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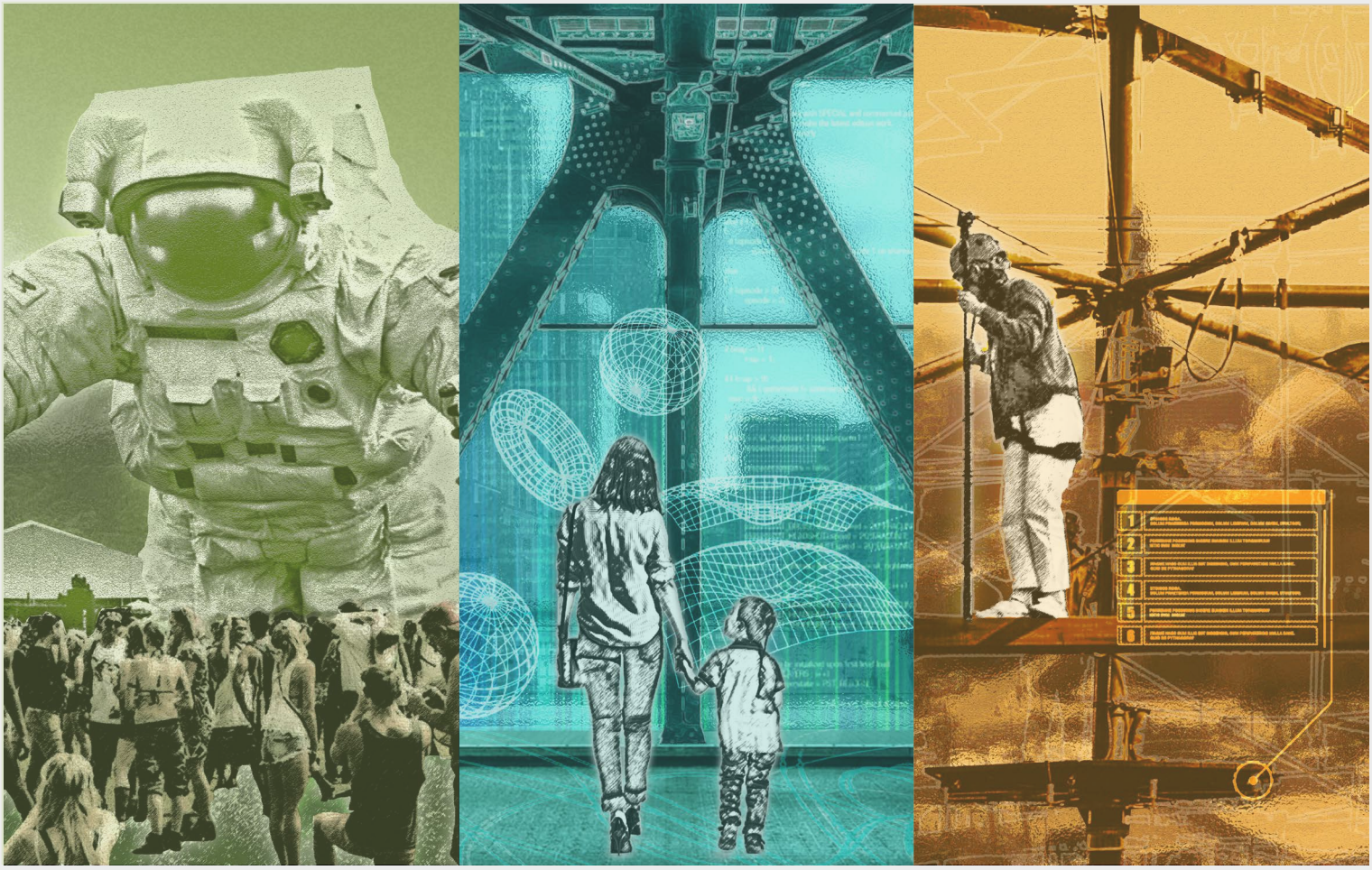


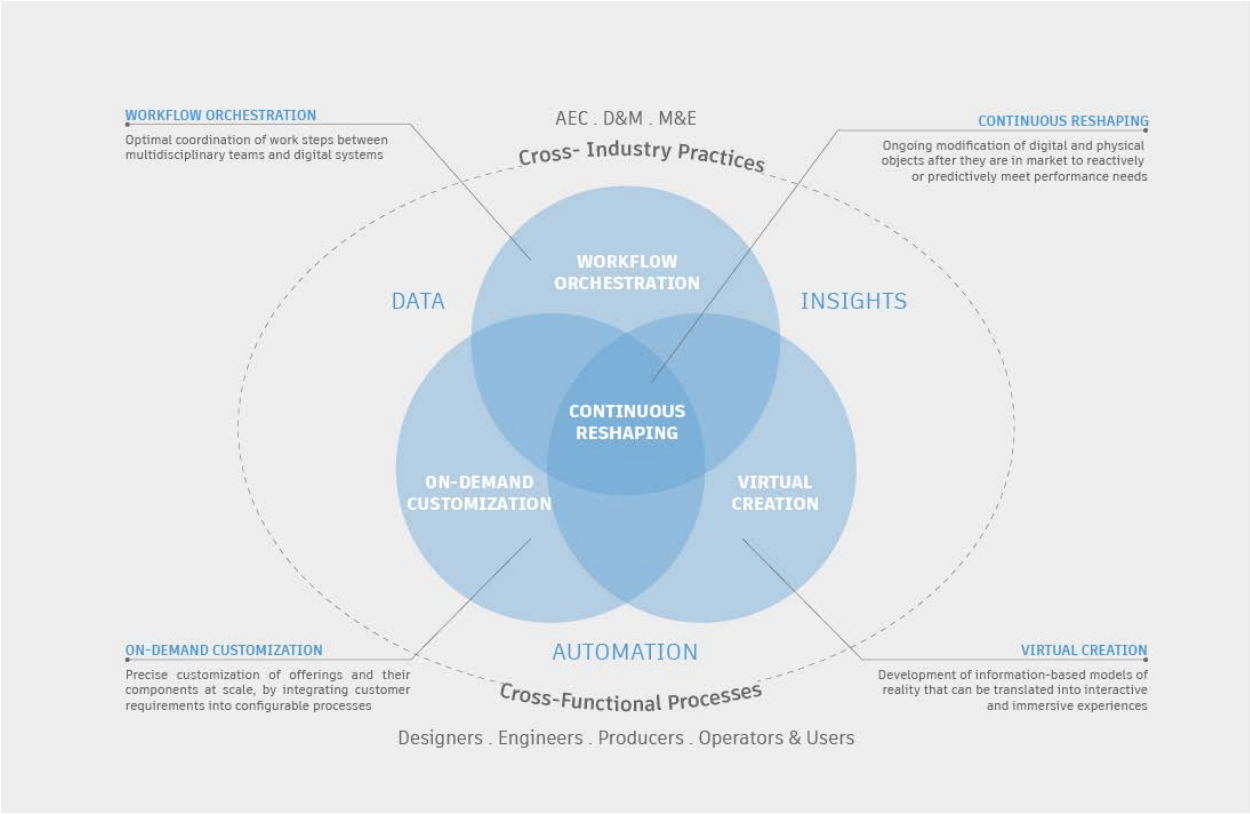
FUTURE SCENARIOS ON CONVERGENCE

Strategic Foresight Team

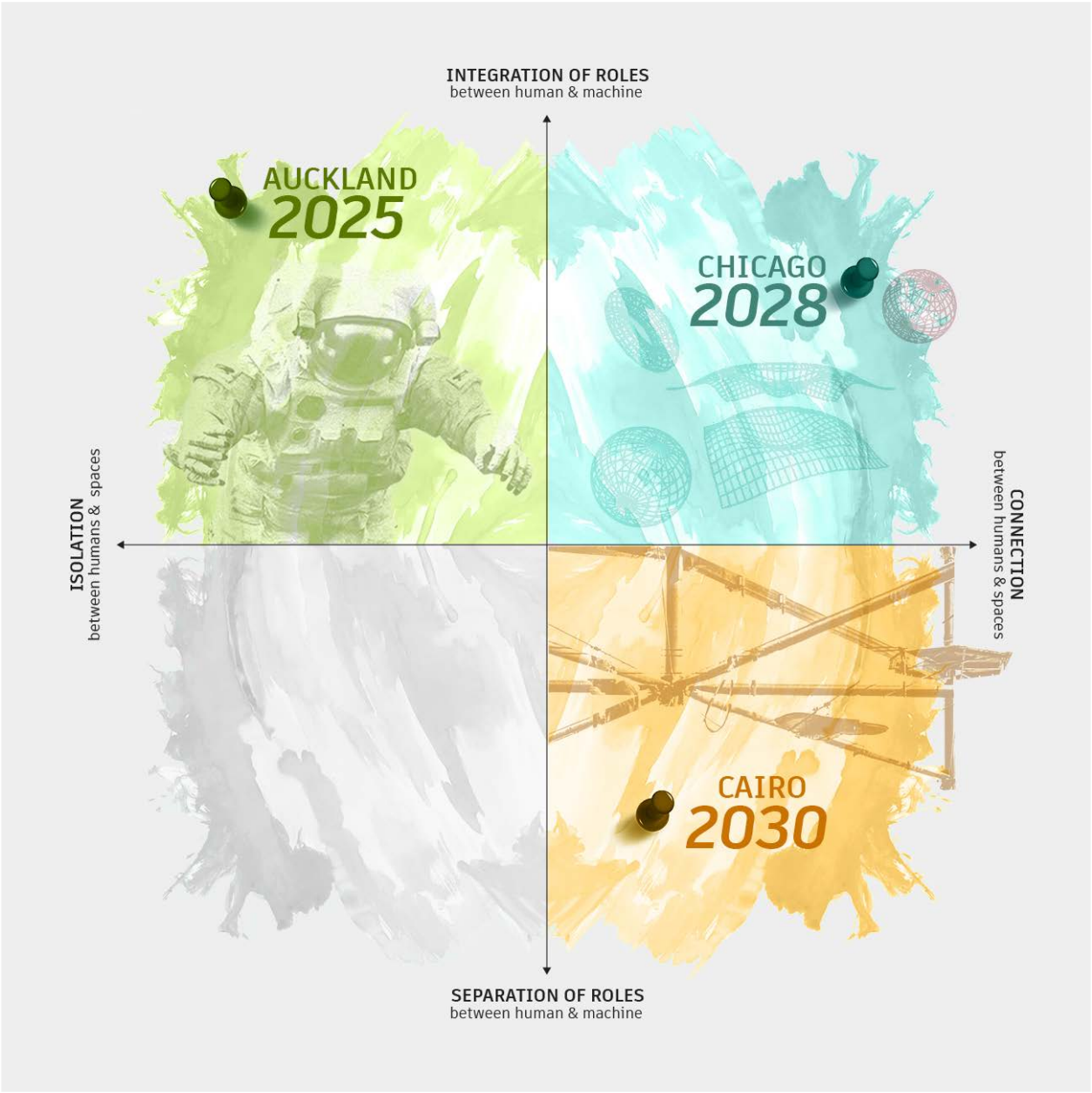
Autodesk's corporate DNA conditions us to always think ahead.

Since the early days of AutoCAD, we have continuously speculated where technology trends and democratization of tools might take us, and we have built a successful business around it. Nowadays, the practice of Strategic Foresight brings intentionality and disciplined co-creation to this process, so we can examine our strategic choices to chart the path towards a preferable future. Convergence is an important example of an area where different teams within the company have come together to explore various future states, drafting an impactful point of view around the topic.

Key to understanding the different paths Autodesk could take in the face of convergence are scenarios. These are stories and illustrations of future states. They can be optimistic, pessimistic, or even strange. Comparing their implication educates us about the human experience in the worlds we describe. By articulating different scenarios around the convergence of processes, supply chains, and even entire industries, we hope to gain a better understanding of how value increases for our customers and how Autodesk can act as an accelerator.



The Convergence Story Framework

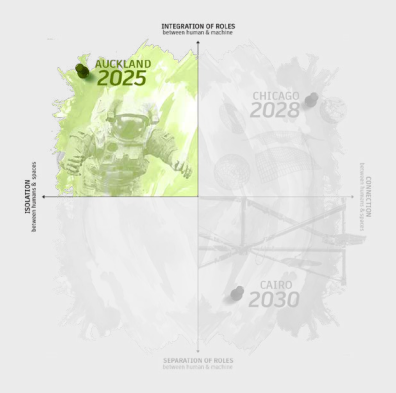


X AXIS: CHANGE IN RELATIONSHIP TO BUILT ENVIRONMENT

Y AXIS: WIDESPREAD INTELLIGENT CO-CREATION BETWEEN HUMAN & MACHINE

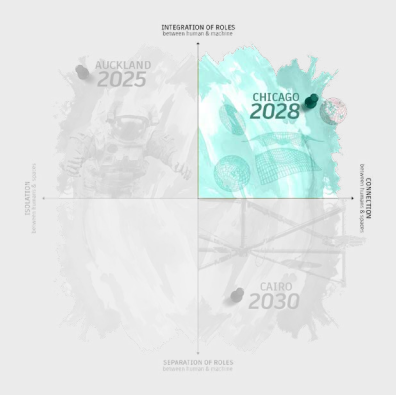
Scenario Matrix

Scenario Overviews:



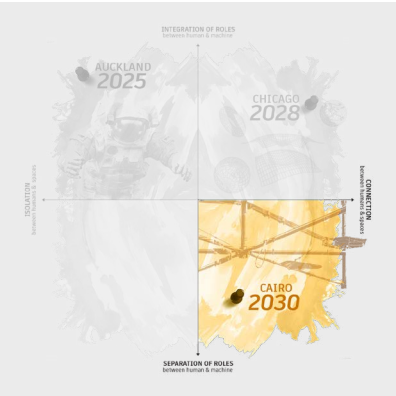
Auckland 2025: Augmenting Circular Realities

Taika Waru is a 28-year-old manufacturing technology manager. Taika works for Epic Entertainment who (for the first time) will be holding an augmented reality music festival just outside of Auckland, marketed as zero waste. Taika's goal is to ensure the massive festival set pieces are built on time and for easy assembly and disassembly. Using AR technology originally developed for entertainment purposes, Taika successfully tests a prototype with his adapted software and connectors that he has 3D printed. He feels he has landed on an effective build and reuse plan. However, Taika's manager wants him to get the set pieces built as is, waving Taika's sustainability goals. Being Maori, Taika is highly conscious about the environment and deeply saddened by the high level of waste generated by New Zealanders. With the help of an entrusted friend directly impacted by this new technology, Taika will have to learn how to speak up for the value of his work and show his boss that efficiency and sustainability can easily work together.



Chicago 2028: Trusting Machine Intelligence

Emma Lee is a 35-year-old experience designer. She is developing a permanent interactive experience for the entrance hall of the Warped Park Tower, set for completion in 6 months. Emma is leading the project with Emilio, an architect at the firm. And, working alongside them both is SHEILA, the software program that helped design the entire building and is now helping design and render the experience. Emma and Emilio both have problems with SHEILA, but where Emma sees hope in machine intelligence, Emilio wants to stop working with it entirely. Currently, Emma feels she is at a roadblock with the project and is having repeated disagreements with Emilio and SHEILA, who is making more decisions than Emma feels comfortable with. Meanwhile, Emma's seven-year-old son is getting into trouble. Through her overlapping roles as a modern mom and as a manager, Emma will learn how to best modify the firm's project to better engage with its audience. Through watching her son interact with SHEILA, she and Emilio will discover how to reshape their project through trust in the program, utilizing both participant's creativity and machine intelligence's potential.



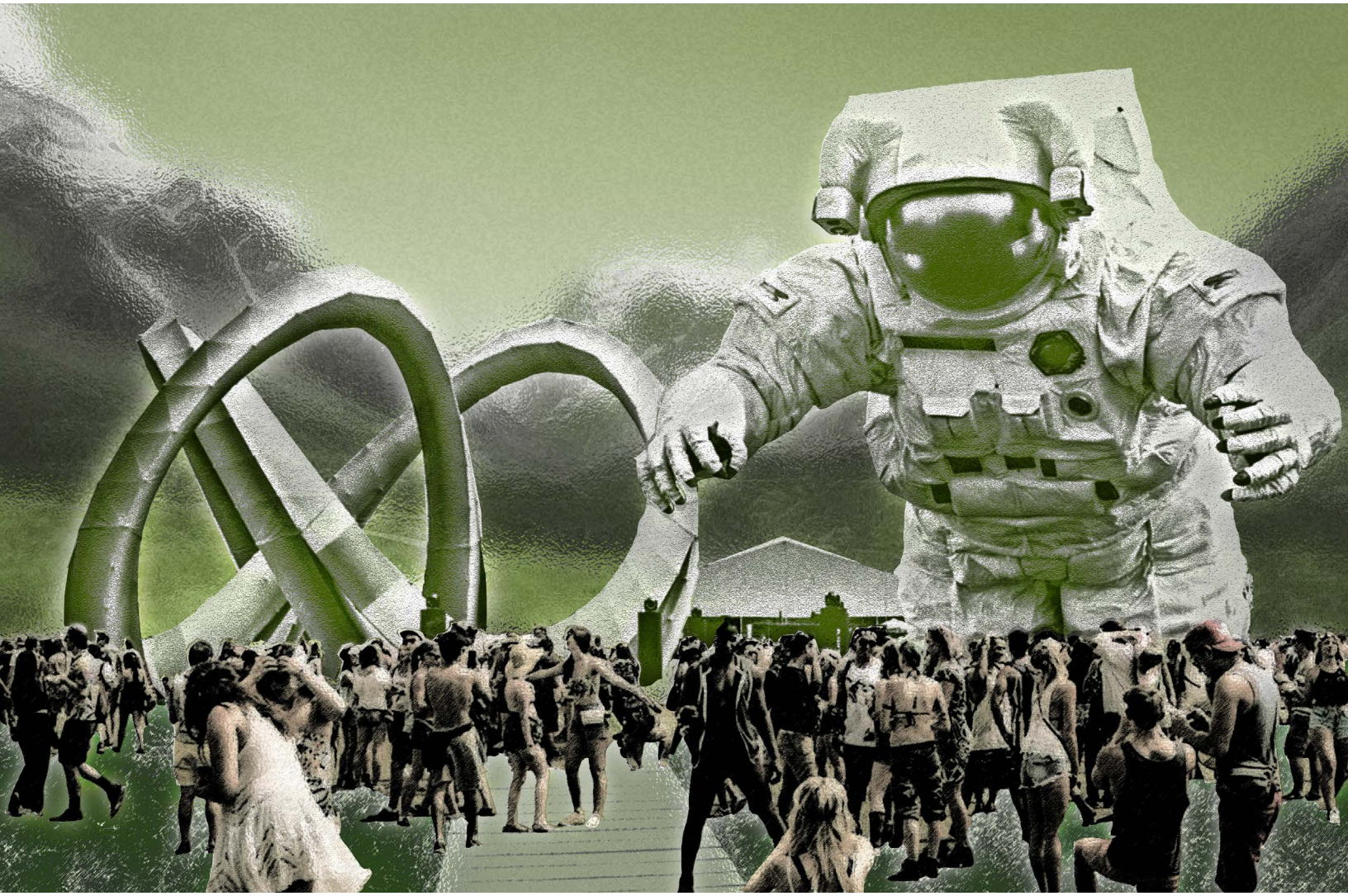
Cairo 2030: Orchestrating a Digital Twin

Hassan Abdel Hady is a 60-year-old construction company owner who lives in Cairo, Egypt. Hassan and his architect daughter, Mona, are working on Bouyoot, a residential project targeting the average middle-class Egyptian family. In its design phase, Buyout came about by aggregating and synthesizing data related to the project's local and contextual conditions, including budget, family size, building material availability, expected and unexpected environmental conditions, as well as universal best practices for mid-size residential design. This data-driven approach continues to the construction phase as digital twining allows for a continuous feedback loop between physical and virtual. Hassan and his co-workers recognize the value of this work method, but struggle to maintain a sense of agency as processes becomes too mechanized. As Hassan works on finding the right balance, he is reminded of the true value of hands-on, tactile, and cumulative experience. He reassures himself and his team that their expertise will remain to be the project's driver, and that technology serves as a supportive enabler.

Auckland 2025:

Augmenting Circular Realities

We are in Auckland, New Zealand, in the year 2025. This is a time when people are engulfed by the digital world. The need for awe-inspiring experiences necessitates going all out in order to immerse ourselves in worlds where imagination has no bounds. Creating digital experiences that are seamlessly integrated with physical objects means that people are accustomed to working collaboratively with machines. Taika Waru is a 28-year-old Manufacturing Technology Manager at Epic Entertainment. Working towards an augmented-reality music festival, he is at a breakthrough in the design and make process, one that can save time, money and avoid, what may otherwise become, a very wasteful event.



Auckland- Scenario Artwork

Auckland- Scenario Persona

Taika puts on his pair of Augmented, pushing them up to sit better on the bridge of his nose. His pile of prototype pieces lies messily on the ground in front of him, with metal rods of different lengths and the adjustable 3d printed connectors that he had designed himself. Augmented's welcome menu fills Taika's vision. He locates the experience: "Assembling Dave with Augmented". Dave is the 100-foot tall astronaut from Epic Entertainment's newest season of Fortnite, set to stand next to the main stage at the upcoming augmented-reality music festival. Taika is attempting to build a 1/16th scale version of Dave. Working on it for months, he has been modifying the Augmented-enabled binning and assembly solution that had worked for other companies and adapting it to his own challenge: Dave. Blinking twice, he launches the experience, and is ready for the first test. Numbers appear on each part of the model, and an outline of the prototype's first layer lights up on the floor. One of the pieces to Taika's right pulses, as well as its corresponding spot on the floor. "Yes!" Taika grabs the piece and sets it in its place. A connector lights up. Now, his Augmented tells him exactly how much to rotate the piece, and the correct angle is overlaid on top. After the piece is assembled, Taika switches to disassembly mode, and the process repeats in reverse. Although this time, he is told where to put everything away. He claps loudly in his excitement. Then, he stops. Now that the assembly and disassembly systems work, Taika has to talk to Carrie, the head of the entire festival. He can feel his hands clamming up already. "Oh crap."

"Carrie will join any minute", Taika thinks to himself as he nervously stares at the meeting interface. "Ohhhhh, she is connecting to audio," his heart is racing much more than it usually does before his "very important people" meetings. "Taika! What can I do for you? Your email sounded mysteriously urgent considering we just caught up the other day" Carrie chimes in with her commanding tone of voice. "Hi Carrie. I hope you're doing great. Is the weather good in the Bay Area?" With a day full of back-to-back meetings, Carrie has little patience. "Taika! It's California and the weather's always great. In a few sentences, tell me what the problem is. And no rabbit holing into details, please." "What a lovely start" Taika thinks to himself.

34%

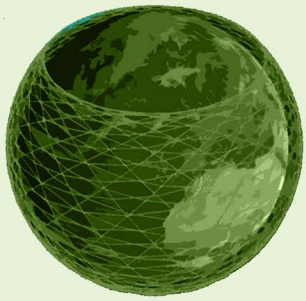
Maori representation in New Zealand Parliament

12,831

Tons of garbage pulled off New Zealand beaches in last year

87%

Of waking hours spent by Gen Z looking at screens



45%

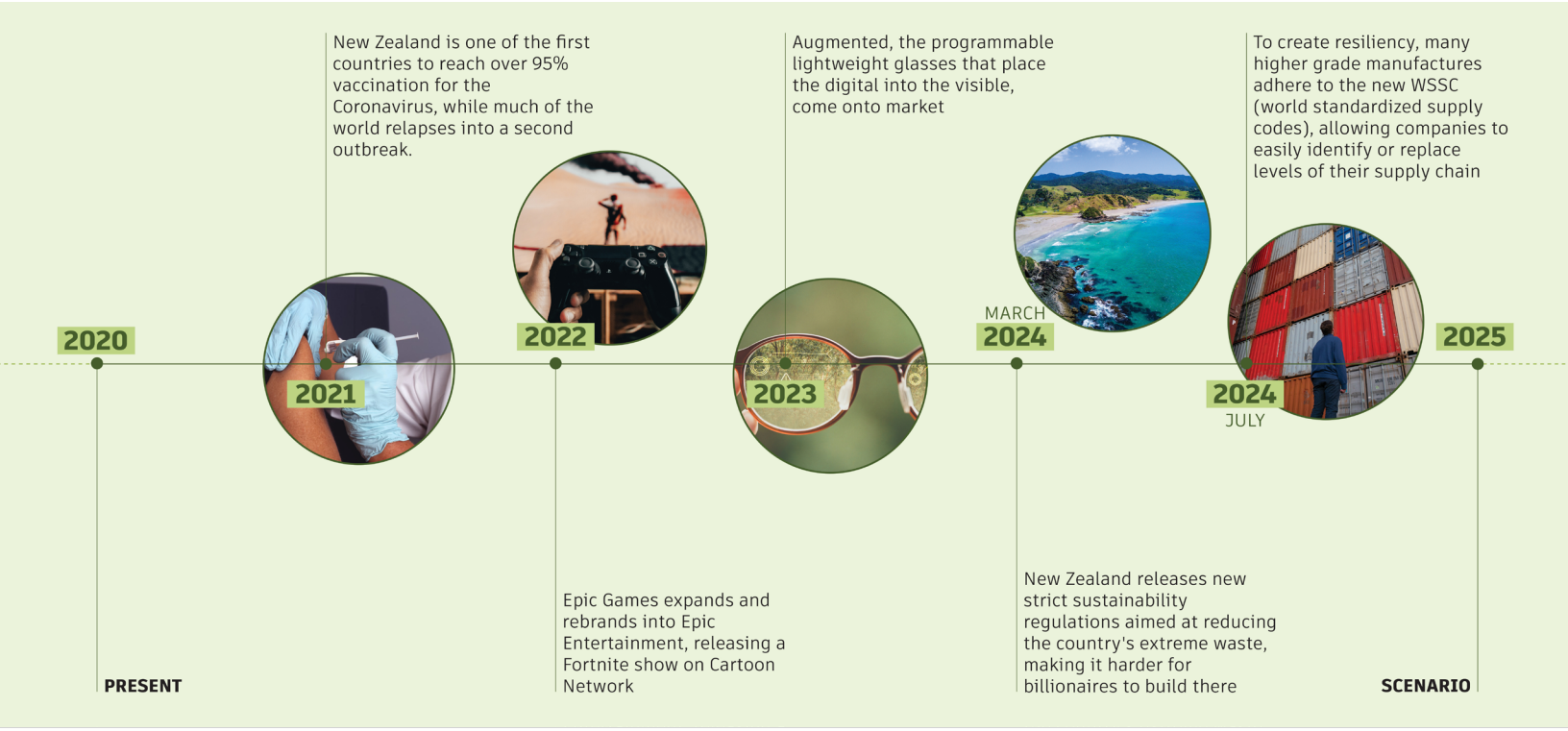
Of New Zealanders using Starink internet

Auckland- Speculative Statistics

"So... Dave is over a hundred feet tall, which poses a problem for manufacturing in terms of material efficiency and waste production. A skeleton is needed for construction and if that it is welded together, the skeleton can't be reused. Given that this is supposed to be a zero-waste festival..." "Taika, what is your point?" Taika hopes she can't sense his terror. "Yes, well, I think I might have figured out a way to use Augmented not only for Dave's design, but also for its assembly and disassembly. I have seen it work before and I know it will reduce the amount of material needed, which will also cut waste. If we do this, we won't have to outsource manufacturing to the Indian supplier. It works because I, I made this connector joint, and..." Taika gets up to look for it, more nervous than he's ever been. "Come back Taika!" He hesitantly sits back down. "Look, I know you're probably stressed about all the regulations in your country. Trust me I am too, but we've done enough sustainability work already, and with the audience members each getting a pair of Augmented, the festival is already half digital. Isn't that impressive? To be frank, I just don't have time to learn about what this method of yours is. Go back to constructing the set pieces using a mold." Carrie looks away at a call she is receiving. "Um, actually Carrie, if adopted, this would require no extra training as assembly is quite easy and uh..." "Taika, lovely chatting with you today. I appreciate the valor, really, but I have to go." In miraculous speed, Carrie's image blinks out.

Taika slumps back in his chair, defeated. Trying to take his mind off the humiliation, he switches to the festival's website and plays its main promo video. A New Zealander's voice booms. "Are you ready for the most epic augmented festival of all time?" A young woman puts on a pair of Augmented. Suddenly, a stage and the larger-than-life Epic characters appear. As music blares, these digital giants dance with the crowd below. The scene changes to shots of New Zealand's mesmerizing landscape. "Experience music like never-before and immerse yourself in a 360-degree augmented experience. Other than the live performers, you won't know what is real! This once-in-a-lifetime experience will be held in the most beautiful nation on earth, and to preserve its beauty, everything will be absolutely zero-waste." As the narrator begins to list the live performers, Taika frowns. He is immensely proud to be involved in such a sustainable event for his country, which desperately needs to do better in their treatment of the environment. And yet, Taika knows not enough is being done to live up to this promise. He really thought that he had found a way to help. Taika droops his head. All that time wasted. Taika's phone beeps with a text from Ihaka. "How did your first test go?" As a fellow Maori New Zealander, the head of crew for a local events company, and a dear friend, Ihaka knew all about Taika's experiment. In fact, Taika had been hoping Ihaka and his crew would be signed to build Epic's event. Another text from Ihaka follows. "Zoom in five?"

"Kia ora! [Hi]", Ihaka's face appears. "What is so loud?" Taika stands to close the door. "Sorry the roommates are starting another round of Fortnite and you know how loud they'll be." Ihaka laughs. "All 8 of them? I'd go crazy." Taika sits. "So, Taika, how did the test go?" Shifting uncomfortably in his chair, Taika replies, "It worked, but, um, the thing is, I really blew it with my boss Carrie. She turned it down." "What?!" Ihaka exclaims. "This was going to make everything so easy! I thought your festival was all about sustainability!" Taika shrugs. "Carrie seems to think we've done enough on that front. I guess it's not really worth pushing the issue further." "Are you kidding me, Taika? Don't just give in like that, especially when it's something this important. What about kaitaki [guardianship]? I wish I could use Augmented like that for every event. I mean, we know it works! Taika's face lights up. "That's it! We need someone who's on the ground like you, to sell the idea to her. She does not care so much about how this will help our people, but maybe if she hears how it will help her operations..." Taika checks Carrie's calendar. "Can you join a call in two hours with Carrie and I?" Ihaka leans forward. "Absolutely."



Auckland- Scenario Timeline

“Two Carrie calls in one day is a lot”, Taika thinks to himself as he, once again, waits for Carrie to join the call. Although this time, he is more confident because he has Ihaka with him. Carrie’s face pops on screen. “Ok, Taika make it quick. I have another meeting in… Oh hi, who is this?” Taika starts talking. “You’re on mute!”, shout both Carrie and Ihaka. Fixing his mistake, he starts over again. “This is Ihaka. He and his crew are the best local team we can have to build the set pieces. They have a wealth of experience realizing music festivals in NZ and they’re already excited about using, uh… Augmented.” Carrie waves. “Lovely to meet you, Ihaka, but we’ve already settled this. We’re outsourcing the manufacturing efforts. It’s a done deal.” Taika inhales and sits up straighter. “I know time and money are important, but this is how you can cut costs and time along the entire supply chain, especially during assembly and disassembly. I want you to hear from someone who’s always doing this type of work … Ihaka?” Ihaka goes on to detail the horrors that his team regularly faces with these types of events, having to bill last minute and late-night overages to the production company, and how Augmented would solve his problems. “I would have only needed half my guys had we had Augmented, and I’m sure this saves money.” Taika chimes in with “In our case, that would be 85 thousand dollars on average, per set piece. Plus, if you build the frames this way, it can all be reused for later events by Epic, saving them hundreds of thousands in labor and materials. Carrie leans back in her chair, clearly thinking. “Well, I’m a little surprised by your persistence on this issue.” After what feels like ages of silence, she finally speaks again “Ok, here’s what we’ll do. If this demo is as great as you say it is, I’ll fly out next week and test it myself. If it’s easy enough that I can do it, then we’ll discuss the details of full development. I gotta run you guys, but Taika, expect another call from me.”

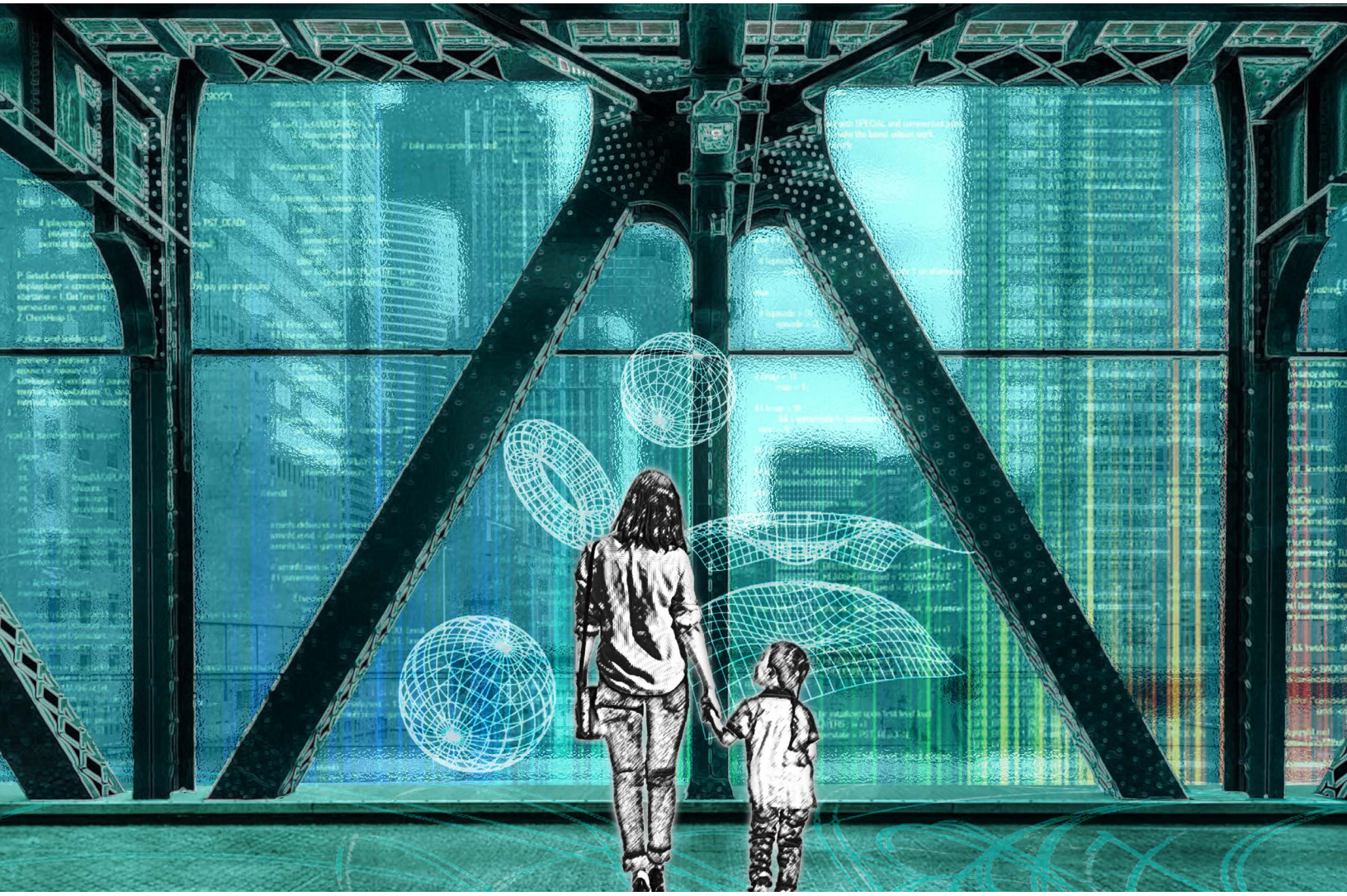
Taika is still grinning hours after his call. Yes, there’s a long way to go, but he’d already overcome the most difficult challenge: getting Carrie to listen. He can’t wait to get her and all the festival goers, to see how innovation can go hand in hand with sustainable practices. Placing Augmented back on his face, he is excited to work again. Taika daydreams about being at the festival, jumping up and down to the live music as the digital and physical worlds blend together, swirling around him.

Whatungarongaro te tangata toitū te whenua [As man disappears, the land remains].

Chicago 2028:

Trusting Machine Intelligence

We are in Chicago, USA, in the year 2028. The developed world has a strong bond to the physical spaces around them, working environmental and social concerns around the need for improved homes and workplaces. The division of tasks and responsibility between man and machine for the creation of these spaces is blurred. Emma Lee is an experience designer with a background in VFX. In the push for greater agility and productivity, Emma wonders whether humans have sacrificed creativity and ownership to the machine.



Chicago- Scenario Artwork

Chicago- Scenario Persona

“Who makes the decisions around here?!” Emma says, throwing up her hands, exasperated. A voice from the speakers responds. “Would you like me to revert my last addition?” Emma stands. “No, it’s fine. Just warn me before you reorganize image layers.” Emma continues to work on the backdrop. SHEILA adapts to each change, rendering the full image with only a few lines drawn by Emma. She glances at the training data, checking which past models are referenced for style. Considering SHEILA was used to help design and manage massive structures like skyscrapers, Emma wonders why her team with far simpler tasks couldn’t get on with her. The program is capable of designing, editing, and planning, all while completing advanced calculations about operational, environmental, and social needs. Currently, Emma just wants her to render an experience. She keeps trying for a brick facade, but SHEILA keeps putting in cinderblock. She taps that part of the screen. “Brick.” “Ok, Emma, but with tradeoffs, calculated brick is not the best choice.” The adjustment is made, but it is still gray. “For the thousandth time SHEILA, you shouldn’t consider tradeoffs with my work. This design isn’t ever getting built. You keep reverting to that. Can we just skip ahead to the version of you that actually knows what I want?” The brick changes to a different shade. “Remember, I’m just a generative algorithm, not a mind reader.” As a co-project lead, Emma has continuously played referee between SHEILA and her team, especially with Emilio, her architect co-lead. Even Emma, a longtime advocate of the software’s labor-saving powers, struggles to trust SHEILA, lately feeling like just an observer. When SHEILA is almost creating more creative content than Emma, it is hard for her to understand or have confidence in her work.

Emilio pokes in his head. “Have you seen SHEILA’s latest rendering of the tower?” Emma gestures for Emilio to set his laptop down, swiping his screen’s view onto her own. What appears is a rotating model of the 35-story Warped Park Tower in Chicago, which features a public park winding up the outside, set for completion in six months. “My gosh, Emilio, what did they change now?” He shrugs. “Something about the park layout. How do people approve of this? Emma zooms in on the model. NBBJ’s tower is a chance for it to prove itself in a new environment and provide opportunity, with universal basic housing in the lower floors, an adaptive factory and offices in the middle, condos on top, the whole structure powered by a Lake Michigan windfarm.

3
Days working in the office is standard for most white-collar jobs

813
Wind turbines in Lake Michigan

117
Miles of widened and new bike lanes in Chicago in last 3 years

32
Average age a woman has first child in the U.S.

Chicago- Speculative Statistics

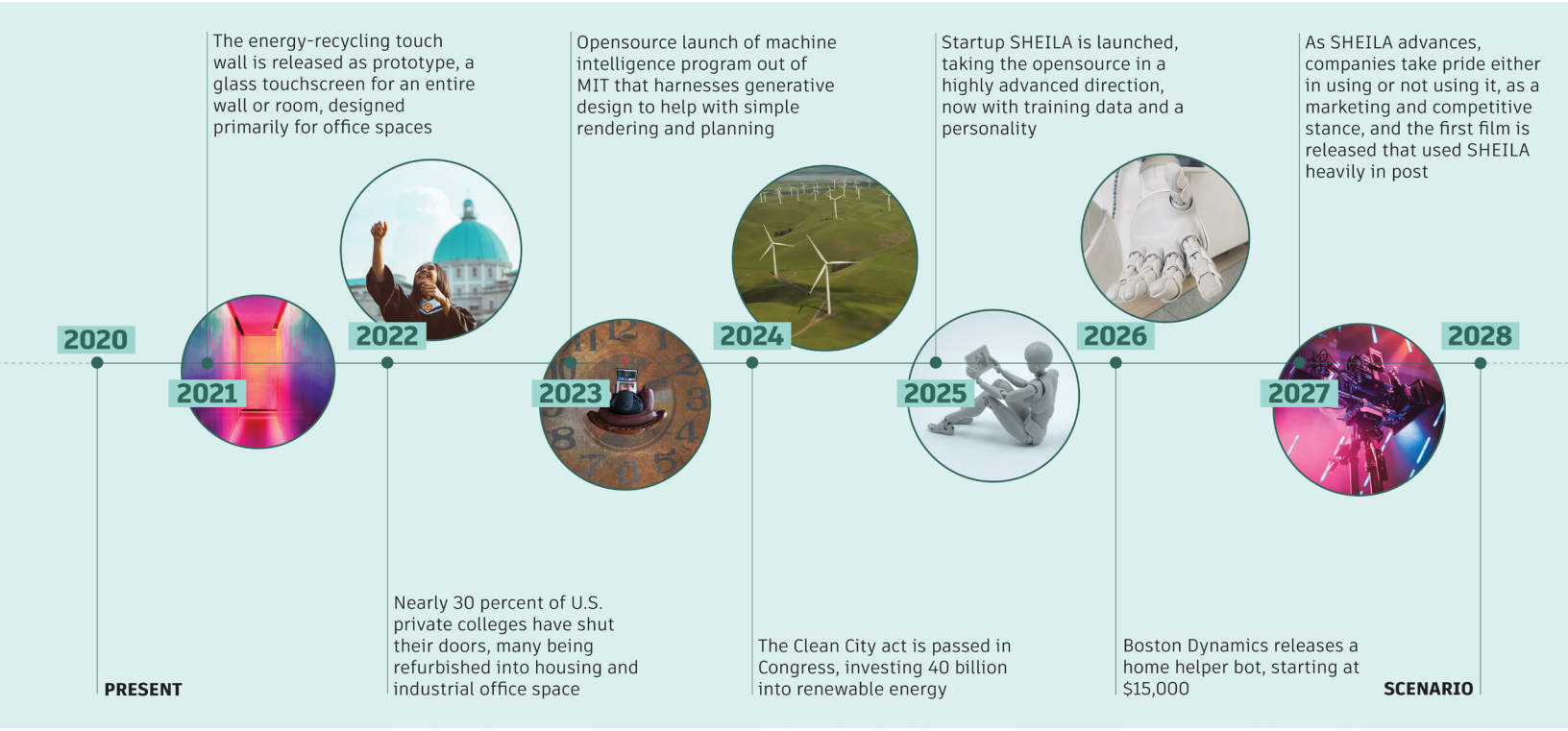
Drawn to work with the firm because of the Warped Tower, Emma knows she is one of many attracted from other fields to leave their mark on the structure. Her team's contribution to the tower will be a permanent immersive entrance hall experience, projecting a digital show onto towering fifty-foot glass walls. "Yeah, it's definitely frustrating with the workarounds this could cause, but I know these changes are probably for the best." For Emma, her project is an opportunity to scale the message of the excitement of the industry's future alongside machine intelligence and weave Chicago's rich construction history with the story of the tower.

Emma and Emilio view a rough cut of the 360-degree planned projection. Emma smacks the screen, pausing the show. "I don't like it. Something is missing." Emilio nods, "Yeah, but hard to know what that is with SHEILA. The whole thing feels off because it's not really our work, right? It's hers, and now we're behind by a week. Maybe we should figure out how to turn her off for a while. Might help..." Emma shakes her head. "We can always keep fine-tuning her training sets. This project would've taken five months with a team twice the size before... excuse me for a second." Emma's phone buzzes. The school is calling. Again. Her sweet little Danny apparently bit a kid and needs to get picked up. She ends her sparring session and leaves, as if she didn't have enough on her plate already.

An hour or so later, in a conference room, Danny gets time out in a pillow fort he quickly constructs from the meeting room cushions. She switches the wall to whiteboard mode. "Mommy's going back to her work. We'll talk more about what you did when we go home." Back in her office, Emma shovels down noodles in a working session with Emilio. She spins around when Danny yanks on her pant leg. "I made a racer car, and it's got fire, and there's going to be more and..." "Whoa Danny, slow down. What racer?" Danny bounds off, Emma and Emilio following him. Somehow, SHEILA had been left operating after the last meeting. Danny draws with the marker, yelling "another car". Make it fast!" A hyper-stylized neon vehicle appears next to his first, flames on its side and a tall fin off the back. "Space wheels!" Suddenly the cars float in space. Emma and Emilio sit, captivated by Danny's playtime with SHEILA. He excitedly accepts her input without question. Within ten minutes of more yelling, scribbling, SHEILA's "Oks", and running back and forth, Danny has filled the wall with his racer scene. Emma is amazed. As a child, he automatically hands over his complete trust, treating his co-creator like a playmate. Understandably, Emilio and their team have much more at stake and treat SHEILA instead like a potentially difficult coworker. Emma knows she is guilty of this too. She watches her son, now running back and forth with his hands on an imaginary steering wheel, with SHEILA throwing up a swerving race car alongside him. Emma didn't even know that was possible. "I think we should figure out how to work like Danny is doing with SHEILA. I might have an idea, but it will require more than just our team." Emilio nods.

Twenty weeks have flown by. Emma enters the entrance hall for the Warped Tower, Danny running a Hot Wheels car along the curved glass walls behind her. Emilio is already there, as well as most of her team and important stakeholders. The ribbon-cutting is at 7 PM. Behind those involved in the project is a rope holding back a crowd of people extending outside the large glass doors, waiting to enter.

Exactly at 7, the overhead lights darken, and the hall's walls light up with the show, moving through the years of Chicago's built history with famous structures, some now gone and some still standing, recreated digitally with people of the time walking around. Move close enough to one of the people and wave, and they might stop and wave back. Near the end of the 20-minute loop, the modern Chicago skyline appears, and one's attention is drawn to a time-lapse of the Warped Tower's Construction, highlighting layers along the way, like the prefabricated outer panels, the recycled water system, and the wind-driven electricity. Narration from SHEILA explains how, with her help, the firm considered the operational, social, and financial tradeoffs at every stage. Emma's team and the technical crew clap as the projected narrative starts over, but that is not the fun part.



Chicago- Scenario Timeline

After seeing her son's trust in SHEILA allow him to create his racers, Emma realized the key to rebuilding the connective collaboration between humans and machines is actually trusting the machine's input and relaxing the constraints of the training set, leading to more unusual designs closer to the person's intent. People are already walking up to designated portions of the walls. There, both kids and adults can draw with their finger and talk to SHEILA in order to reshape the Warped Tower, changing the capacity of its different living spaces, and its water and energy usage. SHEILA works with them, taking input from a camera set up watching the wall and projecting from overhead. In this way, the hall welcomes people to have a personal connection with the space. It is also a crucial element in the building's lifecycle, as SHEILA shall store the data from their designs for possible future adaptations of the tower.

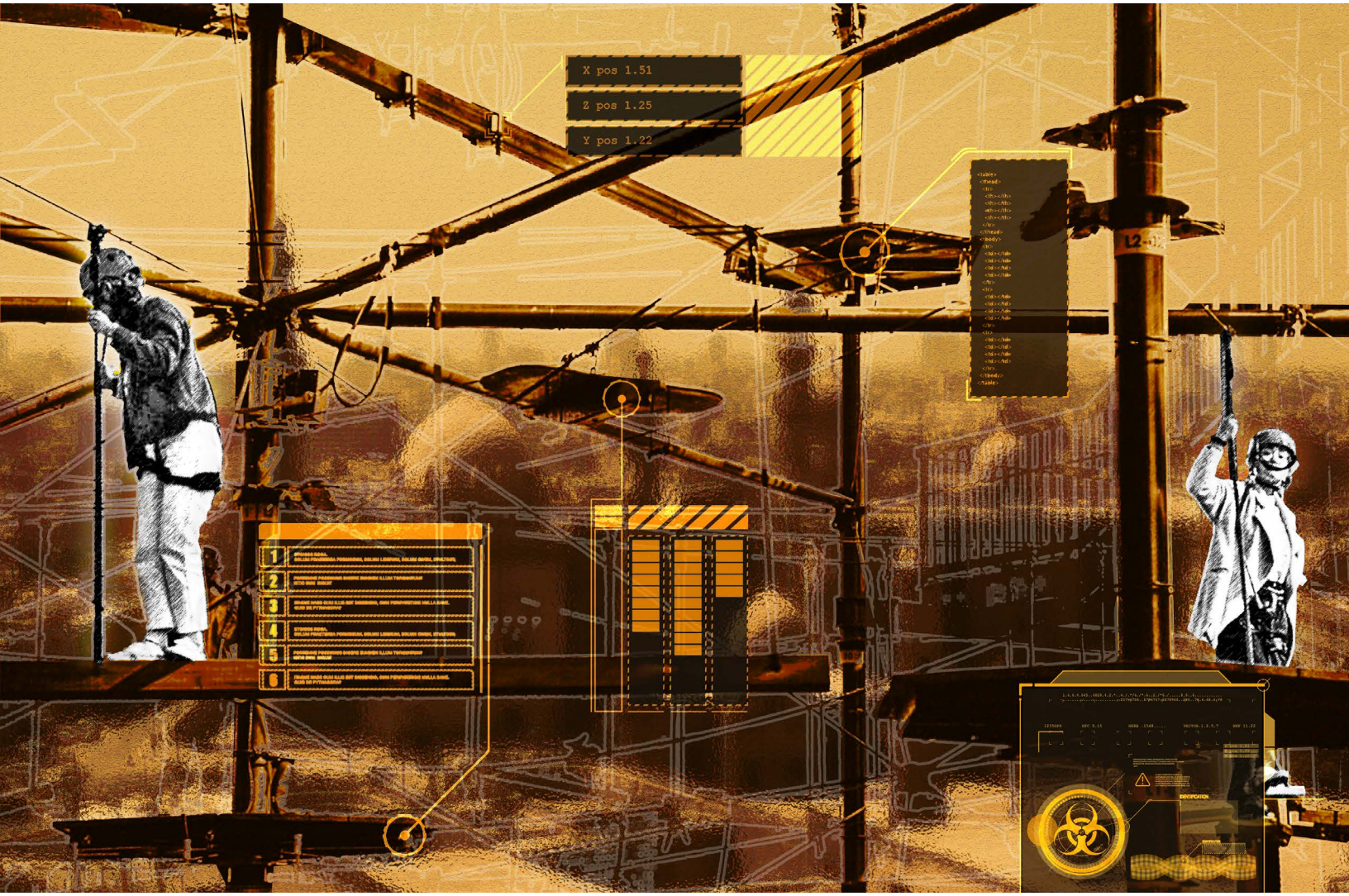
Emma wanders to the side as the public flood in. She spent so much of this project questioning if the experience was even deliverable, if she was in over her head trying to make an engaging experience while she struggled to engage with her co-creator. Now, Emma is proud that she got both her team and the public to collaborate with SHEILA, ultimately contributing to the continuous reshaping of the tower. Emma knows that it will not be the last time that she will have to push people to trust, SHEILA, and this new way of making. She welcomes the challenge.

Cairo 2030:

Orchestrating a Digital Twin

We are in Cairo, Egypt, in the year 2030. This is a time when human beings have developed a strong attachment to their built world, especially their home environments. Human ingenuity has successfully molded technology to best cater to our various shelter requirements, placing a particular emphasis on those most in need, and the ones who –most traditionally– have been left out of the equation. In order to construct these types of spaces, it became necessary to draw a distinct line between the roles that only humans can engage in, the ones where machines are needed, and the ones that require a collaborative effort from both.

Hassan Abdel Hady is an Egyptian construction company owner, who spent his life and career in his hometown, Cairo. With vast experience in delivering residential projects, he is using the UN-Habitat's new model "Sustainably-Affordable Housing" to construct a development of 2-story housing units and aimed at the average middle-class family. Having all the data is one thing, but working on-site –in context– is another matter altogether.



Cairo- Scenario Artwork

Cairo- Scenario Persona

Hassan gazes at his daughter, Mona. He saunters towards her workstation and tries to recount how long it's been since she moved from her chair or stretched her legs. "Hey, you doing okay, there? I don't know if anyone else would have put up with the amount of work this has been. Maybe I shouldn't have been as encouraging when you said you wanted to be an architect," Hassan says jokingly, with a twinge of guilt. Mona had been examining the 3D model of Bouyoot [Homes], a virtual replica of the ongoing work that has been happening on site. This digital twin is changing fast. Like clockwork, it reflects hourly changes to the site's machinery, material supply, and field workers' movement. "It's uncanny," Hassan says as Mona shows him how the construction workers have been progressing throughout the day. "I know they don't like the feeling of being watched" Hassan laughs. "They don't like it when I'm there with them, and they don't like it when I'm seeing their work from here." "Well you know that's not true", Mona counters with a smile. Bringing up Ayman, the head of crew, she elaborates, "Ayman keeps urging us to come down there more often. You know how much he ..." A little too enthusiastically, Hassan interrupts her. Eager to showcase his well-rehearsed Ayman impression, Hassan says, "There's only so much you can get from looking at a virtual creation, even if it's incredibly smart." Mona laughs. "This is your best impression of him yet, but I know –you know– he has a point." Hassan agrees.

Both Hassan and Mona have often talked about how technology like this was helping projects like Bouyoot. Looking back, some things were undeniably advantageous about how this work method had helped the design phase. The whole concept of residential design had utterly transformed. It is no longer just about designing and building in the most cost-effective manner without thinking about the potential occupants. Nor is it about lucky one-off projects where the circumstances happen to align and work for the benefit of the incoming families. Instead, universal access to data allows there to be 3D model templates of residential design. It isn't an exact formula, but these models serve as design-phase archetypes and adapt to a range of predictive needs.

29

Million people in Greater Cairo

$130

Per month salary of average Egyptian construction worker (2,078 EGP)

1.2%

Of homes in Cairo now self-regulating

20

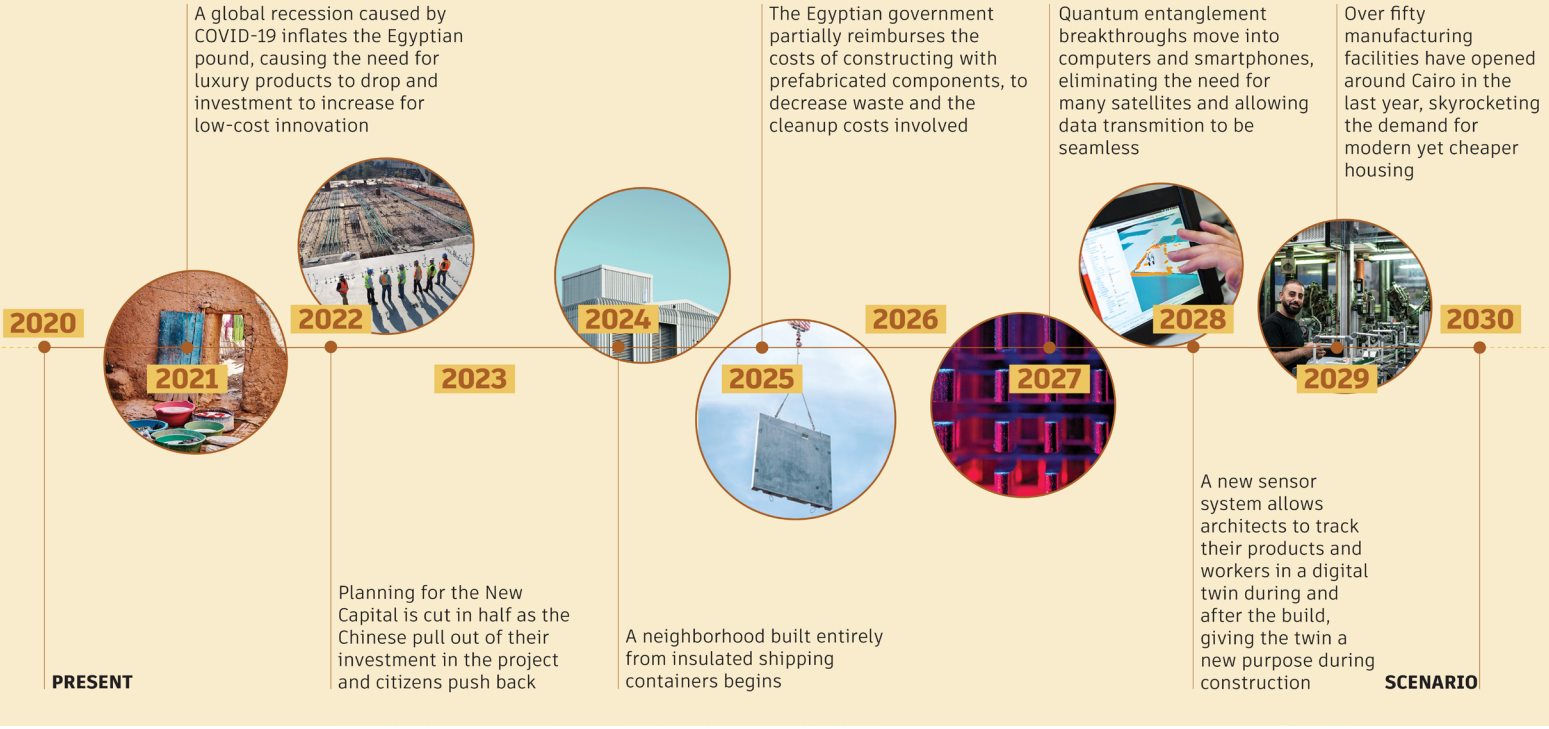
Days of rain in Cairo last year, above average

Cairo- Speculative Statistics

"You see… you'll never have two buildings that are exactly alike," Hassan would explain to a young Mona. "Even if, say… we want 7 identical twin houses next to each other, each with 3 bedrooms, 2 ½ bathrooms, an open kitchen, and an office room close to the door… you get the idea… They will never actually be the same." Mona would listen intently to Hassan during conversations like these. She had such admiration for how much her father enjoyed talking about his work and all its nuances. Indeed, Hassan could talk about this for hours. He would say, "knowing that you can't aim for exact replicability, your best bet is to celebrate these differences, working them to your own advantage." "It's like you are orchestrating all these variables together… like you are music composer of some sort, but in construction," Mona would tell him. When it was time to design Bouyoot 15 years later, Mona built on that same logic to convince Hassan to use the digital twin technology. "We will already have so many surprises on-site. Let's try to account for as many of those as we can upfront, so we don't need to worry about them during construction. The software will know the project's budget, it will know about Cairo's climate, and it will even know about the more extreme weather changes we're facing these days. It will give us indications of material availability, and it will just make our lives so much easier."

Hassan couldn't deny how empowering it was to understand these conditions from the get-go. All the while working with universal best practices of residential design. He did have concerns over methods like these simplifying design too much and giving architects and builders a false sense of full control. "I just worry that design is almost too simple now," he would say. "We can't pretend that construction challenges will be solved by algorithmic accuracy. They won't be." Mona would tease him, joking, "Is this your inner technophobe speaking? The one you so skillfully try to hide?" What she was referring to wasn't entirely untrue. Hassan was skeptical about solutions that seem to appear out of the blue, and that aren't stemming from years of experience in a particular construction domain and a specific location. Over the course of his career, he had been lucky to join forces with many skilled builders, who became his long-time team members and the key to his success as a construction business owner. He and his team worked together with such fluidity, and besides his daughter Mona, there was no one Hassan trusted more than Ayman, his head of crew. Hassan and Ayman built a relationship of mutual respect on the bedrock of playful bickering, and that kept their exchanges fresh and fun. Even more so than Hassan, Ayman was supremely tactile and hands-on, and of course, that meant that he had an even stronger love-hate relationship with the new construction technologies. Ayman grimaces in pain whenever people talk to him about how digital twins will solve any construction problem. For the number of times he's had to repeat this, Ayman has his mantra ready: "On-site, things get real. Too real for a digital model to be in control– even if it is getting smarter every day."

"Hi there" Ayman waves as he sees Hassan stepping out of his old Mitsubishi Outlander. Walking a bit slower than usual, Hassan puts on his shades and tries to mask his tiredness. Due to a long philosophical conversation he was having with Mona the night before, Hassan is already regretting not getting enough sleep and bracing himself for the long day ahead. Ayman smiles. "Wow, I see I finally convinced you that coming down here was more fun." Shutting the car door, Hassan replies, "Yeah… yeah… yeah. You'll never lose that one, will you? You know I'm here in time to oversee the motorized wall system being assembled in place." With a mischievous expression of surprise, Ayman exclaims, "Oh, so you're not here because you miss us? We're hurt!" Ayman and Hassan both laugh as they go into the building and ascend the stairs to the second floor. Sourced from a local prefabrication company, the wall system is a modern take on the traditional wood latticed partitioning. Hassan was particularly happy with this clever addition because it would provide flexibility and a sense of privacy to any incoming family.



Cairo- Scenario Timeline

The wall was composed of patterns that change orientation, varying the shape and size of the resulting gaps. Just in time to see the system operate, Ayman uses a remote to test the motorized wall panels, moving them to create instances of enclosed space, and changing the pattern direction to adjust its level of openness. “It’s looking really great! Yet another genius recommendation by Mona,” Hassan beams.

As Ayman puts the remote aside, his phone starts ringing. “Speaking of Mona, that’s her calling,” Ayman points to his phone and picks up the call. “I see the panel system is up and running, how is it looking?” Mona asks. “Oh, so you’re watching us, aren’t you?” Ayman teases. “Ha! Well, I have to make sure you’re working and not messing around, don’t I? I’m actually calling because the model is detecting a very small crack in one of the circular columns downstairs. It’s the one closest to the floor-to-ceiling window on the right. You may not be able to see it because it’s just a hairline, but I wanted you to check it anyway, just to make sure everything is okay. If you can also connect to the model from the screen downstairs, I can show you exactly where it is.” Hassan and Ayman go down to the ground floor and turn on the 60-inch screen set up in the corner. Still on the phone, Mona hovers the model around for better detection. “You can see it, right?”, she points at it with her mouse. “Yes, we’re on it.” Ayman says as he marches into action. He, Hassan, and a group of field workers examine the columns as Mona observes from her desk at home.

“Phew, I got really worried for a second there. Al Hamdulillah [Thank God], that it wasn’t a structural problem, but it’s still great that the model was able to detect the crack so early. We couldn’t have seen it on our own,” Hassan tells Ayman as he carefully sips on his extra hot red tea, exactly how he likes it, during their break. “Yes, Mona really is on top of everything, isn’t she? I still remember how excited she would get when she used to visit us on-site as a young girl. Look at her now, the lead architect on the project,” Ayman says, smiling. “I am proud of her, even if she’s making us use that software … that twin thing or whatever you call it,” Ayman couldn’t help but add that one in. “You’re worse than I am! What will Mona do with us both?” Hassan says, and they laugh. Back at home, Mona was, indeed, thinking about Ayman and her father. “They must’ve found something else to bicker about,” she laughs to herself and turns off her screen. Besides occasionally having to mediate between the two of them, it was amazing for her to think about how much knowledge they had both accumulated over the years. It’s the software that needs to catch up with these two minds: Ayman, the craftsmen, and her father Hassan, a composer in the world of construction.

Scenarios allow us to understand, relate to and envision the future. The ways of making are changing and converging. And we —at Autodesk — want to work with our customers to realize the most preferable future of making, with all the tools and technology that will make that future possible.

Strategic Foresight Team