DESIGN QUAR-TERLY

ISSUE 09

Stantec

BUILDINGS, PEOPLE & TECHNOLOGY

Dynamic response to digitally driven change

DESIGN QUAR-TERLY

ISSUE 09

THOUGHTS, TRENDS AND INNOVATION FROM THE STANTEC BUILDINGS GROUP.

The Stantec Design Quarterly tells stories that showcase thoughtful, forward-looking approaches to design that build community.

IN THIS ISSUE:
BUILDINGS, PEOPLE & TECHNOLOGY

Increasingly, our digital life intersects with design of the built environment. Technological change challenges our clients to keep pace. The tools and methods we use for designing, building and getting feedback are changing quickly.

In this issue, we look at tech from both the design practice and the client perspective, from the digital twin concept to 3D scanning, which digital trends we should design for, and when to think beyond them.

Get to know the digital twin

The next gamechanger for digital design and buildings.

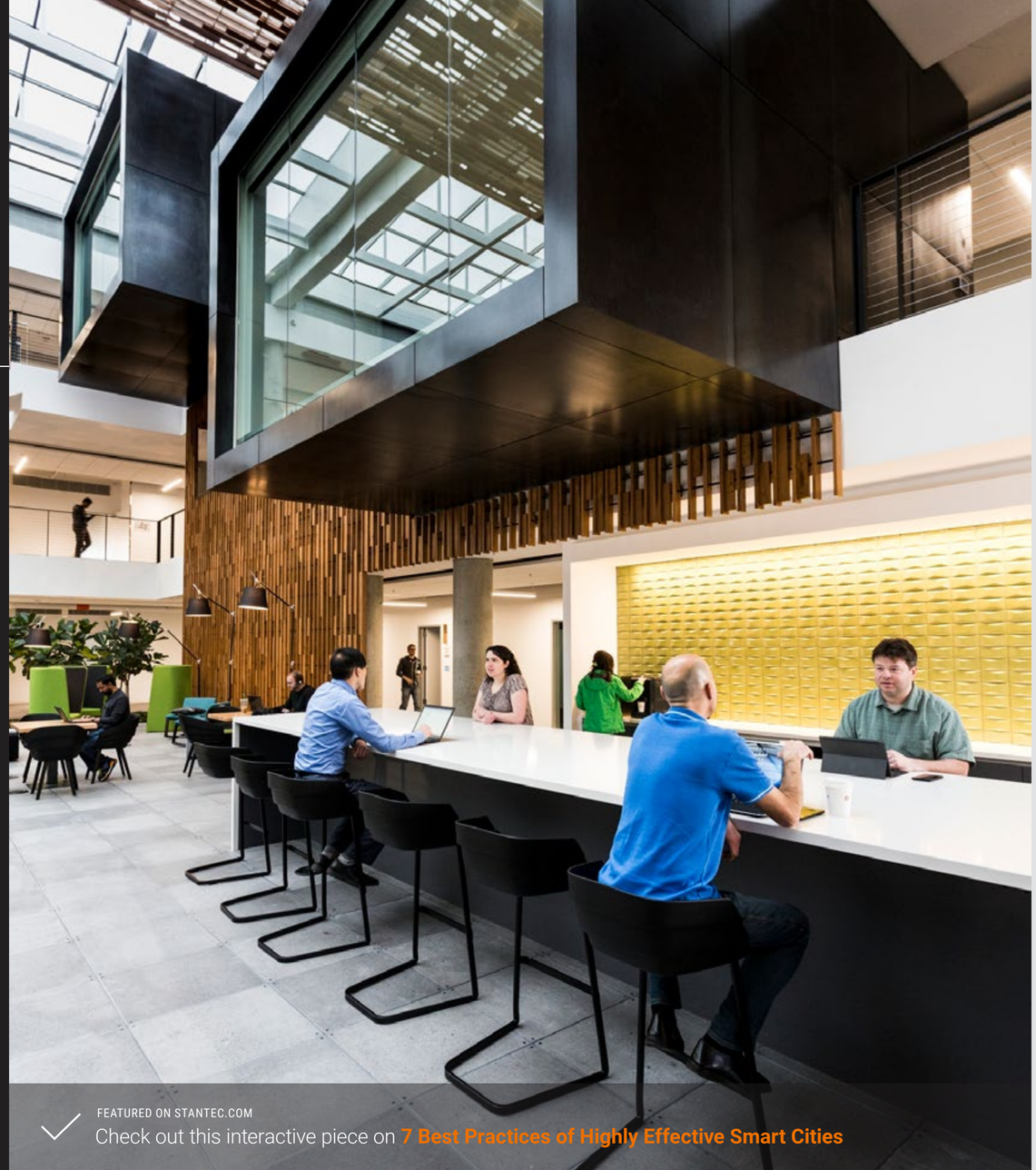
BY RICHARD BAKER AND SETH ELY

→

2020 may be the year of the digital twin.

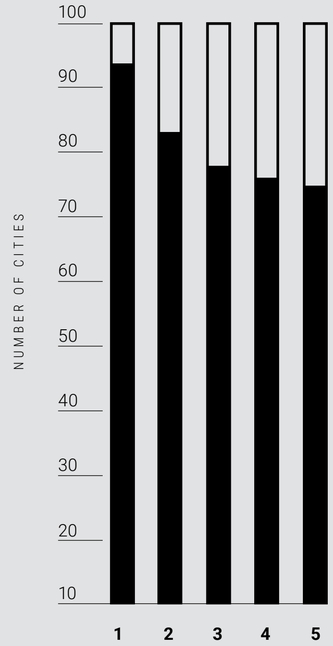
For designers and planners facing the challenges of designing a smarter, more sustainable building and community, the digital twin is a potentially powerful game-changer. We're experiencing a push to develop and implement the digital twin. But what exactly is the buzz about? What is a digital twin, what elements define it? When can/should we apply this technology? What makes it so powerful? And how will its adoption influence our design process and ultimately our buildings and cities? >

Microsoft 83
Redmond, Washington
Architect of Record: BORA Interiors and ZGF Shell
Engineer of Record: Stantec



FEATURED ON STANTEC.COM
Check out this interactive piece on **7 Best Practices of Highly Effective Smart Cities**

Top five categories of data cities are using now



1. IoT–data from the interconnection of devices and machines

2. Artificial Intelligence–data derived through AI and machine learning

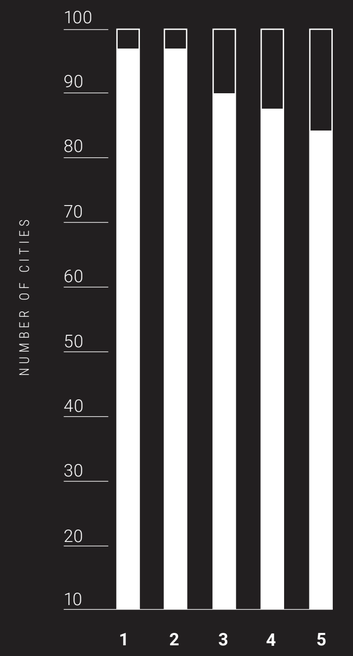
3. Real-time–data used immediately after it is generated

4. Citizen satisfaction–data sourced from regular surveys of citizens

5. Administrative–internal data from across departments and city services

Source: Building a Hyperconnected City, a survey of 100 cities by ESI ThoughtLab co-sponsored by Stantec

Top five categories of data cities plan to develop in next three years



1. IoT–data from the interconnection of devices and machines

2. Real-time–data used immediately after it is generated

3. Artificial Intelligence–data derived through AI and machine learning

4. Administrative–internal data from across departments and city services

5. Business–data from local companies reflecting trends and activities of their customers

Source: Building a Hyperconnected City, a survey of 100 cities by ESI ThoughtLab co-sponsored by Stantec

What is a digital twin?

There are many ways to define digital twin and it's likely our understanding will change as we see it go from concept to real world application. A digital twin is a digital representation of a physical environment that collects real time data, it's where the real world meets data science and computational engineering. This digital model incorporates not only the building information model, but also live system data from devices within the building. All these different data streams are brought together and expressed in a common 3D environment to, in simple terms, recreate the physical world. It allows users and operators to query, analyze and track the inputs as well as the parameters of the model itself to create a variety of uses.

It's visual.

Buildings have been collecting data for years. It's the 3D representation that enables us to visualize the data and see it in real time that's the game changer. This data rich platform allows us to see and use that historical collection of data to understand how a building performs and how it's being used. Rather than a virtual "mirror" of the building, the digital twin is a visible abstraction of all the usable, relevant data about the building.

A single pane of glass

Across the industry, the ideal metaphor for digital twins is the "single pane of a glass." Ideally, we are creating a single pane of glass to look into the building where all systems are in one spot. In general, today's systems and data are distributed and siloed, they are difficult to manage and understand as a whole. From an operations perspective we could have users creating different KPIs for what they feel is critical and necessary information, but it results in a mixed and unwieldly segmented data stream. But what happens if we create a unified data platform that places all this data together, side by side?

User interfaces

Not everyone accesses the data the same way. A unified data platform is overlaid with a system featuring multiple user interfaces. The building operator will work with an interface that show the KPIs that are important to them, say energy consumption and occupancy. Another user might access the data related to emergency preparedness to see how the building will operate during an extreme weather event or emergency. Another access point might simply allow employees to see the location of the available desks in a free address system. >

Lincoln Square
Bellevue, Washington
Architect: HKS Architects
Lighting design by Stantec

TAKE THE QUIZ
Are you Smart Cities Smart?

BUILDING SYSTEMS HAVE ALWAYS PRODUCED A LOT OF DATA BUT IT IS TYPICALLY ONLY ACCESSIBLE TO ENGINEERS AND DOES NOT PROVIDE ANY VALUE TO USERS. THIS IS COLD DATA.

THE DIGITAL TWIN PROMISES TO MAKE BUILDING DATA VISIBLE SO IT CAN BE ACCESSED AND ANALYZED BY END USERS TO SUPPORT THEIR GOALS. ACTIONABLE BUILDING DATA IS **HOT DATA.**

What are the elements that make a digital twin?

Internet of things

Internet of things or IOT devices are devices that collect data from a sensor and send that data to the cloud. In the cloud, a conglomeration of data from many devices has the potential to relay a lot of intelligence about everything from room occupation to technology use to temperature and air quality.

The IOT device itself is not necessarily a digital twin but combining IOT sensors and IOT inputs with the digital twin creates a really powerful tool. When we talk about live data inputs, we're talking about the data from IOT devices relaying information into the digital twin.

Can be focused

The digital twin can be leveraged at several levels of implementation. Some digital twins are relatively focused on a specific function, say on energy use. A power utility company, for example, might deploy a digital twin strategy on a district scale.

They're interested in data sets related to energy use because their key performance indicators are all about power usage and efficiency.

Hot data vs. cold data

A digital twin offers clients the opportunity to bring all this data together, to harness the future power of cold data, so that people understand how their interactions with the building and business are related to it. When we're making data relevant, we're turning it into hot data.

Stantec Tower
Edmonton, AB

Creating a digital twin at Stantec Tower

We are in the process of creating a digital twin and a smart building and living learning lab in Stantec's Edmonton tower. Here are a couple of the promising facets from Stantec Tower's digital twin we're investigating and hoping to push forward.

THE INSTANT FEEDBACK LOOP

01

Typically, in the process of design development you do research, you develop strategies, you build it, you implement it, and then you evaluate how successful it was. In the traditional building design process, we receive most of the feedback at the one-year mark in a post-occupancy evaluation. Then you do the next project with the data or feedback from your previous project, captured at just one moment in time, in mind. So, traditionally, we accumulate design feedback sequentially from project to project.

Digital twin technology changes all that. A digital twin gives us access to continuous and ongoing feedback around systems, performance, and utilization within the building. It's a much richer and prolonged feedback process.

With continuous access to the data visualization of the digital twin, we can receive instant and continuous feedback from our design. We can test and simulate changes to the system before they are implemented. Ultimately, this means that the digital twin will change the design process just as much as building operations.

Practically, digital twin is likely to have a profound effect on how we design buildings. Either by code or by training, overwhelmingly, designers are taught to over design in the current paradigm. Overdesign impacts costs, but also sustainability and embodied carbon. Once we start to understand the data, we can understand where overdesign is happening, we can reduce infrastructure, we can update codes, and then we can start to create truly sustainable smart buildings, which aggregate into sustainable smart cities.

We could, for example, through digital twin identify a peak energy requirement. We could then design a system that meets that maximum requirement but leverages timing or scheduling to shift the load and minimize the energy use so that a smaller system can be used. The result? Greater efficiency and cost savings.

And we're just getting started imagining the potential of the digital twin. It's theorized that in the future the digital twin will harness the power of AI to refine and improve systems autonomously. Constantly adjusting toward smarter and more efficient systems. >

Stantec Tower
Edmonton, AB

This Globe and Mail series speaks to the breadth and depth of our experience and expertise in Smart Cities.

Stantec Tower
Edmonton, AB

02

INTEGRATING THE DIGITAL TWIN AT THE DISTRICT LEVEL

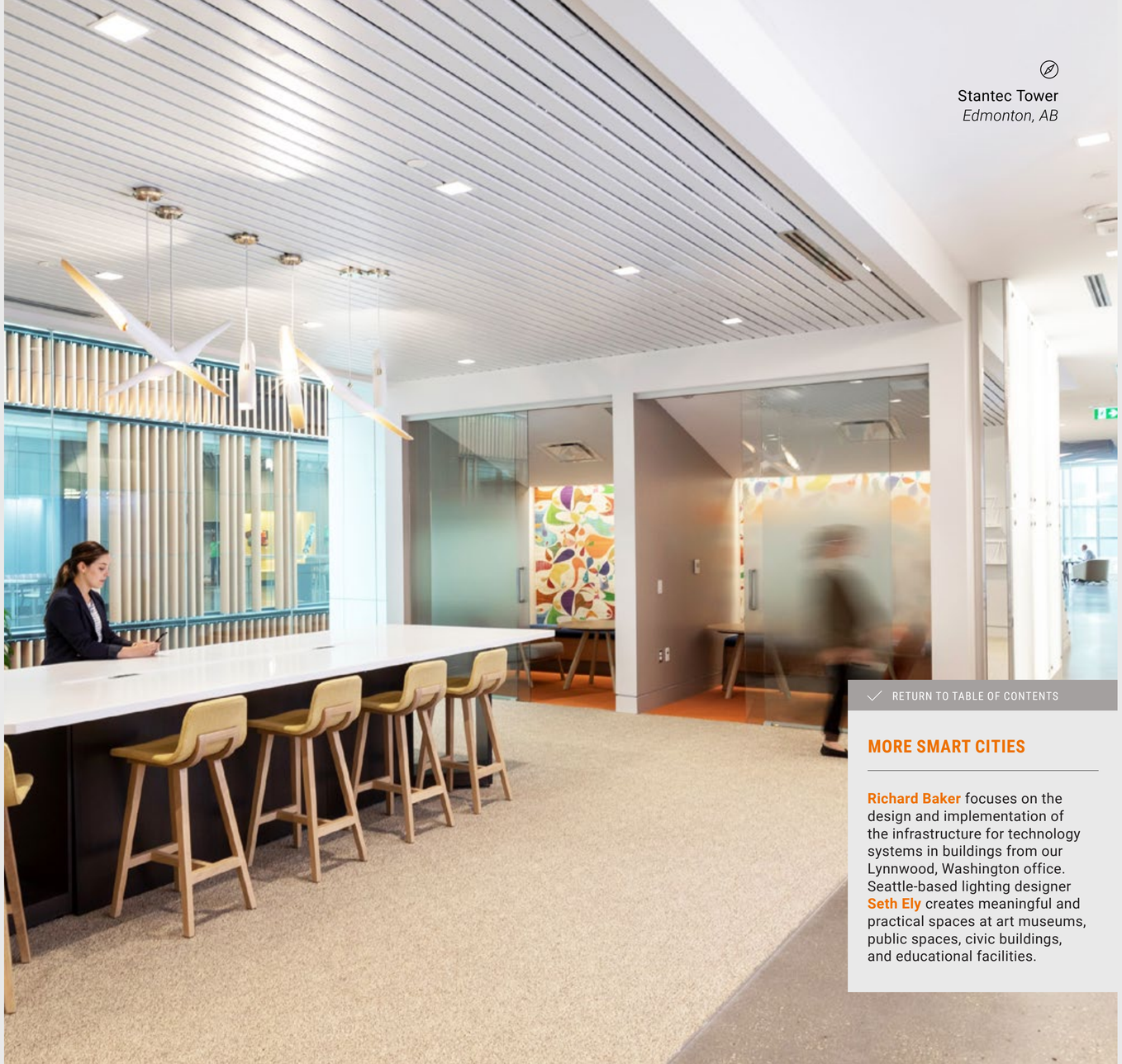
The power of a digital twin really starts to get interesting if we think about aggregating data digital models of buildings within a defined area. We could literally create a model of a district, a town. In the example of Stantec Tower, how can our data be integrated into the ICE District in Edmonton in which it resides? How can this help us make connections with intelligent transportation or intelligent power? What kind of information can we gather on the district level that will help us change the way we approach design for buildings? We're just beginning to uncover the possibilities. >

03

A UNIFIED MODEL

At present, the typical digital twin often consists of minimal characteristics modeled onto and specific to one type of system. We have yet to see fully integrated, 360-degree integration. Based on what we're developing today, we think the most powerful platform in the future will be a model that unifies disparate systems within a building. We're working to refine and develop our digital twin at Stantec Tower to incorporate the deep resources and pools of expertise we have into this unified, integrated model. By doing so, we create a broader vision and potential for digital twin—one that is connected to a broad range of KPIs that our owners can use.

We're just starting to understand the collective power of digital twins. Once we can aggregate individual building's digital twin into districts or geographies, we'll be able to realize the power of a smart city. We'll be able to uncover efficiencies possible with district heating or water or other interconnected infrastructure. We'll be able plan and build more resilient communities because we can test scenarios for extreme weather events or pandemics using the digital twin—at the building and community scale. That's game changing. This data-rich approach is going to change the way we design buildings, cities, and our sustainable future.



Stantec Tower
Edmonton, AB

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MORE SMART CITIES

Richard Baker focuses on the design and implementation of the infrastructure for technology systems in buildings from our Lynnwood, Washington office. Seattle-based lighting designer **Seth Ely** creates meaningful and practical spaces at art museums, public spaces, civic buildings, and educational facilities.

Staying smart

Hospitality design in the digital era

BY DUK KIM

The way travelers use technology is changing the hospitality industry. Apps for discount booking, Airbnb services, and in-room tech have already upended the business. Digital tech continues to present us with design challenges. As designers we look at the ways our design for hospitality can accommodate technological evolution intelligently to bring value to the guest and our client. These are some of the digital trends and challenges I see impacting the hospitality industry right now.

Citizen M Hotel
New York, NY
Architect: Stephen B. Jacobs Group
Engineer of Record: Stantec

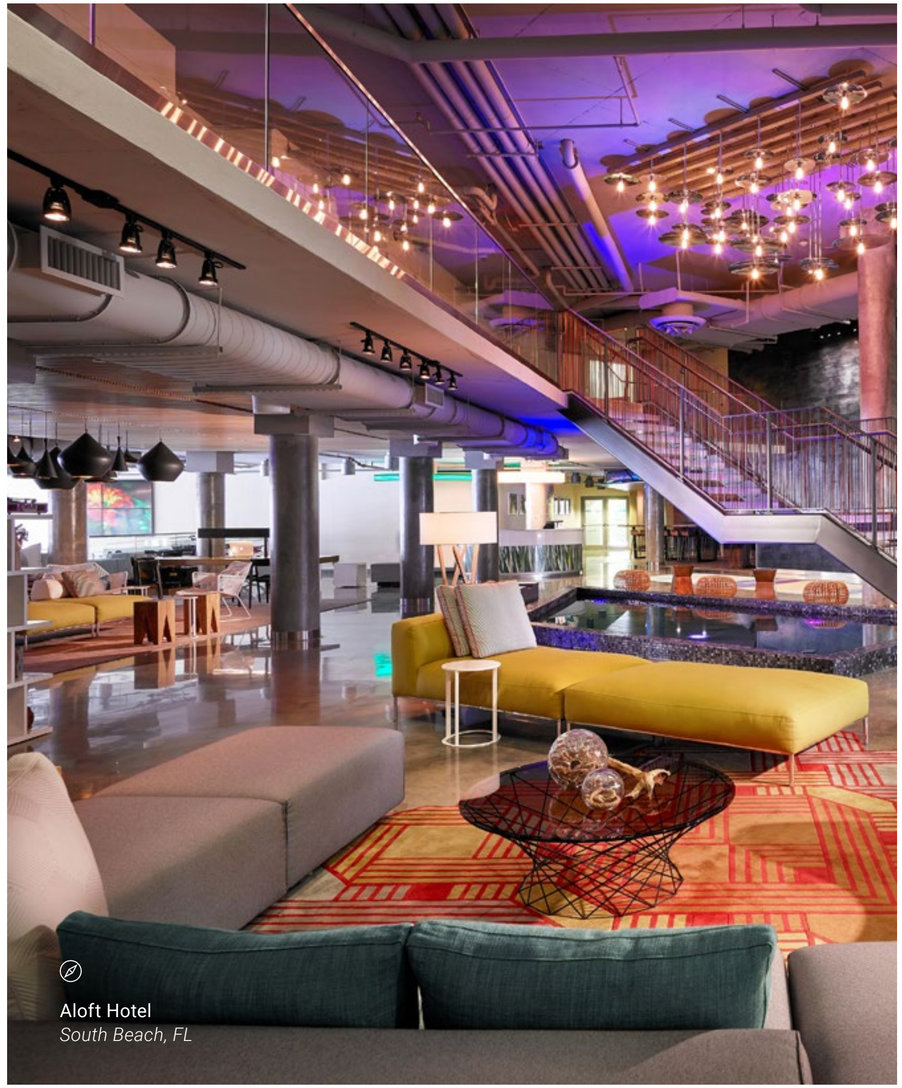
Check-in
Let's talk basics. How are people of the future going to check into and unlock their rooms? Very few hotels use a real key anymore. They're in the process of getting rid of the magnetic strips, that's old technology—the new key is an RFID card. And the next big advancement is a digital key on your smartphone. But a basic question arises. It may work for a good segment of people, but there's going to be a contingent who may not be able to figure out how to use it. What works for most? We must strike a balance between innovation and ease of use.

Universal configurations
It wasn't too long ago when many hotels thought it would be great to have iHome charger/audio devices in guest rooms. And it wasn't so long after they invested in these devices that Apple changed the charger on its iPhones, rendering the iHomes quickly obsolete. Naturally, hoteliers have to stay on top of these tech compatibility details now more than ever. Should they now adapt to Apple's current lightning charger? Not so fast. The European Union is demanding a universal configuration from Apple that would push lightning out. And what about Android phone users? I see more hotels embracing Bluetooth connectivity, a nearly universal feature in smartphones. They must, however, do this in a dummy-proof way. And it doesn't enable charging. Smartphone room compatibility might sound mundane, but these choices about technology add up to the guest experience. And for large hotels, they're a significant investment. Hotels must opt for the easy and instinctual over the complex whenever they can to make the most from digital tech.

Streaming with ease
By now many of us are used to streaming our favorite programs whenever we like at home, on our laptops or via smart devices. And some hotels tout the ability to watch our streams on their flat screens, but if it's too difficult to "cast" our programs, this can lead to frustration. After all, we're traveling, we want to relax, we don't want to click through menus. Hospitality providers that can create more seamless streaming experience for technology travelers use will have an advantage.

Rideshare
The ability to hail a car with a smartphone app empowers travelers, but it poses significant challenges for large hotels. With a 150-key hotel, accommodating rideshare traffic at the entrance might not be a big deal. But at the 5,000-room hotels you find in Vegas and with convention centers, it is a very big deal. How are those rideshare users getting picked up? Where and how do they queue? One solution we we've seen is the creation of rideshare pick-up locations away from the front of the property.

But that's where the details matter. Today's cars are bigger, rideshare vehicles are often SUVs, not cab-sized sedans. And hotels are often adapting areas for rideshare pick-up that were not meant for that kind of vehicular traffic or any pick-up and drop-off at all. Many use planters to create barriers between pick-up and pedestrian areas. Imagine rideshare vehicles entering these unfamiliar areas with an SUV's limited visibility? Predictably, they back over planters and we get gridlock. These are unintended consequences of ad-hoc adaptations to technology and hospitality. We're being asked to create innovative and smart solutions for rideshare at both new and existing hotels. >



Aloft Hotel
South Beach, FL

→

The Merchant Kitchen & Bar
Winnipeg, Manitoba

The Instagrammable moment
In hospitality design, there is such a thing as being too on trend. Take the Instagrammable moment for instance. The minute you start putting up a sign that says “take a photo here” or “Instagram moment here,” you turn a portion of your property into a theme park. I understand that there may be certain times, particularly in restaurants or entertainment venues where you want to be cute, you want to be funny, and that’s great. But you’ll achieve a higher level of sophistication and refinement in letting these moments occur naturally as opposed to forcing the issue.

There’s a trend toward using large scale graphics and street art-inspired murals or enlarged photographs as wall covering and for parts of feature walls. That’s exciting and those can become Instagrammable moments themselves. There are opportunities to create moments that are photographable, memorable without being so obvious.

In my team’s design process, we walk through the entire hotel experience from guest drop-off to room entry, we visit the fitness center and experience the bar and the dining room. We identify how people go through the natural progression of the spaces and we look to create genuine moments. We trace our path through every single possible moment in time in that particular hotel. And we identify which of those could be peak moments or interesting discoveries along the path. We think about design from a long-term experiential point of view.

From our perspective, there’s a chance to have fun with transition or utility spaces. We can create ‘Aha moments’ in the spots where you least expect them.

Tech overload, tech fatigue
But are some hotels going too far with technology? Perhaps. It’s wise to consider that the guests are likely using the room for the first time. Is it intuitive for them to figure out how to turn off the automated lights that switched on when they entered? Some high-end hotels have a glass partition between the bathtub and to the rest of the guest room and with the flick of a switch an electric charge makes it completely opaque or transparent. That’s a cool experience, unless of course, you don’t know how it works or know where to find the switch. >

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MORE HOSPITALITY

Chicago-based hospitality leader **Duk Kim** draws on his experience in global design and design education in collaborative hospitality projects that reflect today's culture.

The same can be said for hotels that experiment tablet-controlled functions. Theoretically guests can control their flat screen TV, the room lighting, window shades, set alarms and order room service, all from a dedicated tablet device. That's great for the technology savvy, but who might be left out or confused? Hospitality design will be more successful when it allows for guests to use their personal technology as seamlessly as possible without forcing visitors to adopt a new app, password or device that they didn't bargain for when they booked. While technology and how we use it will continue to influence hospitality, we should continue to evaluate the experience from the traveler's point of view, not just a smartphone lens. D

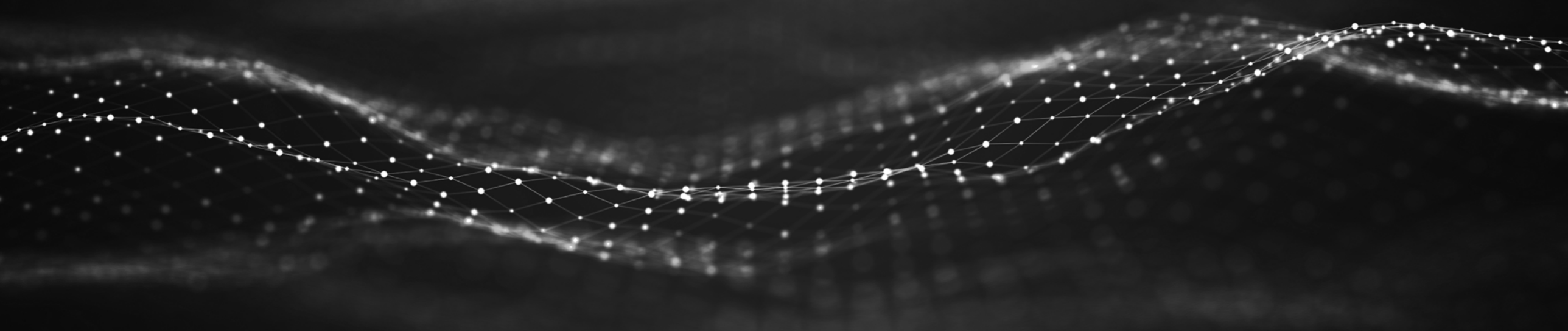
←

Hotel Zachary
Chicago, IL

SCANNING*SMARTER*

USING REALITY CAPTURE TECHNOLOGY TO SAVE TIME AND MONEY ON RENOVATIONS

BY ZILDA HIJAZIN AND DAVID KURY



In the past, the ability to see spaces precisely as they are and walk through them in three-dimension sounded like science fiction. Enter Google Earth. Now anyone, anywhere could visit any place on Earth from our backyard to the pyramids. Today, advances in reality capture technology have made this technology more accessible than ever before. Hyper-detailed virtual walkthroughs for buildings is now a reality. This technology holds enormous potential for the architecture and construction industries. So how are architects and designers using these powerful digital tools to capture, explore, and document spaces?

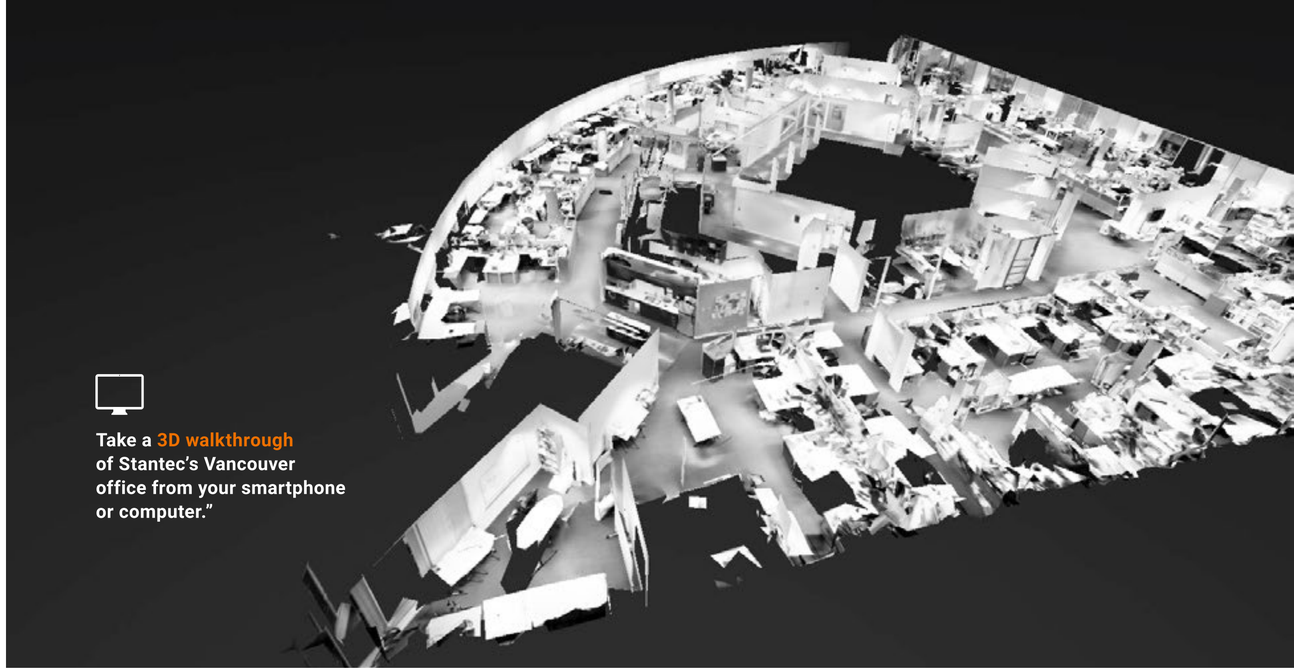
At Stantec, our designers are using programs including Matterport, a 3D- scanning product which originated as a real estate marketing tool. The Matterport's power is in its ability to stitch together thousands of images. Move it through a space two meters at a time and its camera captures detailed, zoomable 360-degree visuals. It's essentially a 3D mapping tool.

Document what exists

Walking through a space we absorb an abundance of information that conventional two-dimensional plans and photos simply cannot communicate. We discovered the Matterport is a fantastic tool for documenting the existing conditions of a site, remote or not. Now we are using creating 3D fly-throughs on most of our healthcare renovation projects in British Columbia.

If we have any existing space, whether its shelled space or otherwise scanning it and making a digital twin is always our first step.

For example, our Victoria office is working on a renovation to the surgical daycare unit within a hospital on Vancouver Island. Hospitals are notoriously hard places to document in detail due to their 24/7 operation and infection control concerns. We can quickly scan a space in off-peak hours to limit disruptions to operations. During a global pandemic like COVID-19, rather than sending our staff into a dangerous environment, we can virtually re-walk the space at the click of a button from our home office.



Take a 3D walkthrough of Stantec's Vancouver office from your smartphone or computer."

The power of conversation

We thought the most powerful feature of 3D scanning would be its ability to link the point cloud scan generated with our BIM and Revit models. In our experience, however, its most influential aspect has been how it revolutionized the quality of conversations we have with clients and consultants. No 2D image has ever been as useful as a client walking the existing space with us as they show us how and where they work. Now, with these fly-throughs, we can speak to them from anywhere while they move through the space in three dimensions. We've been amazed at the depth and richness of the conversation this immersive environment generates. The fly-through enables clients to show and tell simultaneously. We can point to an area and say what's going on here? How often do you use this medical gas outlet, this light fixture?

The digital twin allows us to get straight to the point. We've even begun sketching overtop of the flythrough and saving screenshots as our meeting markups. Even if we're designing a new building, a Matterport scan of the client's existing space to >

understand how and where they work can be valuable. The 3D walkthrough can help the design team and the client develop the functional program of a new hospital.

A tool for collaboration

Stantec is a big company with experts across the globe. Now, when we are flying in an expert for a day to meet and talk about their project, we can virtually walk them through the space in detail and get them up to speed before client meetings. Similarly, the 3D imaging makes it possible to have a conversation with equipment suppliers about replacement versus salvage of existing equipment. When we can virtually walk up to a refrigerator and share a model number we get answers more quickly.

Remote locations, property maintenance, equipment replacement

This tool continues to be useful well after the design phase of a project too. We've started including the fly-throughs within our contract documents, and are considering virtual contractor walkthroughs, which could have the potential to increase the interest in remote project locations. Now they can see and re-see the conditions as many times as necessary while they bid the job and the information can be shared with their subcontractors as well. There's a great potential for clients to use the Matterport data going forward. Several health authorities in lower mainland Canada are considering purchasing 3D scanning tools. These authorities are responsible for maintenance of numerous properties and are looking for better ways to document the existing conditions at each.

Seeing infrastructure

Often, in older buildings, there are significant pieces of complex infrastructure. Years of renovations, additions, and numerous changes make tracking existing condition particularly challenging for both client and project team. Existing drawings often remain outdated, leaving many design decisions to be verified in field and during construction. A digital twin lets us virtually pinpoint the location of that infrastructure relative to the rest of the building, so it's made it easier, for instance, to coordinate our new ductwork and pipes with the existing services in the ceiling.

Before and after

3D scans and digital twins are starting to become great tools for telling the detailed before and after story about a project. Ideally, we will have a library of various projects in 3D to show to potential clients. If we're doing a new hospice project, our client can virtually tour our last three hospice projects. It's the next best thing to having them walk through your projects in real time. It's really powerful.

Before and after renovation 3D scans of the Sea to Sky Hospice Project in Squamish BC

Point cloud scanning to mitigate risk

In Philadelphia and elsewhere, we are using point cloud to map existing three-dimensional space as accurately as possible. Point cloud technology is less about visuals and more about creating a data map of existing conditions in 3D.

Done right, the point cloud can capture and document the 3D geometry of above ceiling fixtures over and above walls. It documents existing architectural and MEP conditions in a single accurate 3D model. You're really seeing spaces that you would not see in a survey armed with the assurance that your 3D model is an accurate representation of reality. The point cloud we receive from our scanning service is very detailed, so we simplify the data to make it compatible with our BIM model.

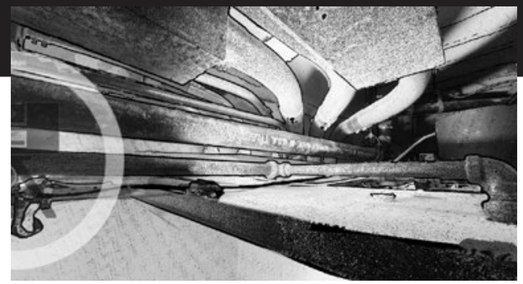
For a client that's been burned before by its unpredictable and troublesome space, the point clouds offer some potential validation before design and construction. For example, one of our clients has a very old building which has been renovated many times and has a variety of poorly documented MEP and structural conditions. >

In the past, upon starting field work, they encountered major challenges that lead to additional costs and delays. To elevate our approach and better serve our client, we decided to utilize a digital twin to provide more accurate design solutions. We used the cloud-based digital twin management platform Cintoo. The point-cloud scans and our data management tools help us gather and understand existing conditions to better mitigate project risk.

Using Cintoo and bit of help from our geospatial technology colleagues in Edmonton CA, we're able to seamlessly incorporate our digital twin data into our BIM and Revit work flow.

Validate clash detection

We can use reality capture for an existing space to conduct clash detection with our BIM model. Once we have received the point cloud, we import that data into our model and continue to design and document as we would usually. Now we have an overlay which we can use to validate our design against existing conditions.



We can see that, for example, if we need to demolish a wall whether that will result in major complications for mechanical systems. It's all about eliminating those gotcha moments and making the most informed design decisions about the renovation. Ideally, the investment in point cloud scanning and clash modeling in the design phase enables us to validate our deliverables and therefore mitigate changes during the construction phase. Construction changes result in premium charges, so by minimizing them, we're saving our clients money.

With point cloud scans interfacing our drawings, we're delivering a highly accurate model of existing spaces to the client that will not only validate our design but will be of use to architects, designers and engineers moving forward on future renovations.

Reality capture technology is a significant addition to the architect's toolbox and we've only begun to uncover its potential.

Point cloud images from digital twin management platform Cintoo

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MORE BUILDINGS DIGITAL PRACTICE

Zilda Hijazin is an architectural designer and master planner out of Stantec's Philadelphia office with a focus on healthcare projects. She recently was a part of completing a new ambulatory care building and a system-wide masterplan for various Stantec offices. Architect **David Kury** works out of Stantec's office in Victoria with a focus on healthcare projects in British Columbia. He was recently part of the team that completed two new acute care hospitals on Vancouver Island.

"Pebble" detail at Stantec Tower
Edmonton, Alberta

TRANSLATING DESIGN TO CUSTOM ELEMENTS

Possibilities for parametric design and custom manufacturing

BY RAY KETTNER

We're exploring a new world of possibilities for creating architectural solutions through the power of parametric design and manufacturing custom interior elements. I've been involved in leading a team in investigating the opportunities for employing this design process and had the privilege of taking our digital design all the way to a finished project via a collaboration with custom manufacturers. I believe these tools and processes can unlock design potential that we've only begun to dream of.

Recently, we had a chance to apply these innovative design practices and manufacturing techniques on Stantec's home office in Edmonton. Our team designed the interiors for the third and fourth floors of Stantec Tower, the common floors which feature the collaboration spaces, shared meeting rooms, large all-hands areas, and cafe space. With a huge floor plate to work with, we were encouraged to spread our creative wings, let our imagination guide us and devise design strategies that would make the space interesting at a human scale.

We came away with several big takeaways from the experience. >

The finished "pebbles" or pods create interest at the human scale within the huge floor plates of Stantec Tower in Edmonton, Alberta

TAKE INSPIRATION FROM NATURE

We took inspiration from the slot canyons of the American southwest such as Antelope Canyon in Arizona as well as large pebble shapes we observed in an architecture project in Rotterdam. We took these organic pebble forms and decided they would become inhabited, while the spaces between would create visual interest like the slot canyon. We chose to scale up the pebbles and then live in them. That was the genesis of the idea. These freestanding forms, blurring the line between interior and exterior architecture, are the homes for the new office meeting rooms and break out spaces. We affectionately called them pebbles during design, while users now know them as pods.

PLAY WITH ORGANIC FORMS

We wanted to be playful in creating organic forms, but we knew that eventually describing those shapes for contractors would become necessary and might prove difficult. Ultimately, this led us to a process where we shared our digital model directly with the fabricator. We then exchanged that 3D model back and forth so we could evaluate their details against our design intent.

USE AN ALGORITHM TO DEFINE FORMS

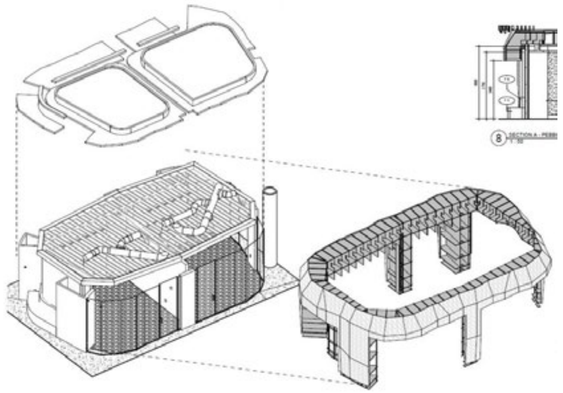
You can define forms mathematically or you can define them by hand. Defining them by hand more than once is potentially a lot of wasted effort. So, knowing that we're going to iterate through forms during design, we want to use the power of a computer algorithm to work through constraints and details for the shape. The algorithm allows designers to play gesturally with the larger form. I trained as a sculptor, so for me it's creating a mathematical paintbrush where I know I can just draw freely. If I create a shape, the algorithm I write does the repetitive calculations for me, so that I don't have to compute it every single time.

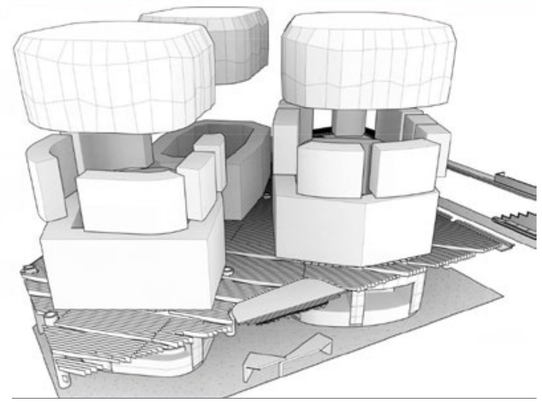
CONSIDER BUILDABILITY

Our algorithm was driven by aesthetic and practical considerations. We didn't want to design with a lot of triangles but rather planar quads, panels with four points which added some complexity to the project but made the expression more interesting. And the other constraint was that our shapes would be built from a four-by-eight plywood sheet. We opted for waffle construction to support the outer skin. The waffle is constructed with a laser cutter and formed into three dimensions with two dimensional ribs.

CREATE A MULTITUDE OF OPTIONS

Parametric design is about creating a range of possibilities. You devise an algorithm to give you a field of outputs. My goal is usually to create something that gives me a field of possibilities that I can pick through—sometimes the algorithm finds a solution you never would have considered. Having a range of solutions allows the design team flexibility to respond and adapt to change that inevitably presents itself. >





To make the project visible and understandable to contractors, Stantec showed them the pebbles as a kit of parts that come together. Each of the six pods we designed had its own exploded unrolled view, sections, and exploded axonometric views.

DOCUMENT IT

As I said, for this workplace project, we found that creating a variety of these pebbles with the usual tools was challenging. So, we started by creating an algorithm in Grasshopper playing with the form and playing with the idea. When we got what we wanted, we translated it all into Dynamo. We were able to embed that in Revit, the industry standard, to hand off to the contractor.

Putting everything in Revit also enabled us to coordinate with our consultants on walls, glazing, audio visual components, as well as the furniture that had to fit within the pebbles.

SHOW PROOF OF CONCEPT AND GET PRICING

To ease our contractor's concerns, we provided extra documentation to show proof of concept for this complex project so they could not only price it but believe in the concept. But typical elevations of non-square objects aren't too useful. So, we wrote a script that unwraps the outside of our pebbles, so our contractor could count every single panel and get the exact square footage. The goal was to make the project visible and understandable, show them a kit of parts that come together. Each of the six pods we designed had its own exploded unrolled view, sections, and exploded axonometric views.

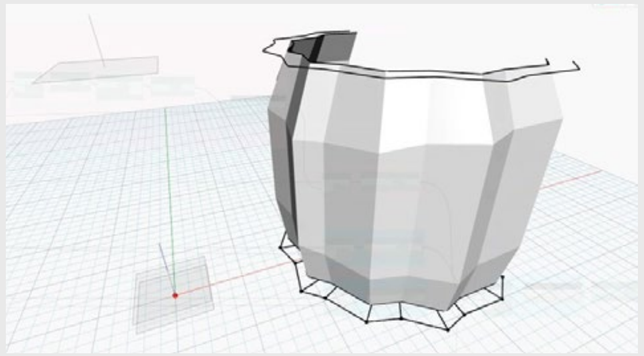
FIND THE RIGHT FABRICATOR

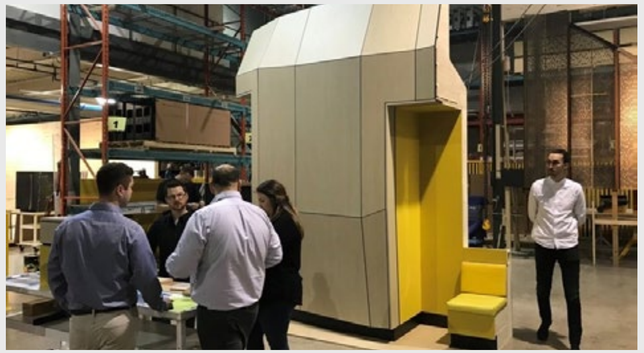
The 3D model must become reality at some point. We found a fabricator that could not only build our pods, but do the millwork, casework, and felt backing on half a dozen pieces of custom casework.

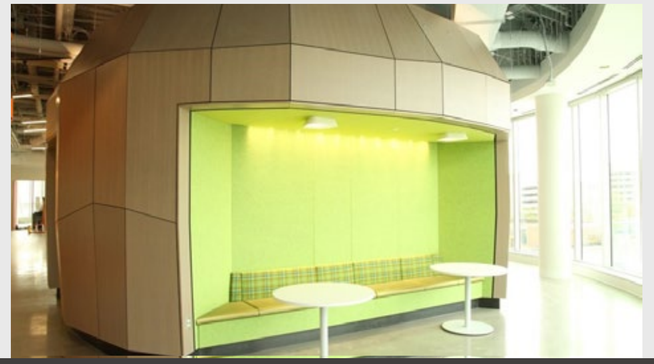
TAKE VR WALKTHROUGHS, GET MOCK-UPS

During a factory visit, our fabricator asked us, 'Why don't you look at your pebbles in VR?' The interior design principal and I did a virtual reality walkthrough reviewing details, making decisions on modifications and fine-tuning the pods. For a project like this which occupies a huge space, our ability to do a walk-through prior to fabrication, to see the designs in three-dimensions and move around them is extremely important.

A couple of months later we came back to visit, and they had built a full-scale mock-up that had all the elements we were interested in evaluating. This helped us validate our design decisions before manufacturing and shipping.







The pebble
From parametric model to factory prototype to final built structure on site.

BUILD ON WHAT YOU'VE LEARNED

We've adopted elements from this parametric-to-manufacturer process into our studio's daily workflow. We're using VR headsets for walkthroughs. We use software algorithmically on more typical architecture projects to take on repetitive tasks and complete them quickly. The more we are leveraging the power of the algorithm to iterate design, the greater our confidence in designing and executing more complex ideas. We learned that incorporating parametric tools and this kind of process isn't overwhelming to the schedule—the time spent designing a robust algorithmic toolset made the delivery of complex geometric spaces quite manageable.

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MORE COOL TECHNOLOGY AND RESEARCH

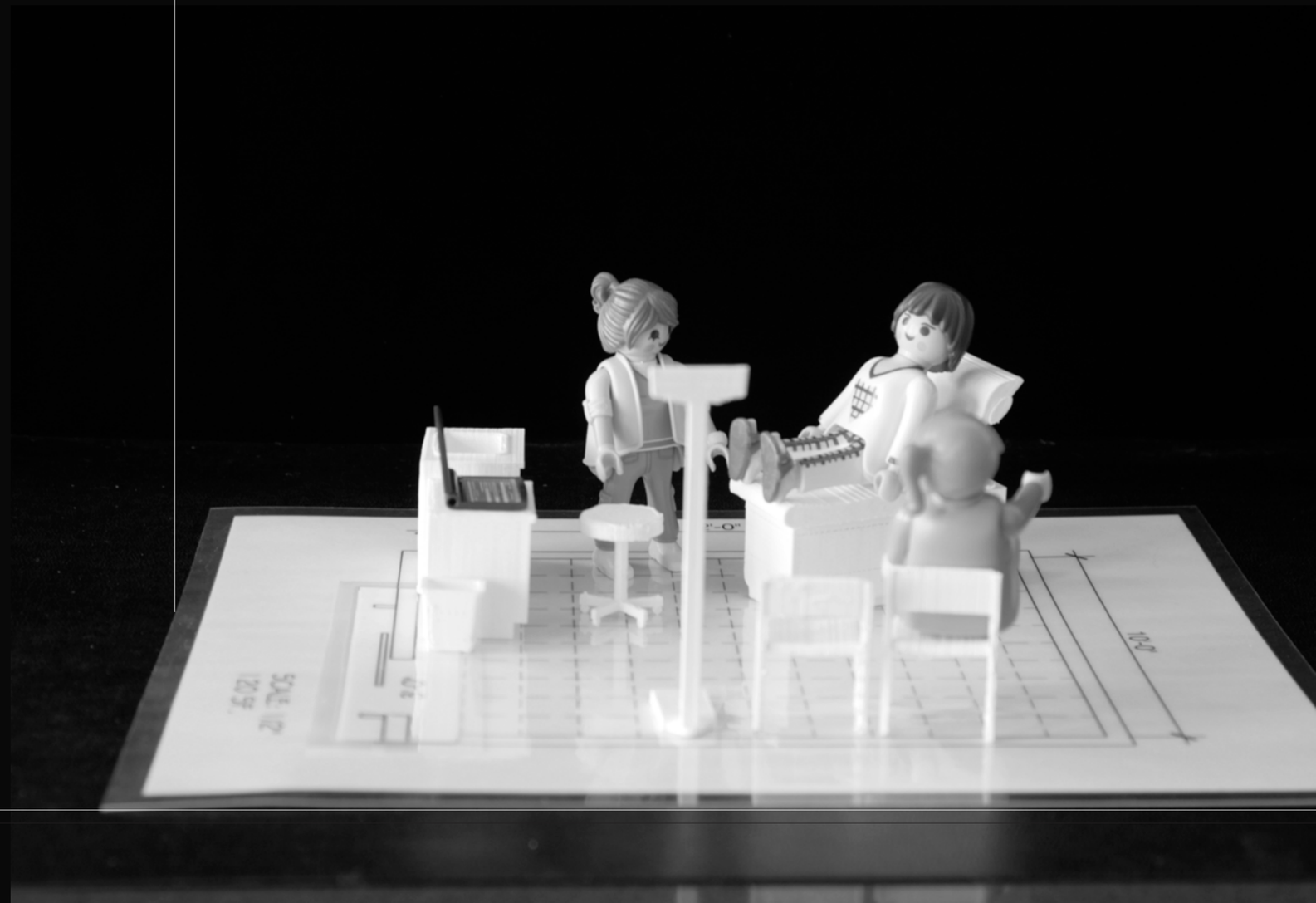
Based in Stantec's Boston studio, architect Ray Kettner enjoys applying parametric digital tools in his daily practice.

Playing for Keeps

Why we've added Playmobil figures and 3D printers to our healthcare planning toolkit

BY MARIA BARILLAS

What do German toy figurines and 3D-printed objects have to do with the size of patient rooms in a hospital? The toys and printed furniture are all about unlocking creativity, ideas, and communication. They're powerful additions to our collaboration toolkit for healthcare clients. Let me explain why.



We design collaboratively with our end users.

Our traditional design process involves conceptual design, schematic design, design development and construction documents stages.

During the schematic and design development phases, we typically have a series of data gathering meetings with the users of that facility in order to obtain vital functional information that will allow the design team to tailor our design to meet their needs, the needs of their patients and code requirements of local jurisdictions. In a healthcare project, these meetings are crucial to the success of the design, and so our communication skills and methods play a very important part on how much information is efficiently received and understood between designers and users.

When we're collaborating with a client, on the organization for patient rooms in a health facility refresh for example, we take the driver's seat and give the client design schemes that they can react to. We take their comments and either sketch it out in the moment or come back later and present options from their feedback.

Traditional methods for presenting developing designs have relied on two-dimensional plans and room elevations. While designers understand these drawings fluently, to some users these diagrammatic drawings might as well be written in an alien language. Much information can be lost, as they struggle to understand scale, drawing symbology, and how this translates in their mind to the real world. If a portion of the participants are struggling to read the drawings, and perhaps too bashful to ask questions, user engagement could potentially be impacted. Their silence might mean that important stakeholder information is not being shared.

I want to maximize user engagement—so what we design is what users want. I'm always on the lookout for new tools to add to my communication toolbox. >

WHEN WE INVOLVE THEM AND THEY ACTUALLY TOUCH THINGS, THEY LOOSEN UP, THEIR IDEAS FLOW MORE FREELY.

We look for ways to boost engagement in the design.

One recent Thursday afternoon we headed down to our second design development meeting with a group of anesthesiologists and surgeons for a new procedure room. Our first meeting had been difficult as both groups of stakeholders struggled to make their wishes understood. Equipment and personnel in the room shifted positions depending on the procedure and stage of the procedure. We needed to quickly explore snap shots of the room in use throughout the day to understand the space better. We needed to see the procedure room in four dimensions.

So, for this second meeting, with limited prep time we decided to create rudimentary paper and foam core cut-outs as a simple tool kit the doctors could engage with in planning.

We had an AHA! moment. As we presented this new tool, the doctors immediately approached the table and began to manipulate the room components. The conversation was rapid, animated, and productive. We had found a way to equalize the stage and give the users a turn in the driver's seat.

Even better, the interactive sessions explored several scenarios, satisfying space concerns for all personnel. And we proved that stretcher movement was feasible, under approving nods from the nurses. We also finalized equipment boom locations. We headed home with a well-developed design concept, and a thoroughly satisfied group of stakeholders. I had to explore this mode of presentation further.

We have to go 3D

The 2D foam core cutouts allowed for flexibility and improved engagement from our users. But we clearly had one more step to explore: We had to go 3D. With this third dimension, our users would better visualize the spatial relationships between room components, staff and the room environment in general. We settled on a one foot-to-one inch scale which was large enough for users to handle easily and maintain a roomful of participants engaged.

This is where the Playmobil set came in. The Playmobil City Life hospital kit is also built at the 1x1 scale and comes with many pre-manufactured room components and figures. It allowed us to set up scaled simulations of basic clinical environments such as exam rooms, recovery rooms and minor procedure rooms. The whimsical figurines also infused the process with a bit of fun. To represent more specialized components however, I knew we had to look elsewhere. >

We print 3D components from our digital models.

Of course, Playmobil doesn't have all the components we need, so we explored 3D-printing them ourselves. We gathered our relevant BIM families into a library, simplifying them slightly for ease of manufacturing—maintaining enough detail to make them identifiable—and printed them in-house.

Before long, we had a 3D-printed library that includes exam tables, mobile light fixtures, computers on wheels, chairs, case work, wall-mounted sinks, and garbage cans. Anything that might take up space within a room. While we do take hardline drawings to our meetings, we also overlay tracing paper and create multiple iterations as we explore a solution. The kit is even more flexible. Anything that can be moved, can be removed, and moved again. These kits make the process even more dynamic and fluid, as our sketches become three-dimensional and accessible.

Lurie Children's Hospital
Chicago, IL

A case study in hands-on 3D collaboration

We first brought out our newly constructed kits to a client in the southeastern United States for an existing outpatient cancer center specializing in head/neck, plastics, and voice cancer treatments. The client's existing space appeared to be undersized and lacked adequate clinical support spaces. The project was at the conceptual stage and our goal for the meeting was to help them define their programmatic needs and establish a vision for their planned renovation.

The meeting began with our team running through the client's existing program, bubble diagrams to understand flow and then moving on to basic planning scenarios to get and understanding of functional needs. The mock-up exercise would help us right-size the exam and treatment rooms, which then in turn would help us define a clinic module.

We laid out three Playmobil/3D planning kits containing typical components for exam and procedure rooms. A 1"x1" gridded base would serve as the floor of the room to enable the users to intuitively move the pieces within the room. Physicians, nurses and administrators alike were thoroughly intrigued by the models. From the get-go, they were engaged, and the brainstorming was energetic and productive.

We gave them the components (sinks, base cabinets, storage cabinets, exam table) to arrange and the ability to look at options such as a wall-mounted or mobile computer monitor system or swinging doors versus sliding barn doors. This helped the client see that a sliding door or wall-mounted monitor unlocks more wall space.

Through this exercise, all three specialties laid out their ideal exam and treatment rooms. Each of the groups had a Stantec facilitator helping the process along and answering questions. I moved from table to table to offer medical planning advice and guidance. At the beginning of the session they had all expressed how differently each clinic functioned and a desire for larger exam and treatment rooms. To everyone's surprise, by the end of the exercise they had found more commonalities than differences. We were able to reduce room sizes because of the efficiencies found in their layouts.

This process unlocked the potential to explore universal room concepts and consider designing adjacent clinics modules to allow for ebb and flow and increased capacity based on fluctuating needs.

Our use of 3D physical models coupled with more our traditional design tools put the users in the driver's seat, allowing them to articulate their ideas and needs unrestrained. We were able to achieve universal layouts for all exam and treatment rooms, reduce space required for exam (-6 SF) and treatment rooms (-28 SF) and better understand the clinic module configuration and the client's current shortcomings in clinical support spaces.

Best of all, our clients were comfortable and secure in their understanding of their current state in order to quickly make decisions for their future space. Their genuine satisfaction and gratitude was evident as we wrapped up the meeting and made plans for future meetings moving forward.

What's next?

We've seen how effective this collaboration can be in healthcare. Now we're curious to see how it can be used in workplace, hospitality and so on, anywhere planning collaboratively with the client is possible. One thing that we've uncovered is that the most engaging and collaborative technology isn't always on your digital screen.

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MORE HEALTHCARE DESIGN

For more on how Stantec is designing for virtual care and pandemic response.

Mary Bird Perkins – Our Lady of the Lake Cancer Center
Baton Rouge, Louisiana

ASK AN EXPERT

Why build modular residential buildings?

Architect **Larry Grossman** on how we are designing modular multifamily dwellings

INTERVIEW BY JOHN DUGAN

Modular residential project 28 Austin
Newtown, MA

How did you get into doing modular design for residential?

LARRY: I've been practicing architecture since 1985, and the multifamily practice at our firm was pretty well established some 15 years ago when we started designing a whole range of residential project types. Our residential design work was an outgrowth of our well-established commercial practice. And this modular project, though it was on the smaller side at 68 units, was an opportunity to learn something new with the goal of finding a better way to economically satisfy our clients.

What attracted you to designing a residential modular building?

LARRY: This was the first time I had an opportunity to work on a modular project and what interested me is that we've been trying for years to crack the nut on the economics of multifamily. We have been challenged to build more economically because construction in Boston is expensive, and prices are continuing to escalate.

This project was a bit unique, it was wood on top of a concrete podium but everything on top of the podium was to be built in a factory in Canada. The "boxes," as they're referred to, are almost entirely completed on the interior in the factory. Everything right down to the paint and the tiles on the wall and the carpets on the floor.

What are some of the benefits of modular construction for residential?

LARRY: For the region that we work in, New England, one benefit is that you're not building in the middle of the winter. Instead, you have a controlled environment and workforce. We visited the factory in Canada in the middle of the winter to see how they do it. It's almost like the old Ford Model T plant that's building the units. There is literally an assembly line where the boxes are built. They're moved across the floor on a pulley system to the different trades on site. It was really interesting.

We found the quality to be quite high and they benefit from working in shop conditions, not in rain and snow. I was intrigued because I thought this could be leveraged up with more practice, more sophistication to really save money. In this case, it saved us time and we got a superior product because of the controlled environment. But there are unique added costs.

Where are the additional costs?

LARRY: Each box is loaded on a flatbed truck and shipped one at a time. Transportation and storage have to be synchronized so that when you start to place the boxes, they all have to be ready. They need to all be stored at some location very close to the site because each day putting six to ten in place. There has to be a stockpile ready for installation. And because the boxes are transported outside, they must be tightly wrapped and able to withstand the elements—rain, snow, sleet. You have to make sure each modular box is watertight. It requires additional costs and logistics.

In terms of design, there's a certain duplicity in the materials. Typically, when we build with wood, a floor becomes a roof and then a roof becomes a floor. But with modular, because you're building a box, you have to build a complete roof and a complete floor in addition to duplicate walls for each unit. This duplication adds some cost but has tangible benefits such as better acoustical separation. >

AFFORDABILITY HAS ALWAYS BEEN THE CHALLENGE.

We've designed buildings with micro-units, which my colleague Aeron Hodges has written about extensively.

↑ Video with Aeron Hodges on living small, sharing more

QUICK LINKS

> Making the case for living small

> Are micro-lofts comingto the suburbs?

> Inside a micro-unit

What are some advantages of it?

LARRY: I think there's a great deal of potential in building modular for residential projects. From a design perspective, we're usually very site specific, we're always trying to improve upon our work and we rarely use what we've done before. But in cases where we want to minimize costs, we may be able to simplify, we could reuse some of our unit designs for a modular project. That encourages us as designers to come up with a kit of parts of standard modules. There are some real benefits to this approach, for example, to a developer. A manufacturer could put a package together, for say a hundred units of various types, and price that quickly. That can reduce the developer's risk. If you can determine prices early on, that's an advantage. Predictability of costs is very attractive as is predictability for project duration. If you know it takes six months to build a 50-unit project and that can be replicated, that's good.

And from the design side?

LARRY: The rules are different. The boxes are all plumbed and wired, panel boards and light fixtures are in, everything's in it's final location. Each box has these stubs—wires and pipes—that project out into the corridor. A crew comes through and connects everything up. But everything's there to be connected. It's plug-in. The rules are not onerous. It's a kit of parts that we have learned how to manipulate and exploit.

There are certain dimensional issues we must be aware of because we have to design a module that can be shipped by flatbed truck. For this project, the module we came up with doesn't vary much from 13 feet wide by 62 feet in length.

You can't tell by looking at a finished building that it's modular construction and wouldn't know that this was the methodology used to build it. Except for the module dimensions, there are really no other design limitations. And it doesn't need to be just an extruded form. The facades can step in and out. With balconies and bays. Some things are more cost effective but otherwise the possibilities are limitless.

How did this modular project come about?

LARRY: The backstory behind 28 Austin in Newton, Massachusetts is kind of interesting. It was a city-owned parcel, a municipal parking lot in an urban location next to a main shopping street just outside of Boston. The city put it out for development and its main stipulation for the program was that it had to retain the same number of public parking spaces.

A client asked us to join it on the competition. They brought in a partner, a husband and wife, team of architects who had some experience with doing modular construction. They suggested we propose a modular solution, so we could build it quicker which would be less of an imposition to that community than traditional construction. The community liked the idea that modular would take less time. We were the only ones who offered modularity and we won the work. Ultimately, we were able to accommodate residential parking in a below-grade garage. We lifted the building up and we were able to replace all the community parking by tucking it behind a small lobby and some retail space. >

Q Do you see a lot of growth potential for residential modular?

LARRY: We need to build tens of thousands of housing units in the New England area over the next several years just to meet demand. And the construction process hasn't changed that much over the course of my entire career. There are still men and women on the site nailing one piece of wood to another piece of wood. And a plumber comes in and attaches one piece of pipe to another piece of pipe and then electric puts the wire in. They all drive, they bring their trucks in, the materials in. It's very linear and slow.

There's an opportunity on the manufacturing side. This assembly line approach offsite offers a lot of advantages. I think it's in its infancy. If a factory fell into place in the Boston area where they could actually build modular units close by, where we could inspect them locally and have local transportation and labor force, I think the program could take off. D

Modular residential project 28 Austin
Newtown, MA

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MORE RESIDENTIAL

John Dugan is the Editor of the Stantec Design Quarterly. **Larry Grossman** leads the planning and design of large-scale, mixed-use residential, commercial, and retail projects from the Stantec Summer Street studio.

Virtual reality still of UCSF PCMB

FINAL THOUGHT

Why VR matters

It might not be in your home, but virtual reality is reshaping our healthcare design practice.

BY JESSICA O'REGAN

UCSF Bakar Precision Cancer Medicine Building (PCMB)
San Francisco, CA

See a project in virtual reality.

Instructions

[1]**From your iPhone camera app**, scan the QR codes below and select to open in Safari. [2]Click the viewer icon (looks like a mask) on the bottom right and place iPhone in the cardboard viewer. [3]Rotate phone and place in cardboard.

Step 1

Step 2

Step 3

UPMC Pinnacle Harrisburg, Neo-natal Intensive Care Unit
Harrisburg, PA

UCSF Bakar Precision Cancer Medicine Building
San Francisco, CA

How we use technology, creatively, internally, and externally is important. When we use it wisely, it can unlock possibilities for our projects. A prime example of this is virtual reality. Hyped in the media for years, VR has not been adopted into everyday life at home, except perhaps by the gaming community.

Designers, however, know how powerful it is. It's been a game changer for my work in healthcare design. How?

Clearer communication
As healthcare designers, our process is based on clear communication. We begin a project by listening to our clients and gathering information. We strive to understand the client's way of working, its culture, its future needs, and ultimately its goals for a new space. Traditionally, we translate this information into floor plans and elevations that we then present back to the client for feedback.

The challenge is that most end users are clinicians or health practitioners, not design professionals. They aren't trained to interpret a floor plan. If it's their first time looking at a two-dimensional drawing, it can be hard to understand the space and how they will work in it. We've developed 2D plans and sections and 3D axonometrics and renderings to help, but this can be laborious. We still find translating design information between these different mediums can be confusing to users. So, we were always looking for better ways to make sure that everyone is on the same page.

Envisioning a new space
One of the big hurdles in designing a new space is that our clients often struggle to envision their future space. They just can't picture it. They may forget or confuse the details of the new floor plan and keep relating things back to their current, likely outdated, space. While we might want to replicate some valuable elements from their current layout, the health system stakeholders often want to improve workflows and make sure that the new facilities support new ways of working. VR helps us overcome the limitations of two-dimensional drawings and broaden our client's vision and understanding of what is proposed. >

VR allows us to collaboratively help users to understand the look and function of various spaces from multiple perspectives as they make significant decisions about design.

Touring and design imagination
Historically, we've used touring other recently completed facilities as a method for demonstrating new ways of working and concepts in healthcare. This presents a challenge, however, that we are not replicating the place we tour or the client's previous space. The client tends to cull bits and pieces from the tour together with elements of their existing space. When it comes down to it, we've found that they might not have a solid understanding of what they are agreeing to for the future space. As designers we want to share the design vision and help clients picture what's possible beyond what already exists. VR is a great addition to touring existing facilities because it allows us to show the aspects we are replicating and confirm expectations. How have VR walkthroughs changed our design process and projects?

Virtual reality walkthroughs of design concepts provide us with a common language so that we can all understand, identify challenges, and work to develop shared solutions.

The virtual walkthrough
We've found that it's most effective for us to begin by walking the client through the space. We can guide them through the patient experience from arrival, to registration, to waiting space. We consider each experience from multiple perspectives (patient, nurse, staff, family) so users understand what a room looks like and functions from each perspective. With VR, we take them to key areas, then we have the user try on the goggles and understand the space from each perspective.

In one instance, we showed a client three floor plan options and they immediately picked option C and had no interest in option B. They just didn't think it was right for them. But when we presented those options again in VR, we presented option B again to give them all an equal chance. >

Someone immediately responded, ‘Now I see that's where the sink is in option B. That’s the right one, why aren't we going with that?’ That's a clear indication of how often the client might see things differently from a floorplan to a virtual experience.

On another project, a client was evaluating the need for a computer for every infusion bay or one for every two infusion bays. They initially budgeted for just the one computer. But seeing the infusion bays in VR, they realized that its distant positioning didn't allow for the level of patient privacy required to complete the personal questions required for treatment. The virtual environment quickly uncovered this privacy issue. With the issue identified early and addressed, we expect greater patient and nurse satisfaction with the completed space—a win-win.

Externally, no surprises
Previously we may have shown our design intent in carefully selected renderings of the most significant spaces. While those renderings are still valuable, with VR, we can show that design intent in the selected area, but also what’s around the corner, down the corridor, everywhere. By engaging in a virtual walkthrough with our client, we can shine a light on our design intent more thoroughly.

With a recent project for UCSF Bakar Precision Cancer Medicine Building, we rendered the entire model with finishes and we were able to walk down every hallway and confirm that floor patterns and colors were in harmony. With VR we can drill down to those details, explore the space in 360 degrees from every vantage point and reduce the chance of surprises during construction.

Collaborating with contractor
With our UCSF Bakar PCMB project we were co-located with the contractor and during our weekly meeting about interior elements and we could virtually walk around the space with them to understand how we can achieve the desired design while staying on budget. VR was a hands-on collaborative tool for realizing our design.

Quick assessments
Capital projects are complicated. Budgets get squeezed, priorities change, timelines get compressed. It’s a reality of our industry.

VR helps us stay nimble and add value to our clients as they make tough decisions. Our recent work with Main Line Health is a good example. They had a very short window in which they needed to reevaluate some of their pricing assumptions. We were able to virtually walk them through the design, talk about key elements, get more accurate pricing figures, and help them make smarter decisions about where to invest.

→

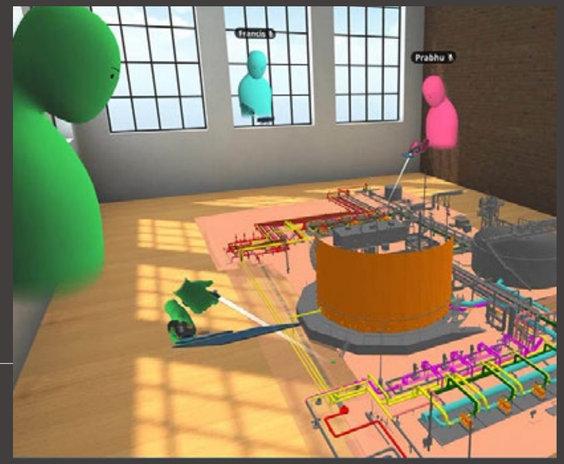
Video

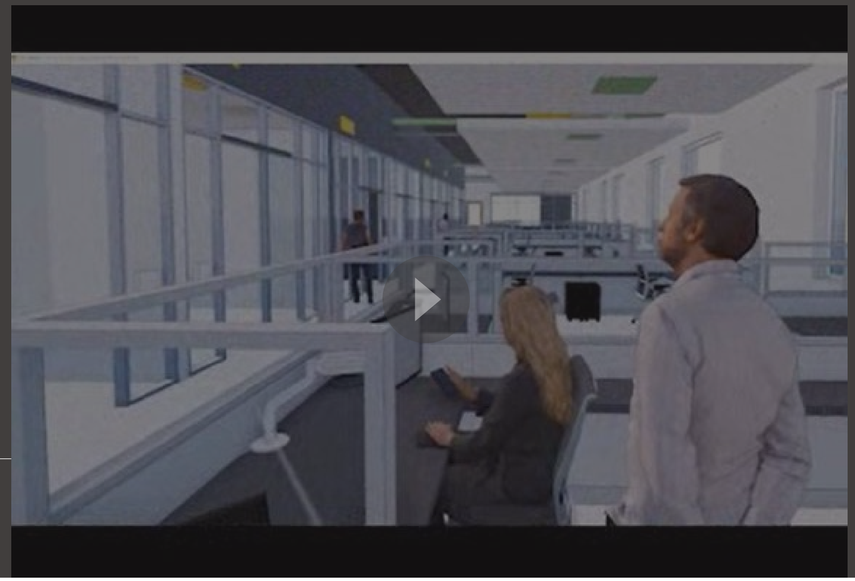
See why a **virtual walkthrough** is valuable for communication in interior design and architecture

SPOTLIGHT

How Stantec is using virtual reality

How remote Insite VR meetings help design teams overcome the challenges of COVID-19





Exporting views
When we can't share a full VR experience, we can always export a 360-degree image. We've started including these views in our documentation or pricing drawings and for reference in the actual construction documents so that our contractor understands our design intent.

Using it on small projects, getting past the novelty
VR is starting to become more of an expectation on projects. I am doing a series of lower budget temporary renovation projects for a client right now. While the client isn't making a huge capital investment in these temporary spaces, we still find value in producing 360-degree renderings and showing them VR walkthroughs of their space. We believe there is long-term value in introducing virtual reality as a design tool for future projects. Ideally, our clients will become accustomed to the technology so that they can focus on making major decisions rather than the novelty of the technology.

Right now, people can get distracted by the wow factor of the VR experience itself. But someday soon I believe that VR will be an everyday experience. D

Scan the QR code with your smartphone camera to see the UPMC Pinnacle Harrisburg, Neo-natal Intensive Care Unit in Harrisburg, PA

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MORE HEALTH

Based in our Philadelphia office, designer **Jessica O'Regan** is passionate about create healing environments that are beautiful and functional.

DESIGN QUAR-TERLY

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