces such as a library, cafeteria or study hall, a zoned, dual level campus union allows for lively collaboration over a coffee or a meal. Staff areas within and adjacent to the campus union allow for student collaboration and mentorship, while private break areas and wellness rooms, allow teachers to release stress and take care of themselves. Providing these respite opportunities for teachers allows them to better serve the next generation of innovators and leaders.

CAN YOU IMAGINE...

If we fully understood the brain in different learning environments?

Nobel Prize winning neurobiologist Eric Kandel describes the brain as "a complex biological organ of great computational capability that constructs our sensory experiences, regulates our thoughts and emotions, and controls our actions."[14] This is because the brain is a naturally quantum mechanical organism and one of the most advanced pieces of technology on Earth.[15]

If we can use the principles of quantum mechanics to further our understanding of the human brain and its cognitive development over time, we can unlock new ways to design educational spaces. We could create learning environments that more accurately reflect the neurological needs of students, resulting in truly human-centered experiences.

But to fully understand the brain will take time and advancements in fields like quantum computing and neuroscience. The following exploration is intended to be a tool that examines what architectural design could look like if we had a more mature understanding of the human brain, and how it responds to immersion, identity and purpose.

Immersion

The transition from home to school in early childhood introduces an environment, brimming with new experiences and opportunities to explore, connect, and grow. Upon entering kindergarten, the portions of the brain responsible for touch, vision and other sensations are fully developed. Areas governing language and mathematics will grow rapidly while reasoning and abstract thinking remain in the formation stage.[16] Young learners should be offered a wide variety of ways to engage with their physical and social world[17] while provided with structured boundaries and guidance aligning with their emotional needs of safety and comfort.[18]

Identity

Entering secondary education, capacities for emotion and logic are expanding rapidly while

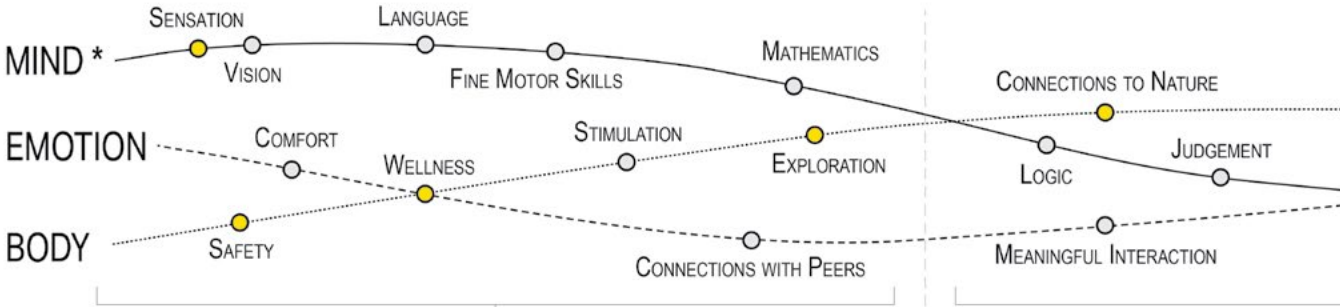
the prefrontal cortex governing judgment lags behind (aka a teenager!)[16] As a learner develops their capabilities and unique interests, a passion for independence and self-identity grows. Neural links which are used most actively will thrive, leading to increased specialization.[16] Educational spaces should support focused exploration and innovation while allowing students ownership of their surroundings and providing opportunities to make an impact in ways that are unique to them.[19] Designs should foster mentorship opportunities and meaningful social interactions.

Purpose

Nearing high school graduation, the prefrontal cortex finally catches up to the rest of the brain and a greater capacity for abstract thought emerges.[16] Significant growth in emotional maturity, impulse control and decision-making will continue developing throughout university and beyond.[16] Many college students face signifant stress as they are charged with finding a career direction, developing their own sense of purpose and preparing for life beyond academia. Environments should be restorative and expansive and fitted with all the tools a student could need to succeed.[19]

We already know a fair amount, but can you imagine if we knew even more?

Can You Imagine If... We Could Wrap Our Minds Around The Brains Of Learners?



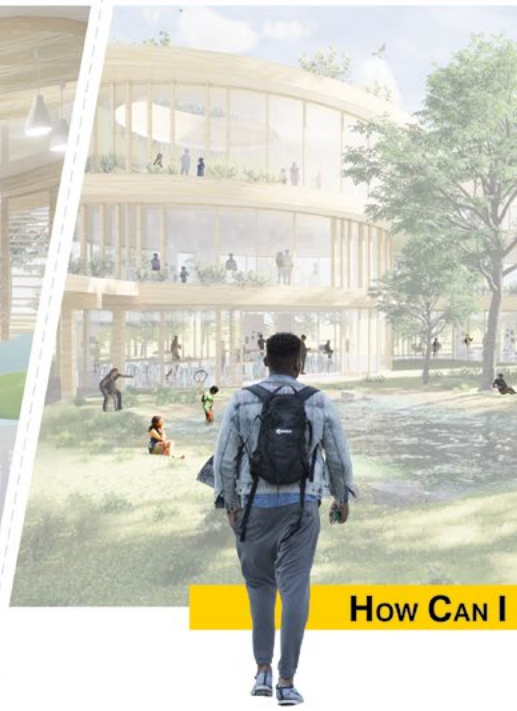
Immersion

The transition from home to school during early childhood introduces students to a new environment brimming with challenging experiences and opportunities to explore, connect, and grow.

As a learner develops their capabilities exploration grows. The ability to u meaningful connections strengthens a

PRIMARY

SECONDARY



What Will I Discover?

How Can I

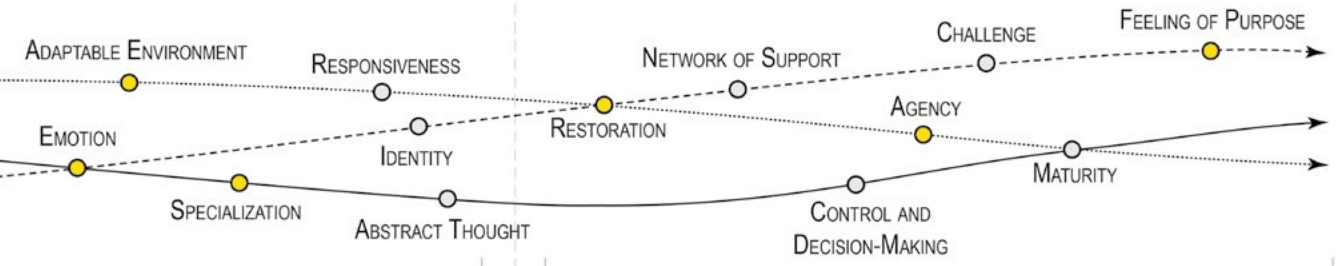
...How Would We Design?

Design Responses

- Sensory Rich
- Sense of Home
- Zoned
- Appropriately Scaled
- Naturalness
- Outdoor Connections
- Space for Mentorship and Counsel

Technology Responses

- Safety and Monitoring
- Track Developmental Progress
- Identify Needs
- Support Exploration and Innovation
- Global Connections



Identity

s and interests, a passion for independence and niquely impact their surroundings and make nd molds their identity.

Purpose

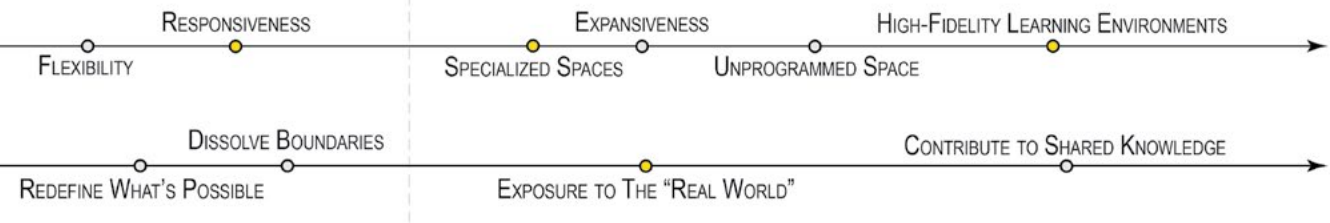
Emerging adults are shaped by their experiences, passions and a developing sense of purpose. The jump into the "real-world" is a significant one that provides both opportunity and stress to graduates.

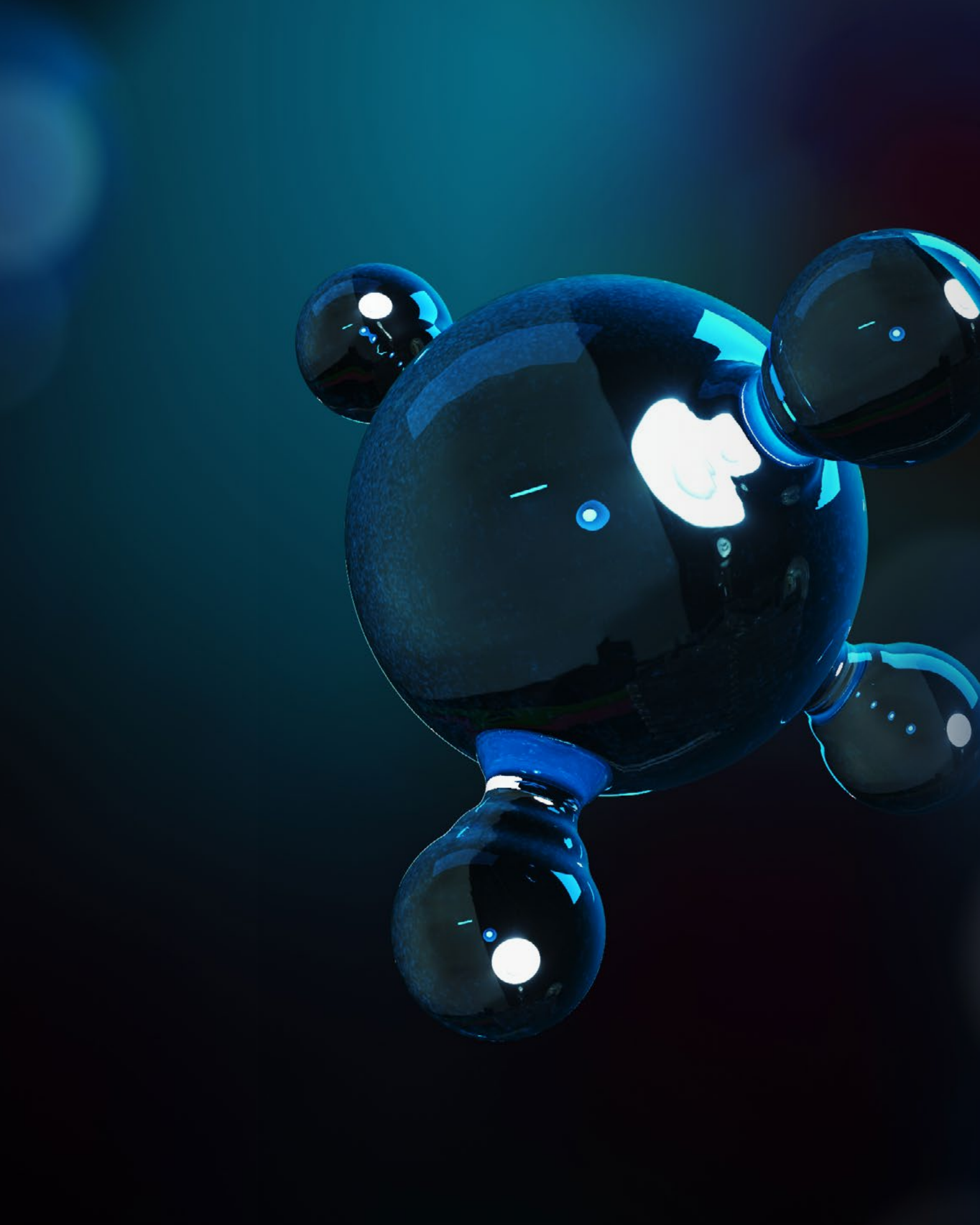
* Source information provided by Dr. Jay Giedd, National Institutes of Mental Health.
Produced by Tara Parker-Pope, Jon Huang, and Mike Mason/The New York Times

HIGHER EDUCATION

Make My Mark?

Do I Have What It Takes?





05

CURIOSITIES IN HEALTHCARE

"You treat a disease — you win, you lose. You treat a person — I guarantee you, you'll win, no matter what the outcome."

- PATCH ADAMS (1998)[1]

What to expect

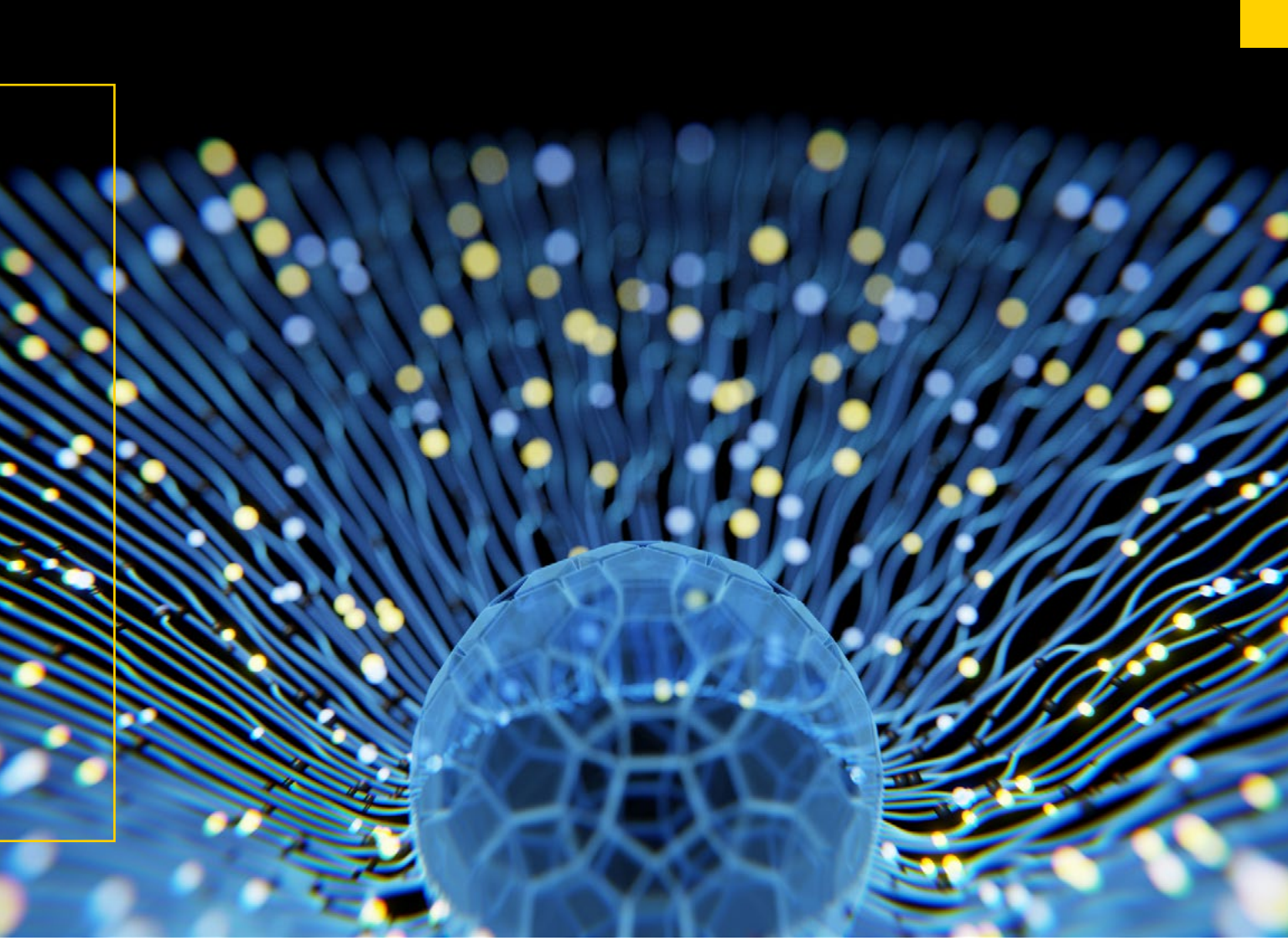
Welcome

The complex challenges of modern healthcare demand that places lean into the future. Design is the physical expression of intellectual rigor in the service of empathy. Every design decision must maximize performance, minimize risk, and enhance the experience of the caregiver, patient, and family.

As a sector, we are collectively committed to bringing an innovative and evidence-based mindset to support our client's vision and promote health and well-being.

Innovation usually emerges when individuals collaborate to generate a broad gamut of ideas, which they then refine and evolve into new ideas through rigorous debate. Innovation requires trial and error and solutions emerge that are usually different from anything anyone anticipated. Creating something novel and useful involves moving beyond "either-or" thinking to "both-and" thinking. Innovation requires integrating ideas, combining options, sometimes even if they seem opposite in direction, to create a new and better option.

Many think of innovation as disruption or revolutionary, but often innovation is defined as evolutionary, translating ideas, sometimes



incremental ones, to create value by solving a specific need, creating a new dimension. Healthcare is challenged with the emerging technology, changing demographics, shifting of attitudes and political influence. We must be aware of and knowledgeable about these external forces driving our client's business. We are eager collaborators, who respect expertise and listen deeply to multiple viewpoints. We must bring new solutions.

We are entering the DARQ era which is likely to have a profound transformational impact on the healthcare industry in the coming years, with AI perhaps having the most opportunity. These technologies will impact payment activities, medical chart reviews, and diagnosis and treatment planning assistance, to name a few. Extended reality technology has shown promise in pain management and even mental health diagnosis. Healthcare administrators see these emerging technologies accelerating innovation in the industry, leading to less waste and more improved customized care. We need to understand what impact these exciting technologies will have on the built environment.

- Corgan's Healthcare Leadership

Lab100

Mount Sinai Hospital, New York

CORGAN IS CURIOUS ABOUT

Using Data for Personalized Care

Part clinic, part research lab, Lab100 uses precision diagnostics to empower patients and help scientists advance their understanding of human health.[2]

Upon arrival, patients receive a 90 minute one-on-one guided consultation with a physician. Information gathered during this session, like vital signs, blood analysis, cognition, and body composition, will then be used to fabricate a personalized health plan. Patients also get to see their data compared to a population of their peers. These sessions are designed to empower patients to track their health and to witness firsthand how their lifestyle choices affect their health over time.

The goal of this pop-up clinic is to collect an aggregate of secure data from the users. Then medical specialists analyze and cross-reference similarities of the patients in order to start treating congenital diseases before symptoms ever arise. By combining the knowledge of providers, researchers, innovators, and artificial intelligence,

Image Courtesy of Lab100

this data-driven healthcare model shortens the distance between the patients and the required treatments they may need.

Lab100 was also designed to be easily upgraded with the latest medical laboratory technologies. According to lead designer, David Stark, "No one knows what the future of healthcare is, and neither do we. We made our best initial guess, recognizing that we're going to change based on the data we collect."[3] The entire clinic is designed like a stage set. The panels are built on an easily-reconfigurable grid system so that machines and technology can be taken out and replaced without it looking like an after-thought.

Before starting any of the design, CACTUS and Mount Sinai established a strategy with design principles that drove all decisions and objectives.

1 "We must dramatically increase patient agency through not just access to best-in-class data, but also the educational and interactive elements necessary to give a deep understanding of what that data really means."[4]

2 "Our system must continually adapt and improve. Fast and often. We must be able to show medical innovations actually happening at the speed of the tech industry."[4]

3 "We must quickly show that our system fuels both the medical and data science research fields, demonstrably pushing the industry towards a predictive, rather than merely reactive, model of healthcare. From here the brief was clear: Make it medically precise and effective. Make it eye-opening and educational. Make it fun."[4]

With this foundation, the system fuels the medial and data science research fields, pushing the industry towards a predictive, rather than a reactive model of healthcare. By relying on the data collected from the patients, the knowledge and outcomes of the care continuously morphs into an ever-evolving education tool to tell the story of each individual.

Images Courtesy of Lab100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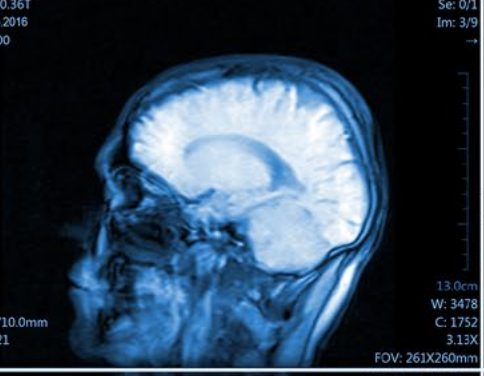
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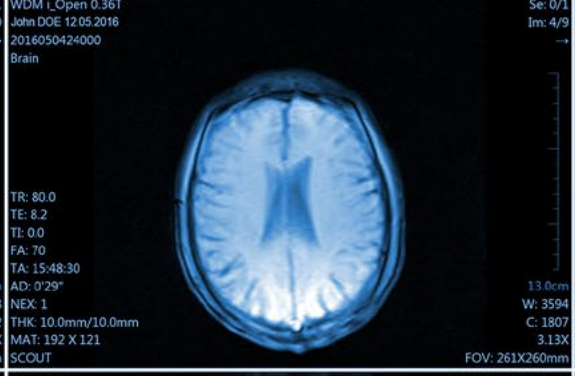
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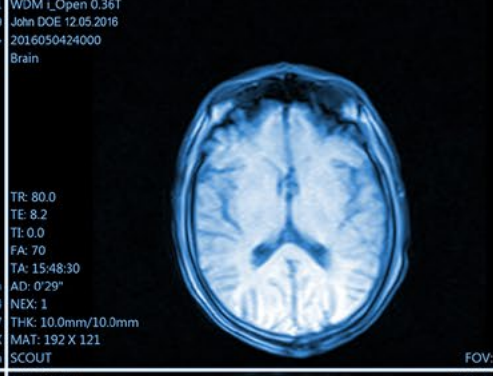
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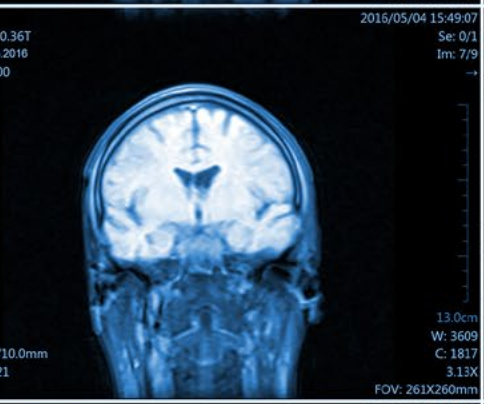
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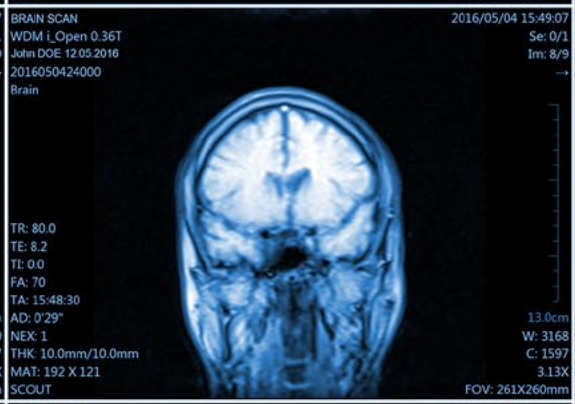
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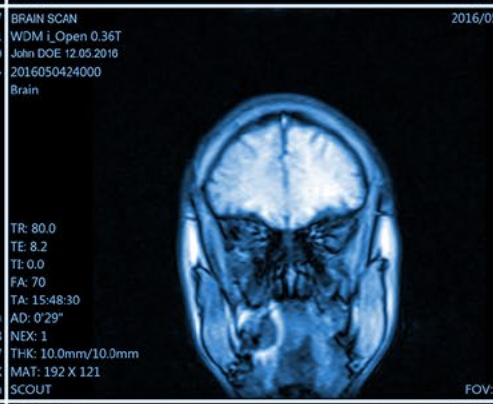
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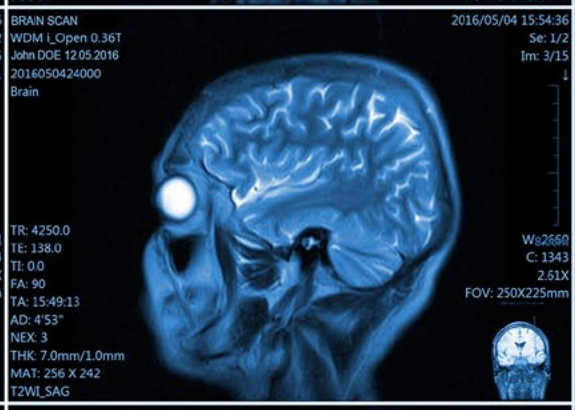
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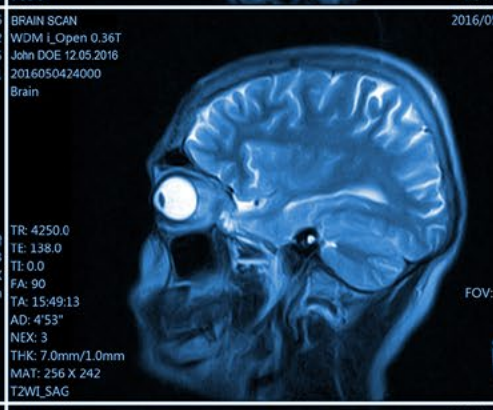
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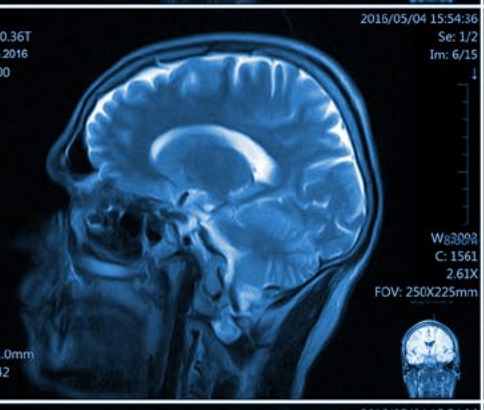
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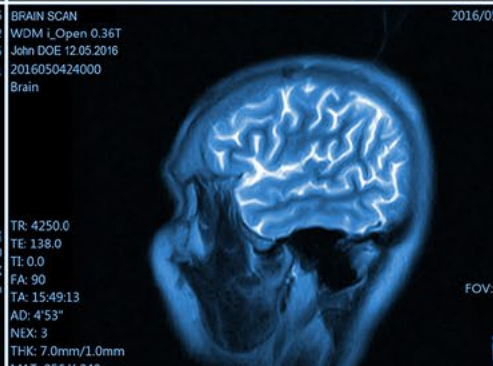
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WHAT CORGAN IS CREATING

Dementia Friendly Environments

According to the World Health Organization, the number of people living with dementia increases every 3 seconds.[5] In the U.S., there are 5.8 million people living with Alzheimer's, which is projected to more than double to 14 million by the year 2050.[6]

In response to this epidemic, there is a worldwide initiative to create *Dementia Friendly Communities*.[7] This program provides organizations a ripe opportunity to reimagine the way spaces are designed for individuals with dementia.

Through a local partnership with Hospice of the Valley, Corgan participated in a dementia care fellowship. Inspired by cities who have become members of the *Dementia Friendly America* movement, this research initiative sought to establish *Dementia Friendly* design guidelines that would enable healthcare organizations to become more knowledgeable when designing spaces for individuals with dementia.

By gaining a better understanding of how dementia affects the brain, designers have an evidence-based process that is rooted in neuroscience. Their initial research suggests that these environments can be enhanced through the clever use of color and lighting, the intelligent selection of finishes and furnishings, the savvy implementation of way finding and layout strategies, and the vital inclusion of outdoor spaces. Designing optimal environments for patients with dementia is also conducive to more social interaction, higher levels of activity engagement, increased focus, and sharpened cognitive functioning. This indicates that multisensory stimulation and physical stimulation are key to designing effective environments for patients with dementia.

The *Dementia Friendly* design guidelines will enable Corgan to implement solutions in their facilities that elevate the experience for those living with dementia and provide much needed support for caregivers. The design insights gained throughout this research will continue to inspire a broader vision for elevating design in healthcare and beyond.

CORGAN IS CURIOUS ABOUT

Design Sound – Not Noise

We are almost constantly processing noise — the sound of freeway traffic in the background, typing keyboards, elevator doors opening and closing, the copy machine down the hall. Most of the time we don't even consciously hear these sounds because they are embedded in the world around us. However, as designers, it's an important element to consider as part of the design process.

Sound has a biological effect on us, especially in a healthcare setting. Studies show that high volumes of noise in hospital settings can slow recovery speed, reduce the amount of sleep for patients and families, and increase the perception of pain.[8]

It's not just the patients that are adversely affected by the hospital soundscape. Clinicians are handicapped by alarm fatigue, learned helplessness and incessant noise which can increase stress and burnout. The average number of alarms heard in a hospital per day is 350. However, 85-99% are false alarms or clinically insignificant.[9] Interestingly, many of these alarms create discordant tones known in classical music theory as "The Devil's Chord".[10]

Sen Sound[11], a research group focusing on the effects of sound in healthcare environments, teamed with Sibley Memorial Hospital to retrofit one of their patient rooms as a testing space — the Tranquility Room. In this room, they were tasked to create a space where patients could imagine the future of sound and sensory experience. After the space was available, they found that staff, doctors, and family members would utilize the space as well to remove themselves from the standard healthcare environment and relax.[12]

Through research being pioneered by groups like Sen Sound, combined with thoughtful discussion and planning on behalf of the design/administration team, we can transform the environment of sound to match the holistic goal of improving quality of life for staff and patients alike.

Speaking of the five senses, Hugo is investigating our sense of smell and how it impacts the way we perceive space.

HUGO

Olfactory Architecture

The association between fragrance, emotion and memory is not just the invention of poets or perfume-makers. This phenomenon is rooted in the very structure of our brains. Our sense of smell is the only one out of the five human senses that is directly wired to the emotion-processing part of the brain.[13] With all the other senses, you think before you respond, but with scent – your brain responds before you think.

Our nose isn't just telling us that someone is baking cookies in the next room; it's helping us determine how we *feel* about those cookies.

This could be due in part to the location of our olfactory bulbs (the structures in our brain that enable sense of smell) which are located near the Limbic System.[13] The Limbic System is a set of primordial structures, including the Hypothalamus, Hippocampus and Amygdala; this part of the brain is responsible for many of our pre-cognitive and subconscious responses.[14]

But more importantly, and of particular interest to Corgan, our Limbic System is also responsible for our spatial memory.[15] A study conducted in 2016 at Tsukuba University suggests there may be a relationship between certain smells and the way we perceive the physical attributes of a room like ceiling height and openness.[16] The fact that our sense of smell and perceptions of space are located within close proximity in the brain presents a unique opportunity to reimagine how we design human experiences.

TSUKUBA UNIVERSITY (2016)
Effects of Smell in Space Perception
Alejandra Vilaplana and Toshimasa Yamanaka

This paper covers the process and results of "The Waiting Room", a study that analyzes if the presence of specific smells has a significant impact in how the room and the waiting experience are perceived. Results show that both scents presented during the experiment affected the room and waiting experience evaluation in different ways.[16]

MCGILL UNIVERSITY (2018)
An Intrinsic Association Between Olfactory Identification and Spatial Memory in Humans
Louisa Dahmani, Raihaan Patel, Yiling Yang, Mallar Chakravarty, Lesley Fellows and Varonique Bohbot

It was recently proposed that olfaction evolved to aid navigation. This research study suggests an intrinsic relationship between olfaction and spatial memory that is supported by a shared reliance on the hippocampus and medial orbitofrontal cortex.[17]


Limbic System
Olfactory Bulbs

HUGO

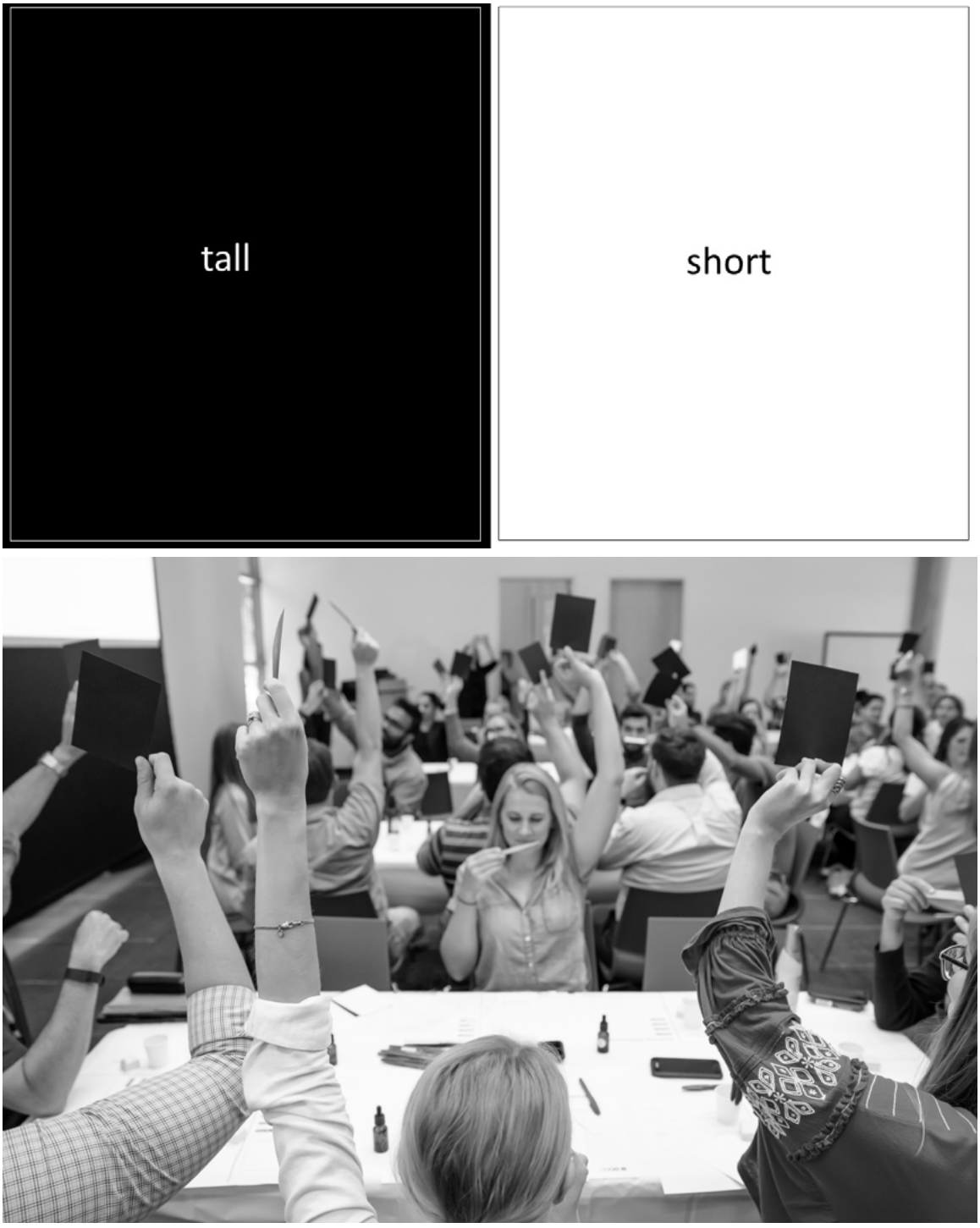
When we design places, we often imagine how they look, function, and the social interactions that occur within them – not how they smell. **When we ignore scent, we are skipping over one of the most powerful ways to experience the world.** Other industries, like casinos, hoteliers, and retail, strategically use the power of scent marketing. Wineries and perfumeries have even developed their own language for smell over centuries; however, an industry leader in the field of architecture has yet to emerge with a comprehensive strategy for olfactory design.

Between the modernist approach to architecture (which has eliminated scent through air control systems and antiseptic surfaces) and a digital future that is primarily focused on visual and audio design, there seems to be no place for aromas and fragrances. But how human-centered can a building be when it ignores one of the most powerful human senses?

Hugo is investigating how we can use our sense of smell to inform the way we design buildings. For example, how might we incorporate scent into airport security design to improve wayfinding? Can the memory of scent be used to help design a facility for patients with dementia? Do certain textiles and textures "smell" a certain way? Are there certain scents that combine best with afternoon lighting, alleviating the 3 PM afternoon slump?

Hugo has launched a series of olfactory experiments designed to test for architectural expressions of scent and its potential use as a design tool. These experiments seek to understand scent within the context of: perceptions of space, impact on mood, connectivity between different spaces, wayfinding, and pigment/texture associations of scent. We hope this research project helps us to better understand how our sense of smell can impact the way people experience the built environment.

Check out the following experiments we conducted with Corgan employees.

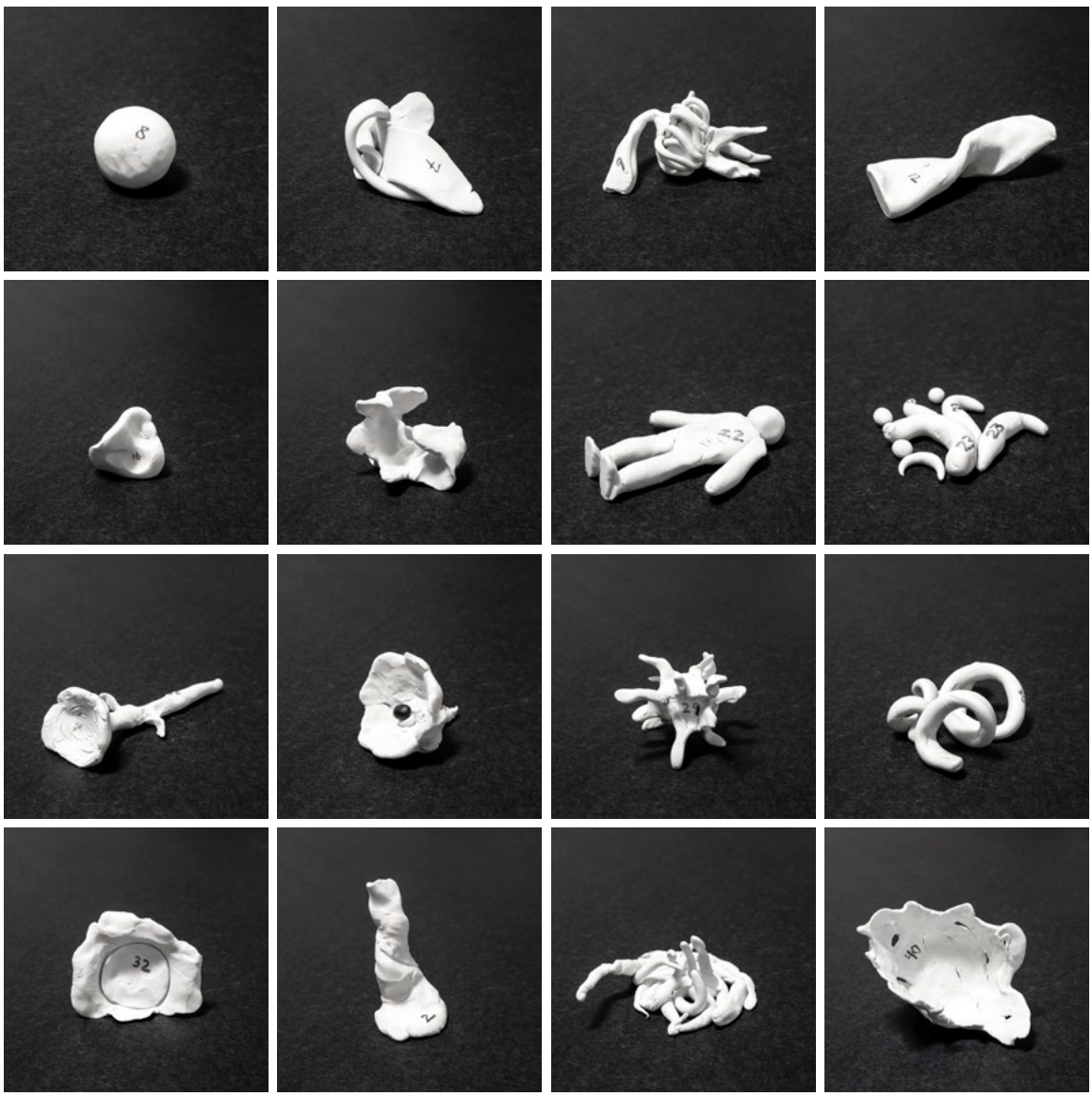


Research participants were asked to describe a scent by choosing one descriptive word over the other. Is this smell… *Hot or cold? Tall or short? Straight or curved? Open or closed?*

HUGO

The shape of a smell.

Research participants were then asked to take a ball of clay and mold it into a shape they believe best represents the scent of their choosing.



WHAT CORGAN IS CREATING

The Clinic of the (Near) Future

The primary care clinic has virtually gone unchanged for over 50 years. With the exponential growth of technology and related industries, Corgan started to pose the question — why has this clinical care model remained the same for so long?

Our healthcare team recently had the opportunity to explore this question in more detail when a client asked us to envision a "Clinic of the Near Future." The term near future implies a forward thinking mindset that is also grounded in realistic expectations of what technological capabilities might be and how user needs will adapt to them. This can often be a harder ask than envisioning a fantastical future with flying cars and teleportation, because we are acknowledging the restrictions of technology today. Thinking in the near future requires a nuanced understanding of expectations and risk.

So let's take a look at where a patient's journey begins.

We've all probably heard that the customer's journey starts the exact moment they interact with your brand for the first time. Digital platforms mean people can experience your services before they necessarily enter the physical brick and mortar location of your facility; and a healthcare clinic is no different.

Patients can review your services ahead of time and decide whether they will select your services or not. If they do choose your clinic, they can schedule an appointment online, where they can enter their personal information ahead of time. The emergence of ride-sharing and autonomous vehicles means that clinic-provided services can dispatch pick up and drop off for patients as well.

On the day of their appointment, they can receive live updates of the patient queue and other pre-check in responsibilities, reducing bottlenecks in the waiting room. Upon arrival a concierge will greet all patients and escort them to kiosks which will automatically collect heart rate, blood pressure, anthropometrics, and body composition data. This will reduce or remove the need for a standard waiting room and will reflect a more inviting, hospitality-feel.

For minor symptoms, fast track rooms will be provided for those who may not need a full examination. This will expedite the time required with a percentage of the patients and will increase patient intake.

The standard patient room is configured to comfort and education to help reduce stress in the exam rooms. Technology will be available for supplemental visuals while artificial intelligence assists with exam charting/recording and diagnosis. Since productivity is more efficient, space planning can be reallocated to different amenities or reduced altogether.

Collaboration spaces for the staff encourage internal discussion with the collective nurses and providers while providing needed amenities that encourage staff retention. Respite rooms will allow staff to take incremental breaks that enhance productivity and reduce fatigue.

As patients get ready to leave the facility, it's important that their discharge process is personalized. Patients will receive a narrated record of their visit for reference and medications deliveries can be brought directly to the patient by an AI-enabled assistant. Options to provide delivery prescriptions or prescription vending are viable options as well. When exiting, the clinic-provided vehicle will be waiting to return the patient home. Patient follow-up will be automated and used predominantly for preventative care. Via a mobile app or clinic-provided wearables, remote monitoring can be done from home and transmitted to the staff. Should additional questions arise, discussion with the providers can be requested.

While this might seem technologically advanced, our understanding of emerging technologies reminds us that this patient experience is not far from becoming a reality. As architects, we want to be ready to invite that change as it develops in the near future.

CORGAN IS CURIOUS ABOUT

The Connected Hotel

Hospitals can be hectic. They're not necessarily places we travel to for peace and quiet which can be stressful when we're trying to recover from an illness; however, the Connected Hotel model offers the respite a traditional hospital room might not, and with it, a holistic approach to patient care.

There are many times a patient does not necessarily warrant an entire patient room with 24/7 nursing care but it's the only option the staff have. In this scenario, the patient ends up paying an average cost per night of around $2,500.[18] To make matters worse, hospitals can be noisy with plenty of interruptions and distractions which reduces the amount of sleep and recovery a patient can get. Not to mention the risk of exposure to hospital-acquired infections and other illnesses.

A Connected Hotel, sometimes called a "recovery hotel," is closer to $142 per night and is located in close proximity to the hospital in case of an emergency.[19] Trained staff are available if needed and patients enjoy other added benefits like more sleep (due to less noise and interruptions), reduced exposure to hospital infections, and their families have better access to the patient's facilities — even if a patient requires a traditional hospital room with 24/7 nursing care, having a hotel adjacent to the hospital can allow for sleeping arrangements as well as a place to bath and wash clothing. It's important to consider the family's experience when designing healthcare environments because family participation in a patient's care process is proven to improve health outcomes.

Lower costs combined with improved outcomes make the Connected Hotel a promising hybrid of hospitality and healthcare services. This cross-disciplinary approach to patient care reinforces one of the pinnacles of innovation: two heads are almost always better than one.

WHAT CORGAN IS CREATING

Flooring Study

In a hospital, cleanliness is paramount and it includes every detail down to the flooring.

It needs to be easy to clean and maintain while being incredibly durable, resistant to heavy traffic, and minimal rolling resistance to handle the flow of patients, staff, and equipment. Another element to consider is that constant hospital activity introduces sound, which as we established earlier, can be challenging for patients who are trying to recover.

Hospital flooring is a particular topic of interest within the healthcare design field. In 2012, The Center for Health Design's Research Coalition examined research findings, industry standards, and best practices related to floor coverings. **They discovered that there is no evidence to support the selection of a specific flooring type as the ideal across the healthcare facility.** Rather, there are trade-offs associated with each desired performance characteristic that may conflict with other EBD goals.[20]

While working on the DUNN Tower Refresh project at Houston Methodist Hospital, the team of Corgan designers ended up researching this topic. They were asked to renovate levels 7-10 and set out to update the finishes in patient sleeping and rest rooms, nurse stations and public corridors.

The client also requested carpet flooring throughout the corridors on three of the floors; however, the team learned that one of these floors would be used for organ transplants and therefore would require sheet vinyl flooring by code. Corgan's healthcare team identified this as a unique opportunity to research the topic a little further and, in turn, elevate the firm's evidence-based design practice. The team of designers ultimately wanted to find out: Is there a statistical difference in sound creation between carpet and vinyl flooring? Do patients and staff significantly notice the difference?

This research is still ongoing and methodologies include:

- A series of surveys that will assess patient, maintenance personnel, and staff perceptions
- Decibel readers to measure the sound levels within corridors
- Resistance scale to measure the ease of roller mobility for equipment

It is important to note that this study is not intending to examine the disinfection or sanitation ease of the flooring materials (although the CDC hasn't identified flooring as a high-risk surface for hospital-acquired infections (HAIs), and there's no conclusive evidence to link flooring to HAIs). Once the project is completed, the team will be analyzing the data to understand and compare the effects of the two different materials.

It's anticipated that between the two material types used in Dunn Tower, there will be trade-offs found. Where carpet may have a greater effect on noise reduction, sheet vinyl will allow less rolling resistance and may be perceived as cleaner. Based on these findings, the trade-offs of each material type will need to be looked at within the context of desired outcomes for a specific healthcare space.

Carpet Flooring

Vinyl Flooring

CAN YOU IMAGINE...

If a personal AI assistant prepared you for heart surgery?

We begin our story at the home of Mary. Mary has been living with a chronic heart condition. Her AI companion, Jody, assists her with the daily management of her condition. Since Mary lives alone, Jody helps her track medication time and type, regularly checks heart rate and blood pressure, prompts for physical exercise and healthy eating, and monitors Mary for signs of emotional distress. In a series of thoughtful questions, Jody's programming allows her to either help make adjustments or wirelessly contact Mary's care team if the situation requires it.

Right now, Mary is getting ready to receive heart surgery at the local hospital. As the surgery nears, Jody has made adjustments to Mary's routine to ensure her surgery preparedness is effective. Jody can order prescribed medication on Mary's behalf to have it delivered by drone to her home. Jody is also able to order the Uber for Mary on the day of surgery and will alert the facility that Mary is on her way when she leaves.

As soon as Mary enters the hospital, she is automatically checked in through facial recognition software. A message to her phone welcomes her and provides augmented, turn-by-turn directions to her room where staff will meet her. If she would like, autonomous wheelchairs can be hailed and will drive her to her room.

Since the room *knew* Mary was coming in for surgery and that she might be a little stressed, the lights are adjusted to a warm color temperature, soft music is playing in the background and the subtle scent of lavender fills the room. Mary's favorite color, green, washes the footwall and the artwork displays scenes from some of Mary's favorite paintings. **These preferences were set up by Mary with a few simple questions from her AI companion, Jody, before Mary ever entered the hospital.** Should Mary have to come back for a subsequent stay, "her" room will always be there to welcome her.

A holographic avatar of Jody is standing in the room when Mary walks in. Sometimes, it's just nice to hear a familiar voice. She asks Mary if she would like her to warm up the room. **Jody has set the temperature to match that of Mary's home but**

perhaps she would like it a little warmer. While Mary is getting comfortable, Jody has "hailed" the care team who assemble in Mary's room. The doctor introduces the care team to Mary. "These will be the nurses on staff during your surgery, this is your anesthesiologist, etc." With the whole care team in the room, the doctor walks Mary through the procedure while showing a holographic video of the process. Mary is able to express any hopes or fears she may have to the entire team and get validation and answers. The majority of the care team leaves to prep for surgery and one of the nurses stays behind to get Mary ready for surgery.

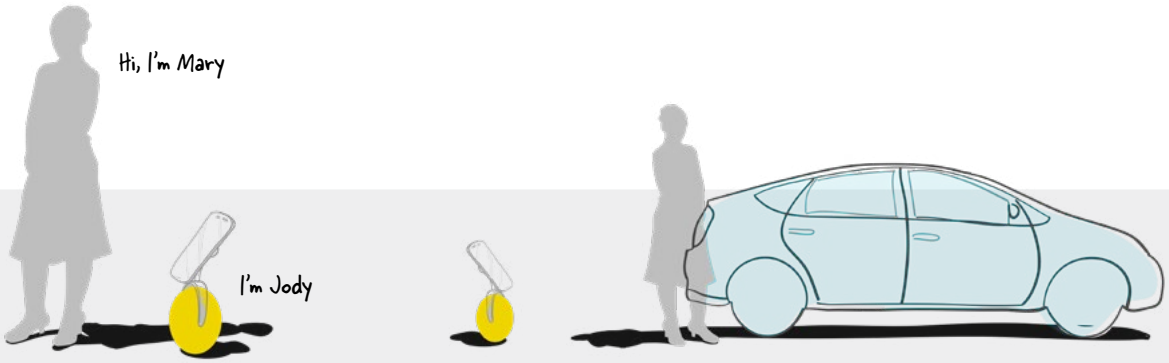
We will take a side trip now with the staff as they head to the OR's. With the assistance of artificial intelligence, staff shortages have not affected positive outcomes. OR suites "know" what procedure will occur in the space when and which physician and care team will be performing the surgery. Lighting levels and placement are adjusted by the room's computer. Automated supply tables wheel themselves into the OR suite. **The patient's information and real time status are displayed on the walls.** The augmented reality allows the staff to see the data from any position. An AI surgery assistant provides "Watson-esque" data base for QA/QC and helps improve performance. Robotic assistance allows staff to be reduced to only three members during the operation: the surgeon, a nurse and the anesthesiologist.

From the OR to the patient room, rooms are scanned for microbes and contaminates. Air quality is carefully monitored by the building's computers. Environmental service bots and smart surfaces reduce hospital acquired infections to almost zero.

Back to Mary; after the nurse completes her hook-up and IV, the automated patient bed transports Mary to the OR with her single nurse escort. Mary will be constantly monitored by artificial intelligence which will be able to actively extrapolate her data and communicate it to the care team. All charting is handled by the AI freeing up the nursing staff to spend more time with Mary. While Mary is in surgery, her room will automatically adjust lighting, sound, color and smell to a post-op supportive space. Since Mary is being monitored by AI that is actively communicating with the care staff, the need for incessant beeps and alarms is removed. The quiet, tailored care environment supports the patient and the care staff.

After Mary's successful surgery and post-op recovery, she is able to check out at her convenience through her device with digital service payment. This alerts Jody's nurse who is able to come wish her a speedy recovery and make a human connection without worrying about paperwork and payment. Jody is able to call her autonomous vehicle and Mary is able to direct an autonomous wheelchair to take her to the vehicle. **When Mary gets home, Jody has been programmed with all the necessary post-operative information, and prescription dosing, and is able to help Mary remember everything and oversee her condition to ensure there are no complications.**

We believe the future of artificial intelligence will allow humans to have more time for empathy and connection and let the machines do the menial tasks that distract and burn-out so many care teams and physicians today.



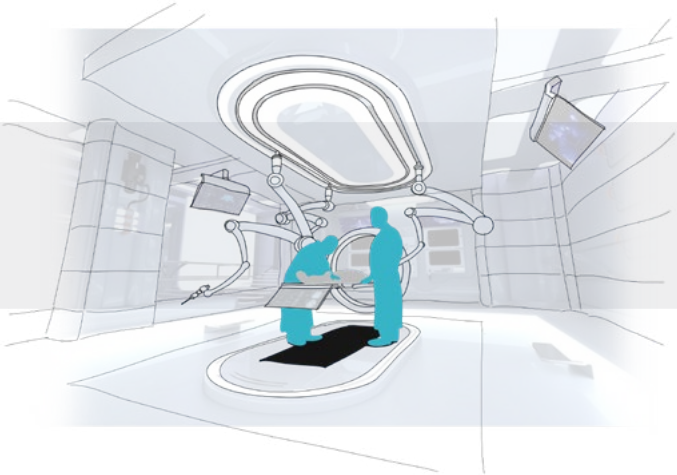
Artificial Intelligence (AI) can help track medication intake, remotely supervise heart rate and blood pressure, prompts for physical activity, and monitors for any distress.

AI can assist in patient tracking. Users can agree to monitoring while using devices. This will help staff estimate time of arrival, and can provide amenities to the patients increasing satisfaction scores.

Recovery will be aided by AI as well; the room will adjust to optimize recovery, staff will have more time to spend with the patients to assist in educating them on the recovery process, and a post-op recovery plan will be presented.

Once vitals are stable, and the surgeon clears the patient for discharge, the patient is automatically checked-out and is escorted to an awaiting vehicle to deliver them back home. Post-operative information is already programmed at their home and will oversee recovery conditions and ensure there are no complications.

Upon entering the hospital, facial recognition, biometrics, and automatic check-in can occur to help reduce or remove waiting times. Automated assistance and wayfinding are available to calm patients and remove stressors.



Within treatment areas, AI will assist in dictation and charting, build personal treatment plans for the patients, assist in quality control of the procedures, and monitor the environment for any contaminates.

AI can prepare the room before arrival for optimum comfort and control. Lights, temperature, humidity, smell, sound, imagery, water temperature; all elements of the environment can be controlled at or before each visit.

06

CURIOSITIES IN INTERIORS

"We don't have a lot of time on this Earth! We weren't meant to spend it this way! Human beings were not meant to sit in little cubicles staring at computer screens all day, filling out useless forms and listening to eight different bosses drone on about mission statements!"

- OFFICE SPACE (1999)[1]

What to expect

Welcome

The Interiors Market Sector at Corgan is focused on the ever-evolving places where people do work. The pallet of these 'places' is continuing to expand, enabled by smart phones, reliable WiFi and improved online collaboration tools. We focus on working in partnership with our clients to make big and small transformations in their workplaces. In simplistic terms, these transformations are driven by changes in how technology, culture, and disruption are affecting their organizations. Our interiors studios, located in seven cities around the country are working on projects that are impacting the daily lives of hundreds of thousands of workers. What excites us most about the current state of our industry is the lens we are viewing projects and strategies through is that of those workers – the individual. Workplace strategy was historically measured in square feet per employee across a portfolio as well as dollars spent on 'churn' within a facility - today it is measured in employee engagement, innovation, wellness and retention. That is exciting. We have grown our practice accordingly with experts in strategy, change management, wellness, lighting design, and branded environments to bring deeper knowledge in the areas that impact the 'new' metrics of workplace design.

Across our practice, our clients are embracing (sometimes more like wrestling) technology in their industries. From our tech platform driven clients in Austin to Fortune 500 headquarters projects in North Texas to niche co-working companies in the Mid-West and entertainment companies in California – the impact of technology is among the first discussions we engage in. Understanding the nuances of mobile and distributed work, how employees meet, and the role of co-creation with

clients are just a few of the topics we are covering in the earliest stages of projects. Creating shared expectations for the current and evolving role of technology in each space is something we are focused on – constantly evolving the best practices for gathering this data.

The barrage of information delivered via technology to each of us today has led our team to deep curiosity about the consequences it is having on the health and wellness of American workers. The study of Circadian rhythms as a measurement of health and vitality and the effect our interior environments have on those rhythms is worthy of our continued consideration and focus. In the following pages, we will touch on the power of Circadian lighting – but the larger area of study digs into managing our energy and cognitive resources throughout the day. Understanding the impacts of distraction and interruption as well as the power of respite and rejuvenation on our ability to engage in the type of deep thinking that leads to innovation is what we are committed to studying and incorporating into our work.

The recognition that one size does not fit all, that you can't align work style with generation puts us in a place to work closely with our clients to truly understand what will move the needle for each organization. Emerging sets of data will help create better, healthier, more flexible, more sustainable and inspiring places to do work.

I think we can all agree work is now a thing you do, not just a place you go. But we haven't yet reached the solution of what the most effective and healthiest menu of spaces is – and how to align technology that optimizes performance within that variety, working alone and in groups. All the while we must keep the next generation of workplaces responsive to continuing changes in the world around us – getting us one step closer to places that can be truly responsive to each individual variable preferences and needs – whether they can recognize them on not. That's what's next.

- Corgan's Interiors Leadership

CORGAN IS CURIOUS ABOUT

Material Metamorphosis

Materials make up our world. Where are you at this very moment? Surrounded by the hypoallergenic cotton sheets hugging your bed, or perhaps teetering in your Pellicle mesh wrapped Aeron chair? Though we may disregard the millions of microorganisms we approach daily, they do exist and impact our world and health tremendously. Over the past few decades the evolution of products and materiality have exponentially developed, due to advances in nanoscience.

Health Enhancing Materials

Disruptive innovations, such as, Celliant®, have inspired new applications and approaches to the textile industry. "Celliant® is a revolutionary, patented technology which utilizes a blend of minerals and proprietary ingredients embedded into a fiber's core. The embedded minerals convert the body's natural energy (heat) in infrared (IR) light and reflect the IR back into the body's tissue and muscles."[2] Celiant has been shown to, "increase tissue oxygenation by as much as eight percent, which helps the body, recover faster from physical activity, increase energy, endurance, stamina, and performance and promote restful sleep and increased comfort."[2] Celliant infrared technology and its benefit to those who sit for extended periods of time takes performance fabrics to the next level: health-enhancing materials."[3] Evolutions in the textile industry have created a platform for synthetic fibers to conduct a whole new world of healing, and sensory materials. Just imagine, your future pair of favorite slacks, can also serve as a wellness attribute, while potentially tracking your every movement…

Evolution of Product Development

Each industry has its own lifespan. Architecture can stand the test of time, where as, fashion is two years ahead and changes seasonal. Interior space falls somewhere in between. As we progress into the future landscape, we anticipate product life adapting with the ever-changing environment it serves. Based on feedback from Mohawk Industries, Jackie Dettmer, VP of Commercial Product Development and Design, predicts, "product life will decrease, as ease/accessibility increase."[4] There is no longer a need for carpet to last 15 years in a space with a 5 year lease. We anticipate products falling into two categories, timeless/neutral or trend-adaptable/momentarily relevant. Will we eventually have spaces that constantly evolve to match the pace of technology? Products will eventually serve multiple purposes, such as sensors embedded into carpet backing to create a heat map of traffic patterns to study durability patterns, among endless other curiosities.

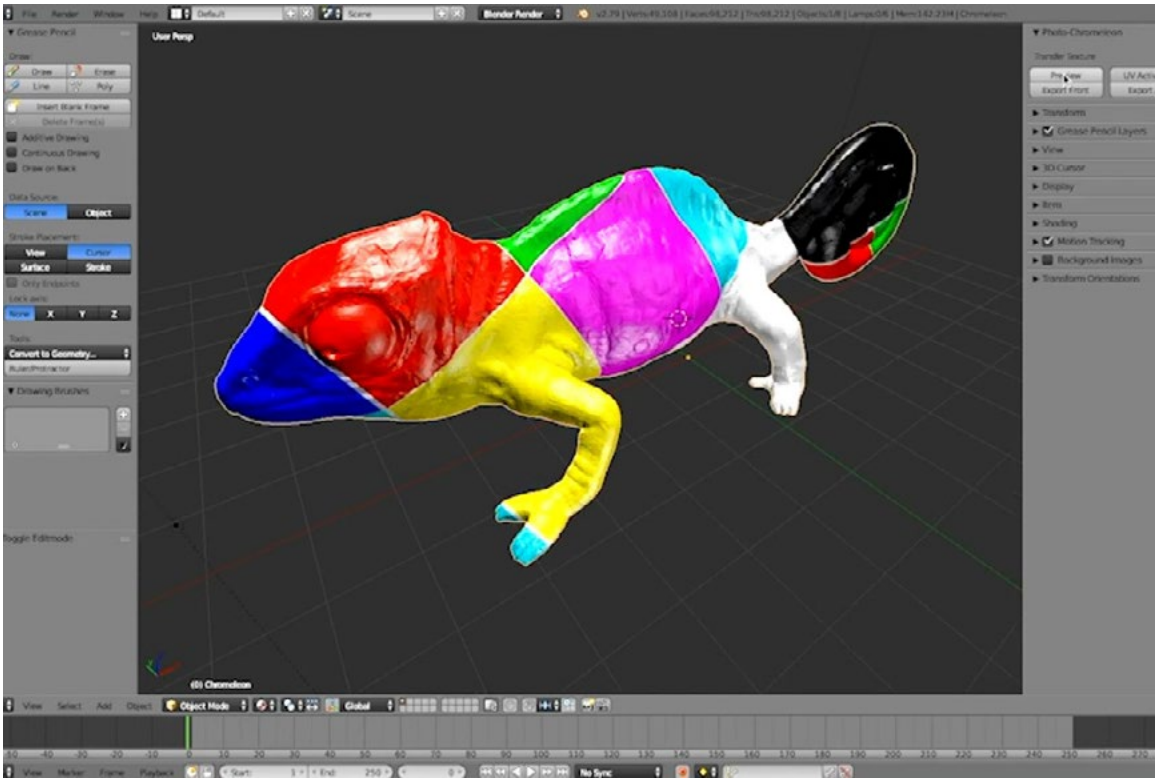
Not only is the pace of product life changing, but the innovations derived from scientific and technological exploration, is rapidly emerging. Recently, MIT's Computer Science and Artificial

Intelligence Laboratory (CSAIL) has invented, "a new system that uses reprogrammable ink to let objects change colors when exposed to ultraviolet (UV) and visible light sources. Dubbed 'PhotoChromeleon', the system uses a mix of photochromic dyes that can be sprayed or painted onto the surface of any object to change its color — a fully reversible process that can be repeated infinitely."[5] Picture the future walls surrounding our interiors, covered in a flexible canvas, constantly adapting to users, reacting to a living organism.

"Material Ecology," a term coined by Neri Oxman, Sony Corporation Career Development Professor and Associate Professor of Media Arts and Sciences at the MIT MediaLab, "considers computation, fabrication, and the material itself as inseparable dimensions of design. In this approach, products and buildings are biologically informed and digitally engineered by, with and for, Nature."[6] A few projects include "Printing Living Materials" – where synthetic biology is utilized to understand emergence of highly adaptable objects,[7] or "Water Based Additive Manufacturing" – which create "fabricated objects that may be chemically stabilized or dissolved in water and recycled within minutes. Applications include fully recyclable products or temporary architectural components, such as tent structures with graded mechanical and optical properties."[8]

This biological material revolution, will serve as a platform for a spread of entirely new approaches to the worlds we design.

Images Courtesy of MIT CSAIL (HCI Engineering Group)



WHAT CORGAN IS CREATING

It's Brain Science

The average employed American will spend approximately 90,000 hours working over their lifetime.[9]

For corporate America, most of those hours will take place in an office, likely an "open office" of some sort. Opinions on the open office are prevalent, but true research on the American corporate office is hard to come by.

The Brain Performance Institute (BPI), an offshoot of the Center for Brain Health, a nonprofit research entity of The University of Texas at Dallas, has a different perspective on successful workplace design. BPI utilizes research to help unlock the potential of healthy brains and improve brain performance. The workplace and its impact on brain performance, is one of their many focus areas. What is a "Brain Healthy Workplace"?

The science says most of us need quiet to focus on tasks requiring deep thinking however, this isn't the case for all. Science also says 45 minutes is the maximum amount of time our brains can do this type of thinking at its highest level.[10] Did you know most people lose focus in a meeting after 20 minutes?[11] Ultimately, our brains need time to recover and reset between bouts of deep thinking—the kind of thinking that leads to innovation and new ideas.

Jennifer Zientz, head of clinical services for the institute explains: "While the science is helping us to understand environmental conditions for optimal performance, the truth is that we are currently working with the brain we've built. It may be surprising, but much of the way we function in the modern workplace is toxic to our brain health, and this translates to a cost on our performance."[11] Having a choice of space dependent on type of task may help to mitigate negative effects.

Corgan and the Brain Performance Institute worked together to design the Smart Space Experience, an activity geared to educating users on how their unique brain functions in a typical work environment. Participants are put into an environment, mimicking a private office and given three tests, each measuring cognitive function relatable to the tasks we often perform at work, such as multi-tasking and focusing. Then, the environment is altered, to mimic a louder, more open office type of environment and the tests are conducted again. Each participant can see, and experience, how their brain performs on various tasks in different environments.

Our hope for this activity, as designers and strategists, was to find the magic formula by which to allocate square footage among social, learning, individual and collaborative spaces. Instead, we found inconsistency was the only true common denominator. Generation, gender, tenure, leadership position, and other commonly studied categories did not make a difference in the results. Instead we found what the Brain Performance Institute already knew, that users are responsible for their own brain health and performance, both inside and outside of the office. Our goal as designers, is to create enough variety to allow all employees to choose the space to best facilitate their brain performance.

CORGAN IS CURIOUS ABOUT

Enlighten Us

Throughout most of human history, we've only been able to access natural forms of light like sunlight and fire. But today, electricity illuminates the way we perceive and experience the world around us. More and more, we are starting to see shifts taking place within the field of lighting design. As certain technologies evolve, the industry is taking a truly scientific approach (independent of manufactures) to examine the ways light can enhance our experience within the built environment.

Circadian Lighting

Our circadian rhythm is a roughly 24-hour internal cycle that helps our body determine when to engage in certain activities like sleep, eating and focused work.[12] Our circadian rhythms respond primarily to levels of light and darkness which poses an interesting opportunity for lighting designers. Our approach to lighting will become increasingly important as we consider things like 24-hour work cycles in healthcare, virtual workspaces, and the future of dense urban living.

Circadian lighting has the ability to augment our bodies clock not necessarily reset them. One way to achieve this is with the use of different light temperatures throughout the day. For example, the morning might feature a warmer 3000k light that resembles the natural look and feel of a sunrise. As morning progresses into midday, a cooler light temperature of 5000k could be introduced to enhance peak performance and focus. As the late afternoon approaches, the cooler light will shift back towards a warmer 3500k to account for sunset. This cues the user of the space and lets them know it's almost time for their return home and anticipated relaxation. The goal of this circadian lighting strategy is not to replicate the sun exactly, but to have artificial light work in conjunction with natural patterns.

Another way to incorporate circadian lighting is through the use of natural daylight and outdoor scenery. Not only does this integrate natural patterns of light into the space, it also provides the user with an opportunity to pause for mental resets (see Attention Restoration Theory in Corgan's education sector section).

Tunable White Light

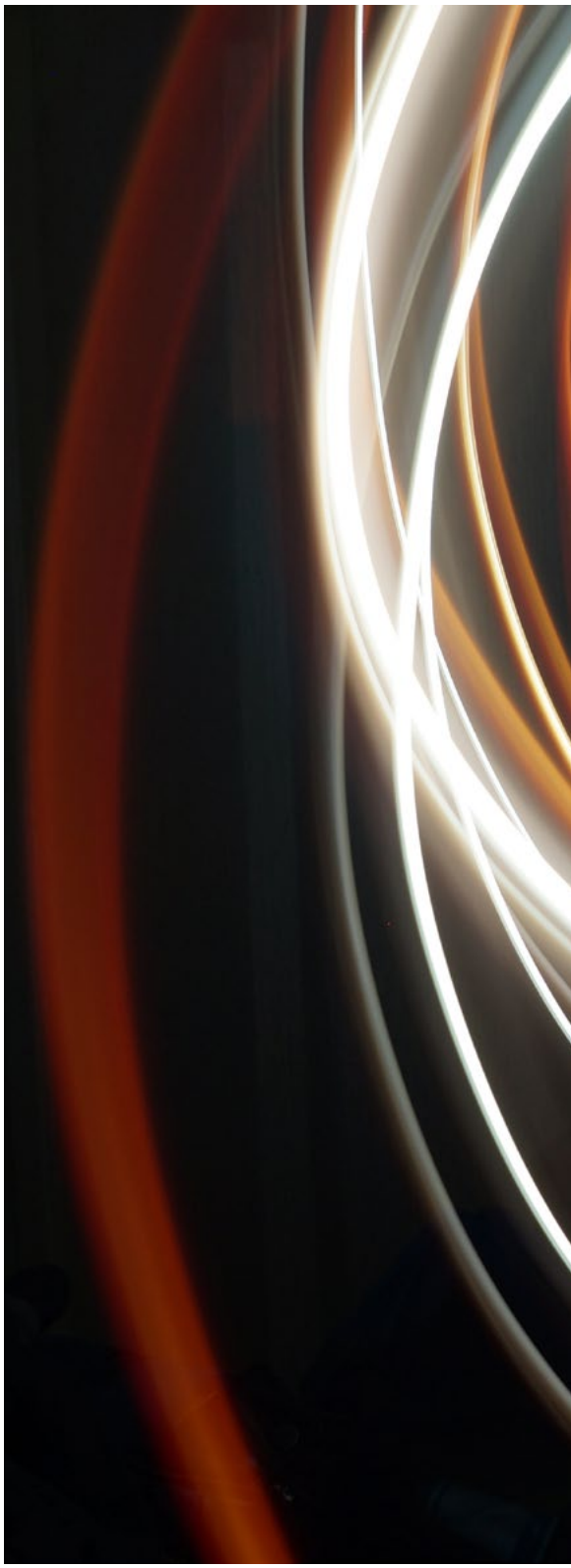
Lighting preferences are personal. In a world of customization, people want options. But most of the fixtures we use today have set color temperatures that are determined at the time of specification. Until recently, tunable white light required the use of three to four LED chips: red, green, blue, white. The technology has advanced and now a single chip

can produce the entire range of white light required. This simplifies the production of LED, and the controls necessary to create a white color range. Now a single chip can provide a broad range of light between approximately 2800k and 4100k; or warm to cool.

Internet of (Illuminated) Things

Light fixtures, like other smart devices, are becoming internet enabled. Since light fixtures tend to layout in a grid pattern, a network of these smart fixtures could then become a data gathering "mesh" that can track objects, temperature variations, light levels, occupancy, and movement of materials and people. If an object has a tag, it becomes an identifiable asset and not just an object.

The light fixture grid pattern also creates a network mesh that can be used to create light signal intranet or LIFI[13]. Unlike current WiFi that is a radio signal, light powered data would use a form of infrared to communicate with devices. This requires a connection from fixtures to devices based on a line of sight. This means the data transfer would work if the fixtures can see the device. For security purposes, only internal users could access the network, unlike WiFi that can exceed the areas perimeter.



WHAT CORGAN IS CREATING

Subscription Real Estate

With the increasing popularity of models like WeWork and Common Desk, we are seeing the emergence of a new type of firm: one that offers flexibility and varying amenities.

Vari

"Finding a better way" is more than just a motto for Jason McCann, CEO of Vari. Disrupting the way workspaces are designed became his mission when he decided to start manufacturing manual standing desk convertor. This allowed for all of the functionally of other sit/stands desks, but at a fraction of the cost. Vari has since expanded its initial offering to include electric sit/standing desks, conference tables, modular walls, lighting, and accessories.

Recently, Vari took their idea of "finding a better way" one step further. They decided to include a unique real estate offering — "space as a service," elevating the way businesses approach workspace. Vari recently decided to purchase the 315,000 square-foot former Zales headquarters located in Las Colinas, Texas, and enlisted Corgan to reposition the building from a single-tenant headquarters into a multi-tenant destination — VariSpace.

VariSpace was reimagined as a simplified alternative to buying furniture, and funding tenant improvement overages. Their concept allows for companies interested in short and long-term leases, fully furnished-turnkey flexible solutions, and best in class amenities in agile/move-in ready workspaces. Flexible lease terms accommodate a variety of tenant needs ranging from temporary/ swing space to a more permanent, long term solution. The space is pre-furnished with the Vari product line and the ceiling mounted electrical grid allows for tenants to easily reconfigure, offering ultimate flexibility as business and space needs change. The amenities include a café, coffee bar, tenant lounges, fitness center, outdoor park, and outdoor walking trail that fosters a sense of community among all building tenants.

Has Vari found a better way? Initial success is evident in the 98% pre-lease of Vari Las Colinas. The space is attracting technology companies, and startups who need to optimize their space as their needs change. Vari is expanding this concept into another local market where they have purchased a 380,000 square-foot building that will be available to lease in summer of 2020.

Vari designed by Corgan


LODGIC℠
EVERYDAY
COMMUNITY

Lodgic Every Community

"Work Smart, Eat Well, Live Flexibly" is the tag line at Lodgic Everyday Community and their answer to work-life blend. Created by Moose International, Lodgic Everyday Community fulfills the mission of Moose International by serving the needs of the modern family. The resulting space enables members to work, dine, grab a coffee, and provide educational daycare for their child, all under one roof.

Lodgic Everyday Community is designed to help you "outperform your daily routine". Coworking provides alternatives to typical office environments or working alone at home. In a world of distractions, one can find a quiet corner for focused work, or at an open desk with access to phone booths. Larger groups can expand or contract quickly as market factors, and employee counts shift. With shared amenities, and the freedom that comes with short-term commitments and flexible terms, coworking has become an attractive workplace alternative for startups, and multi-nationals alike. For property owners, coworking provides revenue-generating method to offer amenities and services in a managed space for the benefit of their tenants.

Technology has enabled users the flexibility to work from anywhere, tailoring their environment to adapt to their preferences for the current task at hand. We ask ourselves, what will the future landscape of work look like? As quickly as change is evolving, our standard real estate model is making a shift as well, which will innately have a direct impact on our current business model, the question to ponder is, "How will we adapt and grow with our evolving industry?"

Lodgic Everyday Community

CORGAN IS CURIOUS ABOUT

Gestural Technology

Gestural technology allows users to utilize simple gestures from fingers, hands, and body movements to control and operate devices. While this technology has been with us for a while, advancements in AI, and biometric technologies are rapidly developing its abilities.

Gesture recognition technology serves a wide range of user interface scenarios. This is because most of our electronics are being designed and integrated with one or more cameras which take us from the 2-dimensional world into the 3-dimensional space around that device. This enables the "mathematical interpretation of a human motion by a computing device."[14]

Take for example, Hitachi's new hand gesture technology that authenticates a user's hand-motion by using ambient or infrared light to detect personalized vein patterns.[15] Their technology is a proposed solution for banks to replace passwords with gestural authentication when authorizing transactions. It's similar to an iPhone that unlocks it screen with facial recognition.

Some other examples of gestural technologies include:

FIBARO SWIPE™ TABLET

SWIPE™ detects not only simple moves, but combinations of moves as well. Raise your hand, and swipe it down to turn off the lights or move your hand up for the color LED lights to turn on. Swipe to the right if you want to turn the TV and other electronics off.[16]

BMW 850I IN-AIR GESTURE CONTROL

To control the volume, take one finger and spin it in the air above the center stack. Put two fingers up – like a flat peace sign – and the screen turns on or off. Make a fist and open it twice to load the navigation or phone.[17]

We can only predict that our future interiors will be surrounded with integrated gestural technologies that facilitate seamless user interactions.

WHAT CORGAN IS CREATING

Space and Things Influenced by Technology

The only certain thing is change. The adaptation to that change can be emotional for some, exciting for others, and met with resistance for many. But how has technology contributed to this change?

Immediate thoughts may be things like neck and back pain from looking at our phones and computers all day or your super new 72-inch OLED TV you picked up on a Black Friday deal. It's true, technology has infused the world with remarkable connectivity and it comes with its perks, and, inevitably, some downfalls. As technology changes, our spaces have undoubtedly morphed as well.

Technology in the workplace is widespread. From the moment you badge in with your employee ID to permit access to the building, to digitally "checking-in" on the room scheduler on your way into a meeting room, spaces are now run through technological assistants. Even the coffee maker has a display screen allowing me to customize my latte, all at the push of a button! It's safe to say that technology is now ingrained in our culture and in return, it's become a natural extension of support in the workplace. How have spaces morphed to adapt?

The butterfly effect of technology on spaces and products has been quite profound. The JXC (JDA Software Customer Experience Center) was built completely around showcasing technology – featuring the latest, greatest in supply-chain management software, robotics, AI, drones- you name it. Not only was this playground of tech limited to the Experience Room itself, but the support functions necessitated programmatic requirements such as "information overload" or "imbedded tech" or "total flexibility". New spatial typologies have even developed from tech itself. Everything from video production rooms with cyclorama walls to audio (podcast) rooms, or how about Southwest's Listening Center- a space dedicated to tracking social media outlets. Freedom Financial had the programming requirement for a "Wow Room"... how large should that be? What's in it? What do we space plan for a "Wow Room"? These are all bridges we've crossed as workplace designers, and the sky's the limit.

JDA Customer Experience Center

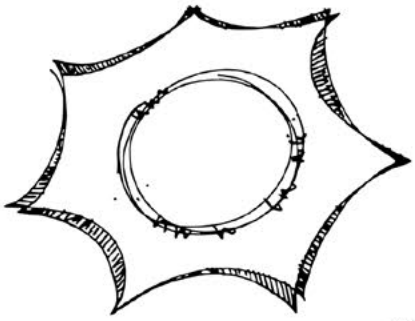
CAN YOU IMAGINE...

What your commute to work looks like in 2050?

Welcome to a day-in-the-future-life of the world of workplace. As the desire for amenities, flexibility, and choice increases, we imagine, eventually, options will become integrated into the brand of the company itself. New hires will base their workplace selection on the atmosphere it provides, rather than the distinguished brand it portrays. People are becoming more aware of the influences on their well-being, in which their surrounding space and culture plays a huge part in.

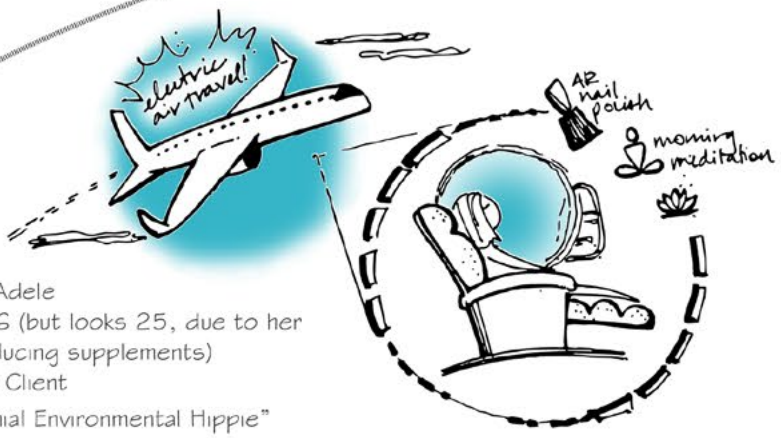
Envision a world where company offices, serve as "clubs" in which you are invited to be apart of, supported your work and life needs, created magnetic environments to be sought after. Similar to an "airline club" or "country club" where a variety of offerings were presented, based on the setting you desired for that moment — a fully tailored experience. Collaboration amongst employees was offered through a combination of seamless holographic connections, along with the ability to meet in-person, and engage in human interaction.

Quantum Empathy has developed to allow spaces encompassing you to adapt to your mindset, creating a platform for evolutionary cultural change. To maintain the balance of tech saturation and the human element, new waves of disconnection biomes will develop, and opportunities for global reconnection will arise.



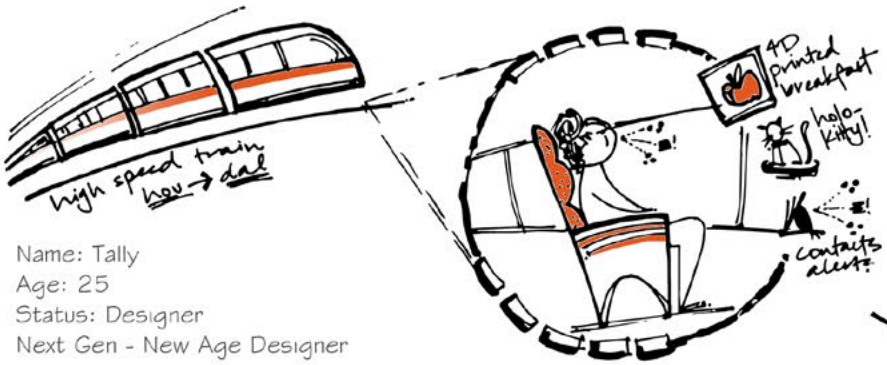
6:00

8:00



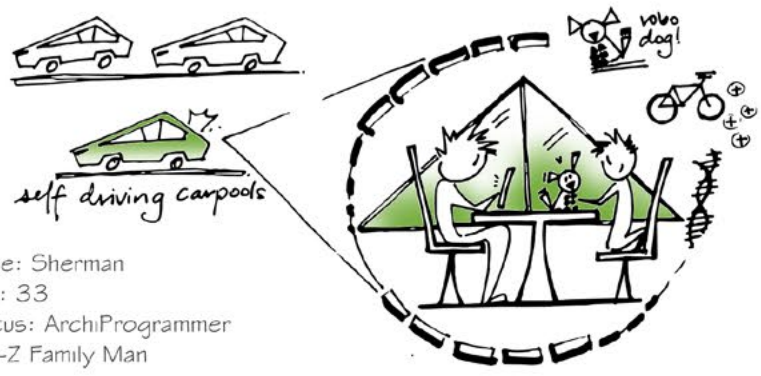
Name: Adele
Age: 46 (but looks 25, due to her age reducing supplements)
Status: Client
"Millennial Environmental Hippie"

Adele is on her way to the Corgan HQ, taking her private electric Boeing airpod. The meditative self adjusting bio-dome helps Adele prepare for her day by diffusing a Biotin concentrate, growing her hair long for the week, and encompassing her with Pebble Beach ocean wave sounds and visuals, as well as, introducing the faint scent of sea salt, to relax her during her travels.



Name: Tally
Age: 25
Status: Designer
Next Gen - New Age Designer

Tally is taking the high-speed solar train from Houston to the Corgan HQ Office. While snacking on a 4D printed apple for breakfast, she finds companionship with her "Holo Kitty" micro pet and reviews her daily alerts through her, "AcuVirtual" contact lens.



Name: Sherman
Age: 33
Status: ArchiProgrammer
Gen-Z Family Man

Corgan Biome office with his Crisper son, "COOP3R," in the new company ride, self-driving electric TeslaZ, with user powered override options. COOP3R is occupied by, "F3TCH" their robotic labrateriier, while Sherman switches to manual ride, and gets his morning pedals in, training for his upcoming ZeroCarbon race.

10:00

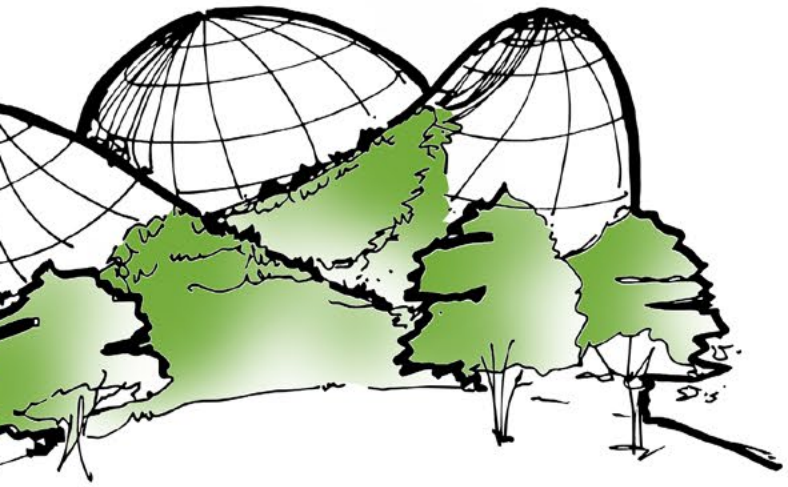
12:00

After the meeting, Adele takes a walk across Margaret Hunt Hill Bridge III, to snag a micro-mushroom psychoactive booster shake and take in some freshly cleaned air. She acquires +5 "BeWell" points for the day, working towards a faraday room session at "The Zenllennial Spa."

Corgan Main HQ, serves as a centralized hub, tied to the nostalgic West End location, where its roots were planted. Multiple offices are sprinkled throughout DFW, diverse as the people using them. Each supported by technology allowing for a Corgan One environment, with varying assets per location, from a nature based learning pre-school, wellness office, to indoor/outdoor sporting space, zero-gravity spas, and rotating restaurant cuisine to name a few!

Adele and Tally meet at Corgan HQ for their morning work session, while Sherman's hologram joins remotely from the Corgan Biome in Plano. As a group, they join a call virtually walking through project under construction located in Auckland, New Zealand.

Sherman devours his entire eco-paper bag lunch and reviews his prioritized schedule from his virtual assistant, Mac. He takes a moment to check his stocks, and realign his Bitcoin account. His, "ErgoSmart" chair, senses a hint of tension in his lumbar area, and offers electromagnetic pulses to help him re-center.



14:00

16:00

For lunch, Tally goes to, "LiFi Café" and has a simulated lunch connecting with friends situated around the world. As she enters the space, her DNA is read and dietary options are provided by a Robo-Sous Chef, embedded into her table.

Tally heads to Corgan's VirtualLab, using gestural Revit I.F., where she designs and picks up changes from today's meeting, to be translated to the design build GC in real time. She then switches gears to work on her SpaceClinic project, exploring new ways to maximize the overwhelming amount of abandoned cables to support a new orbiting device she is developing for the astro site.

Sherman utilizes his flex hours and is helping COOP3R with his homework, programming a new trick for "F3TCH." After they wrap up, Sherman orders his son a "GUber" ride home. He sets his preferences to include, Level 10 disinfecting perimeter lighting, subtle Mozart tunes, stimulating Photo-Chromeleon recent MOMA exhibits, along with an off-duty police officer live driver, and sets his hologram in the seat next to COOP3R, during his ride home.

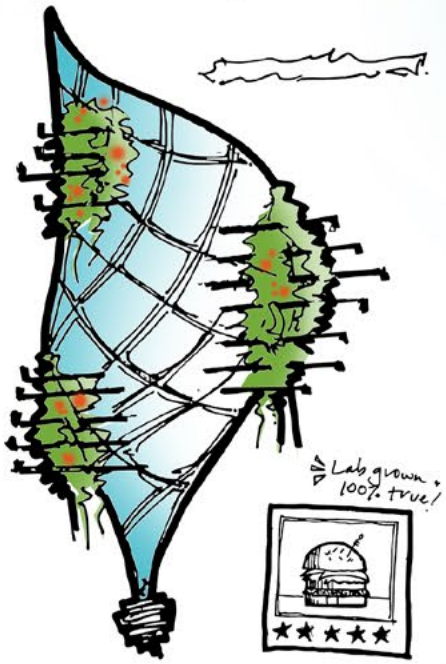
18:00

20:00

After refueling, Adele travels via EcoSub to one of her underwater facilities, "H2Omazon," to work through their new annual quota to deliver any product, to any point of the world (excluding arctic regions), within 3.6 hours.

Adele ends her day with a 37 minute regeneration robotic facial, while submerged in an oldy but a goody, classic HeadSpace mediation, during her commute home to NYC.

Tally heads home for a date night, set up by her matchmaking algorithm. She tries on a cute kinetic dress, fabricated from repurposed straws pulled from her digicloset and heads into an augmented reality date.



Adele, Tally and Sherman connect for Happy Hour at the Bar "Human Engagement." Adele orders an, "O2 Refresh Breathing Sesh, with Lavender," while Tally and Sherman get a round of local, "Trinity Wastewater Brew" and few B12 shots, and cheers to a successful day of work and play!

Sherman jumps into the TeslaZ, switches to auto mode, and heads home to watch the "Galaxy Olympics" with his new, "Oculus Solar" limited edition.

And so, the end. Or the beginning?

We are increasingly aware of the empowering and transformative relationship between our humanity and the novel technologies we create. Curiosity, creativity and innovation are all powerful actors that shape human behavior. These nuanced changes in our behavior call for new, empathetic and human-centered technologies. They influence our interpretation of the world, enhancing our understanding for one another, and providing unlimited opportunities for the future.

Since starting this book, we have traveled on incredible journeys far into the cosmos; we have taken a deep dive into the brain, examining our subconscious reactions to design; we have boggled our own minds learning about novel technologies and how they are going to fundamentally change the way we design; we have seen AI and Machine Learning step up to the plate and tackle COVID-19 head on; and we have seen curious Corganites transform into software designers, deep-sea explorers, space cowboys, mad scientists and futurists, all before our eyes.

We have explored ideas that will evolve our practice – changes that should not be seen as threats, but as new frontiers for your exploration. It's possible to take things that are uncomfortable and make them comfortable(ish). Because as designers, it's no secret – the scale, complexity and urgency, of today's global challenges demand active participation and fearless leadership, confronting the most vital questions facing our profession and our culture.

So now, get uncomfortable. Go try something new. Explore beyond traditional boundaries. Experiment. Adopt. Adjust. 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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