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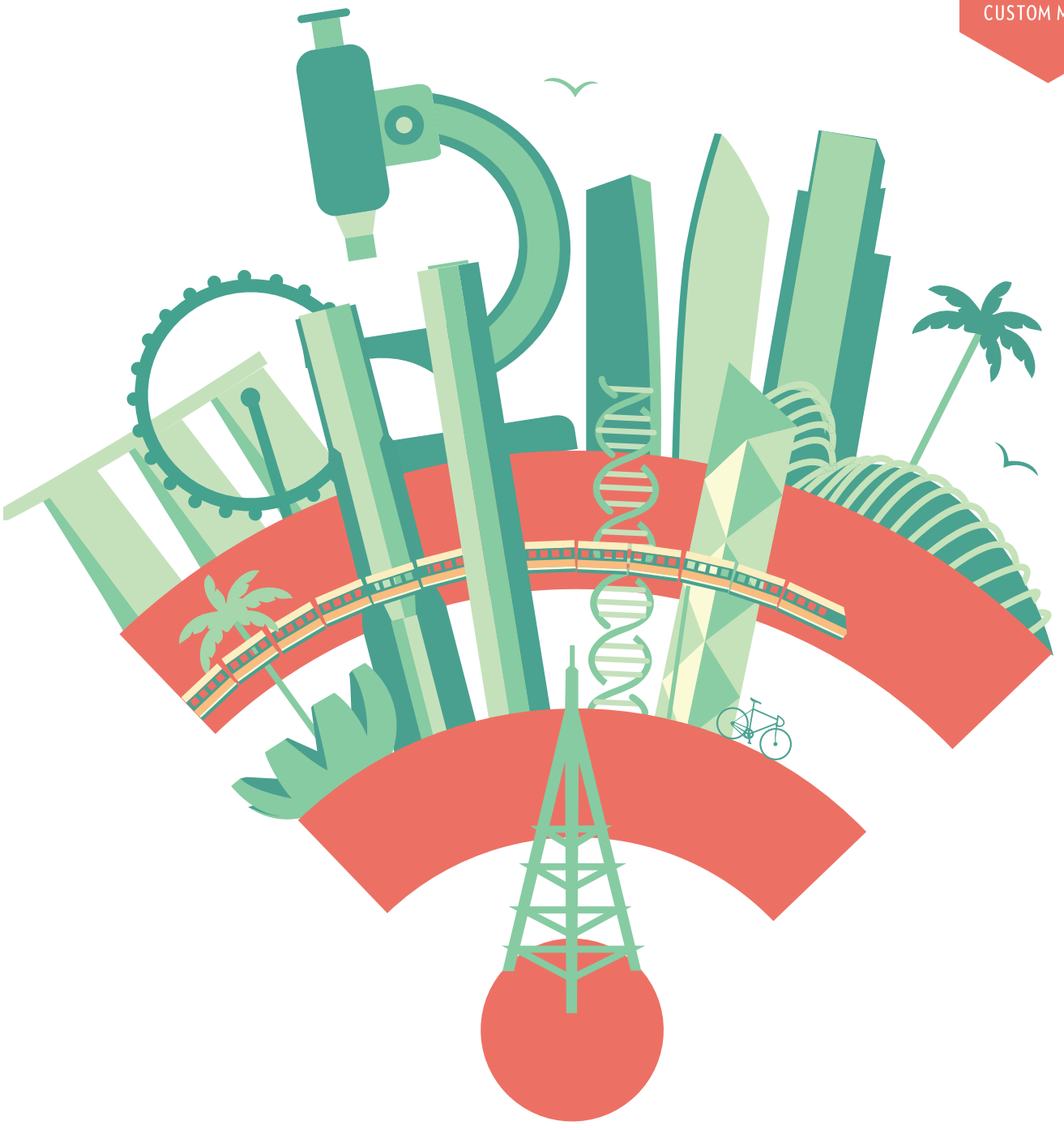

SINGAPORE: A SMART NATION

PRODUCED IN COLLABORATION WITH THE INFOCOMM DEVELOPMENT AUTHORITY OF SINGAPORE (IDA)

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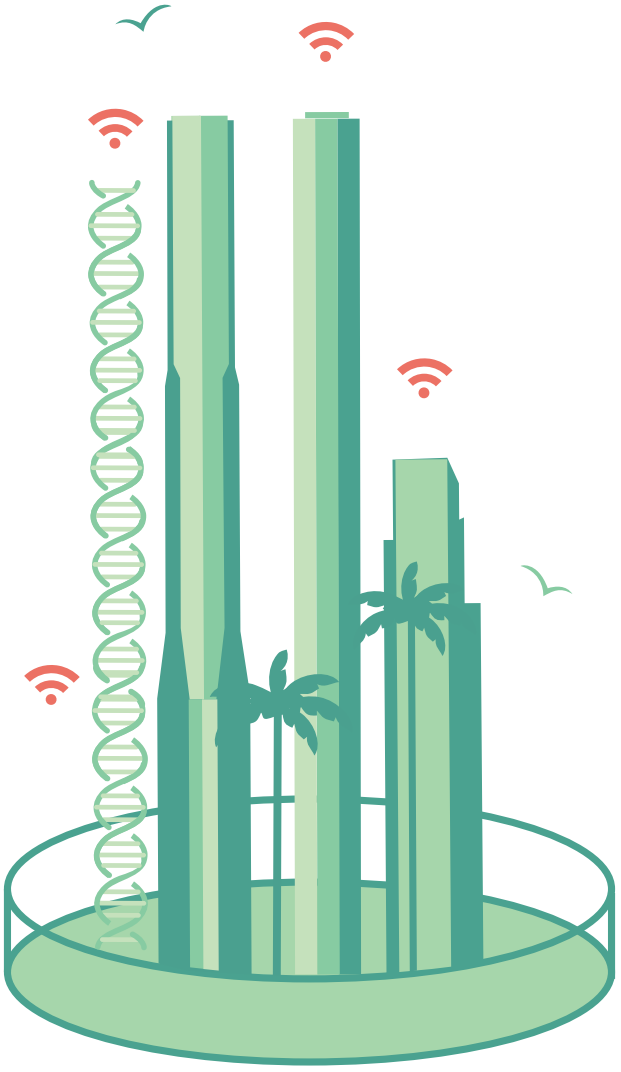


SINGAPORE:
A Smart Living Laboratory

This Smart Nation leverages technology, innovation and talent to elevate the quality of its residents' everyday lives **By Tom Benner**

Using a smart phone in Singapore offers a glimpse of the future. The nation's near obsession with the Internet—it's home to the world's highest mobile penetration rate, of about 150%, as well as the world's fastest peak Internet speeds for mobile broadband, according to Akamai Technologies—belies what its government is looking to achieve. Ubiquitous connectivity, or what the nation calls its "Everyone connected to Everything, Everywhere, All the time" (E3A) atmosphere, is fundamental to Singapore's Smart Nation drive, which was first unveiled by its Prime Minister Lee Hsien Loong in November 2014. This initiative aims to make Singapore a 21st-century nation of smart technology and innovation.

Rather than build such connectivity for consumers of social content—from Instagram and Facebook to messaging apps—Singapore seeks innovations that can flow from unfettered and ubiquitous digital access, such as advanced in-home healthcare. Imagine stroke patients recovering in the comfort of their homes, where "Internet of Things"–based sensors track their vital signs and alert caregivers if something is detected.

The possibilities mount as Singapore sets out to become a Smart Nation, a realistic goal according to its leaders. "We think we have a good chance to succeed," says Tan Kok Yam, head of Singapore's Smart Nation Programme Office. "As we continue to seek growth and raise living quality amid a constrained land mass and a limited and ageing population, it is vital that we continue to be able to innovate as a city and a nation. Singapore sees the global digital revolution as a tremendous opportunity for us to do so... to use technology to improve lives, create economic opportunity, and build societal connectedness on top of digital connectivity." He adds, "We have already made significant investments in the digital infrastructure, by laying fiber broadband connections in every home and business, providing Singaporeans access to the fastest wired and mobile connectivity in the world."

But moving forward entails careful planning. "Smart Nation is about innovation and creating something different," says Steve Leonard, the executive deputy chairman of the Infocomm Development Authority of Singapore (IDA), the country's technology promoting agency. "We have challenges to overcome such as ubiquitous connectivity or helping ageing populations." He adds, "But these are also global challenges, and if we can pull the ecosystem together—institutes of higher learning, startups, investors and more—we believe we can help tackle these challenges and make important contributions to the

world. We are doing this to galvanize the nation and ensure we have that infrastructure built, today."

Without a doubt, Singapore's Smart Nation initiative is off to a great start. "We have a population that is relatively well-versed in computational skills, due to an education system that provides rigorous training at all levels in math, science and engineering," says Tan. "We have an ethos in our society to solve problems logically and practically at the systems level." He adds, "As a single layer of government, we are able to be decisive in making long-term investments in technology. If solutions work in Singapore, our hope is that they can be adapted to solve similar urban challenges in other cities and countries."

> "We have an ethos in our society to solve problems logically and practically at the systems level." —TAN KOK YAM

In short, Singapore today is a "living lab." Set in an ecosystem that facilitates innovation, including good public policy and responsive governance, Singapore is the world's laboratory for ongoing innovation—in everything from housing and transportation to medicine, science and technology.

SEEDS OF A SMART NATION

Singapore's national-level coordinating agency, the Smart Nation Programme Office, is working with many government agencies, including IDA, to harness information and communications technology, networks and data to the fullest potential and put in place the infrastructure, policies, ecosystem and capabilities to enable a smart future.

Innovators around the world are praising these efforts. "Singapore's government really amplifies its impact on innovation beyond its geographical footprint," says Anita Goel, chairman and CEO of Nanobiosym in Cambridge, Massachusetts. "The country is a magnet that attracts a cluster of innovators, and it's creating a global hub of innovation." She also points out that Singapore excels in certain stages of commercial development. "When you are going from a prototype to a manufacturing scale," she says, "Singapore is a very nice gateway into Asia." In fact, she's considered launching her company's Gene-RADAR—which could replace centralized lab infrastructure with a mobile nanotechnology platform that rapidly and accurately detects genetic fingerprints of any disease, empowering people worldwide with real-time, affordable diagnostic information in a mobile device—in Singapore.

Other technologies also get tested in this country. "Singapore is a prime example of the challenges faced by megacities—rapid pace of urbanization, aging population, lack of natural resources and great demographic diversity," says Lee Fook Sun, deputy CEO and president, defense business of ST Engineering, and president of ST Electronics. "These make us a model test bed. But more importantly, our government is very willing to leverage this natural test bed to create opportunities, try out new technology and facilitate experimentation."

Showing its high level of priority, the Smart Nation initiative is run out of the Prime Minister's office, and is overseen by Minister Vivian Balakrishnan, Singapore's Minister for Foreign Affairs. Lee—the son of founding Prime Minister Lee Kuan Lew—said that bringing the current piecemeal uses of technology into a cohesive, nationwide whole "will make our economy more productive, our lives better, and our society more responsive to people's needs and aspirations." He added, "If we can automate the things that are routine, then we can concentrate on the things that really matter."

In addition to a highly wired and forward-looking population, Singapore is home to a thriving start-up scene, a large venture-capital pool, an entrepreneurial spirit, leading universities, billions in investments in research and development, and is the Asian hub for many multi-national corporate headquarters. Ram Sasisekharan, Alfred H. Caspary Professor of Biological Engineering and Health Sciences & Technology at MIT in Cambridge, Massachusetts, and affiliated with the Singapore-MIT Alliance for Research and Technology, says, "Singapore is a melting pot that provides high quality infrastructure to do science and the necessary talent to do good research, and the country is currently involved in significant translational activities." In fact, his own Cambridge-based clinical-stage biopharmaceutical company, Visterra, operates an arm in Singapore. Sasisekharan also points out that top foreign universities—including Duke, MIT, Yale and others—have set up major centers in Singapore.

Government-run, open data portals are also key to building a Smart Nation. For example, the OneService app allows citizens to easily send feedback on municipal issues to relevant agencies for timely responses. Other data resources help citizens and businesses develop their own applications and create business or societal value. Moreover, increased access to data encourages citizen engagement and the contribution of innovative ideas.

International experts see the great value of keeping data open. Goel says, "We could integrate our technology with an open-data society, and that would enable us to build ecosystems to track health in real time and to track outbreaks, like influenza."

Some of the Smart Nation–related innovations already improve healthcare. For example, the National Electronic Health Record (NEHR) is a patient data–sharing platform that enables healthcare professionals to access their patients' healthcare history for better treatment decisions. It also enables a seamless healthcare experience for the patients as they make use of the national healthcare network.

RESHAPING THE FUTURE

When the former British colony became its own nation in 1965, Singapore was little more than a stopover seaport between China and India. The country moved "from third world to first," as founding Prime Minister Lee Kuan Yew put it. Within 50 years, it evolved into one of the wealthiest and most business-friendly countries in the world, with strong intellectual property rights protection, a rule of law that fosters growth and innovation, and a well-integrated, well-educated, forward-looking population.

An early example of Singapore's commitment to bringing advanced technology to everyday life was its introduction of road pricing in 1975, with the Area Licensing Scheme (ALS). In 1998, Electronic Road Pricing (ERP) replaced the manual ALS. Such systems aimed to unclog major arteries by placing a premium on driving on the most congested city streets at peak hours. Today, a satellite-based toll collection system is being built. Although drivers might grumble about having to pay tolls, Singapore commuters have what is arguably the world's best mass-transit system.

As Ambassador Chan Heng Chee, Ambassador-at-Large with the Singapore Foreign Ministry and chairman of the Lee Kuan Yew Centre for Innovative Cities at the Singapore University of Technology and Design, says, "Singapore is a country with many constraints—physical size, population size, workforce size—and absent natural resources." Still, she says, "Smart technologies will help us to overcome these limitations. From a public-policy perspective, governments must deliver governance solutions that are timely, effective and minimize costs.

SINGAPORE'S TALENT STRATEGY

Looking to support the next generation of innovators, Singapore makes science a desirable and rewarding subject to entice more people into the fields that contribute to its Smart Nation efforts.

Three main scholarships from the Infocomm Development Authority of Singapore (IDA)—the Infocomm Polytechnic Scholarship (iPoly), the National Infocomm Scholarship and the National Cybersecurity Postgraduate Scholarship (NCPS)—open doors for young people and professionals. The first two scholarships entice students to pursue infocomm-related courses. The NCPS—offered by the National Research Foundation, an organization under the aegis of the Prime Minister's office—targets graduates and working professionals who want to attain further qualifications in the fast-growing cybersecurity field.

To nurture its human capital, Singapore offers comprehensive education opportunities for students of all ages. The Code@SG movement, for instance, was launched in 2014 to teach coding and computational thinking in a fun way to all primary and secondary students. The collective set of initiatives targets primary to tertiary students with relevant programs, and to date, more than 110,000 have taken part. In addition, IDA's Playmaker curriculum for pre-school children improves problem-solving, sequencing, reasoning, numeracy and literacy skills through a suite of technology-enabled toys. The workshop was designed to help young minds develop the necessary tech-tinkering acumen and creativity to inspire their own inventiveness. Since its introduction in September 2015, 160 preschool centers and about 6,000 preschoolers have participated in the pilot program. Plus, in April 2016, Yaacob Ibrahim, Minister for Communications and Information of Singapore, announced a S$120 million investment to support training for current and future technology professionals.

Other efforts dedicated to encouraging young talent are the Agency for Science, Technology and Research (A*STAR) scholarships and fellowships for aspiring scientists at top global universities. Since 2001, A*STAR has supported and nurtured more than 1,400 students at the undergraduate to post-doctoral levels, helping to attract a steady flow of capable and committed early-career talent to its public research institutes, industry and universities.

In addition, the Singapore government hopes to entice its tech-minded citizens living abroad to return home to work on Smart Nation projects. Earlier this year, IDA rolled out Singapore's first Smart Nation Fellowship Programme, targeted primarily at Singaporeans working overseas. "Building a smart nation requires all hands on deck," IDA managing director Jacqueline Poh said about the initiative. "There are many citizen-centric challenges that are best tackled through the use of technology and open data, but we need a core group of software engineers, designers and product developers who can deliver data-driven insights for the public good and develop tech solutions for citizens." —T.B.

SINGAPORE: A SMART NATION

With advanced communications, efficient living options and a comprehensive public transport system, Singapore's strong infrastructure and commitment to innovation make it an ideal home for global industries and R&D.

POPULATION (2015): **5,535,000***

LIFE EXPECTANCY AT BIRTH: **82.8 years**,* putting it in the global top-5**

GROSS NATIONAL INCOME PER CAPITA (GNI, 2014): US**$55,150**, which is 11th in the world, just behind the United States***

TOP-NOTCH TRANSIT

Singapore's Land Transport Authority (LTA) smoothes the way for walkers, cyclists and riders throughout the country.

80% of households are within a 10-minute walk to a train station.

During peak hours, **75%** of its people are using public transport.

By 2030, Singapore will complete **700 kilometers** of bicycle paths.

COOL & CONNECTED

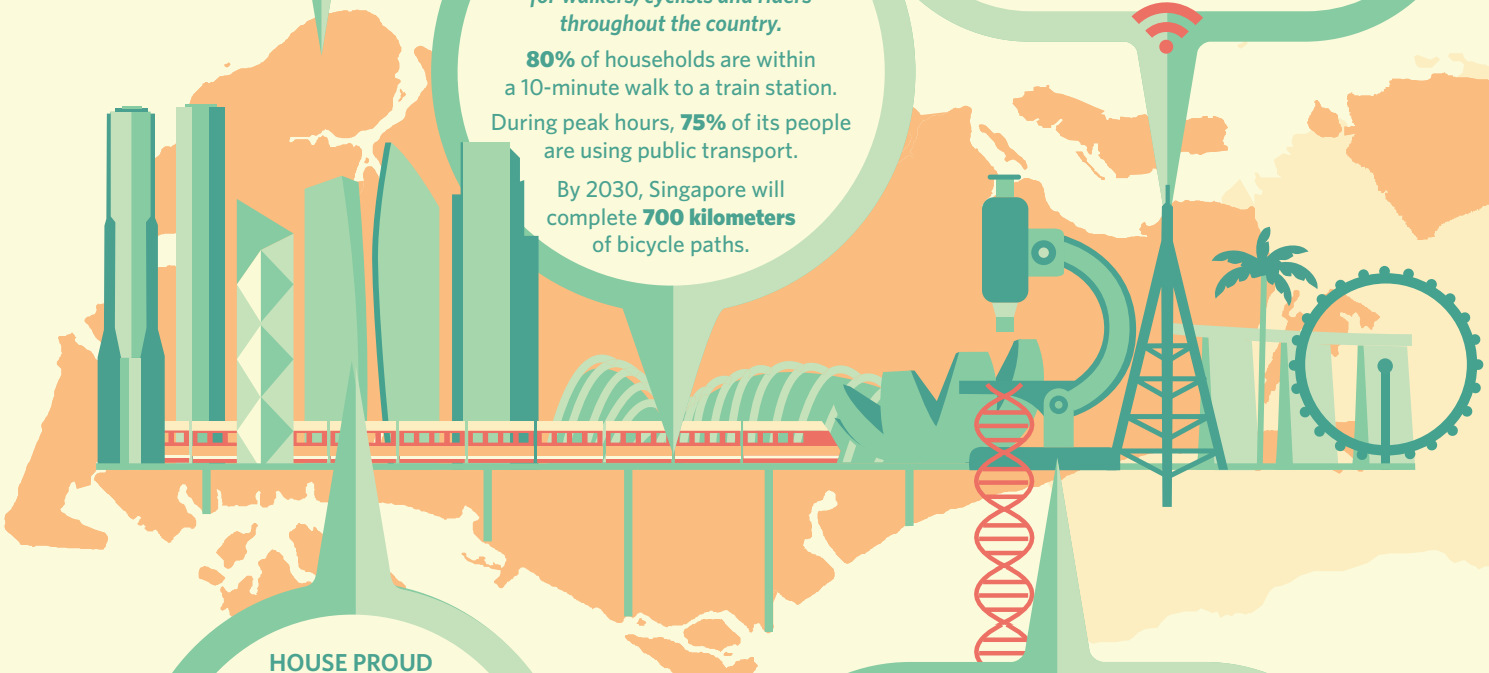
A cellphone for everyone and then some.

8,167,800 mobile subscriptions (12/2015)

147.6% mobile population penetration rate (12/2015)

958,845,600 text messages sent (10/2015)

188.7% wireless broadband population penetration rate (12/2015)



HOUSE PROUD

Singapore's Housing & Development Board (HDB) provides affordable, comfortable & efficient living.

HDB built **more than 1 million** flats in 23 towns.

80% of Singapore's residents live in and own their HDB public-housing flat.

THE RESULTS ARE IN

Singapore excels in leading metrics of capability and production in science and technology.

2nd on the 2016 *Scientific American Worldview* Scorecard, a global ranking of innovation potential in biotechnology.

15th on the Nature Index 2015 Global, which measures international scientific publishing.

*Sources: *Department of Statistics Singapore, **World Health Organization, ***World Bank*

Toward Even Better Living

As Singapore conquers 21st-century problems with cutting-edge technologies, the world takes note

By Renee Morad

If all the world's a stage, Singapore has a captive audience. In about half the area of London, Singapore has built not just a city, but an entire country. In addition to land constraints, the island nation faces a steady stream of challenges, from rapid immigration to an aging population. Despite these obstacles, Singapore has upheld a reputation as an ideal place to do business and as one of the most livable cities. It's also among the world's most innovative countries and best places for start-ups.

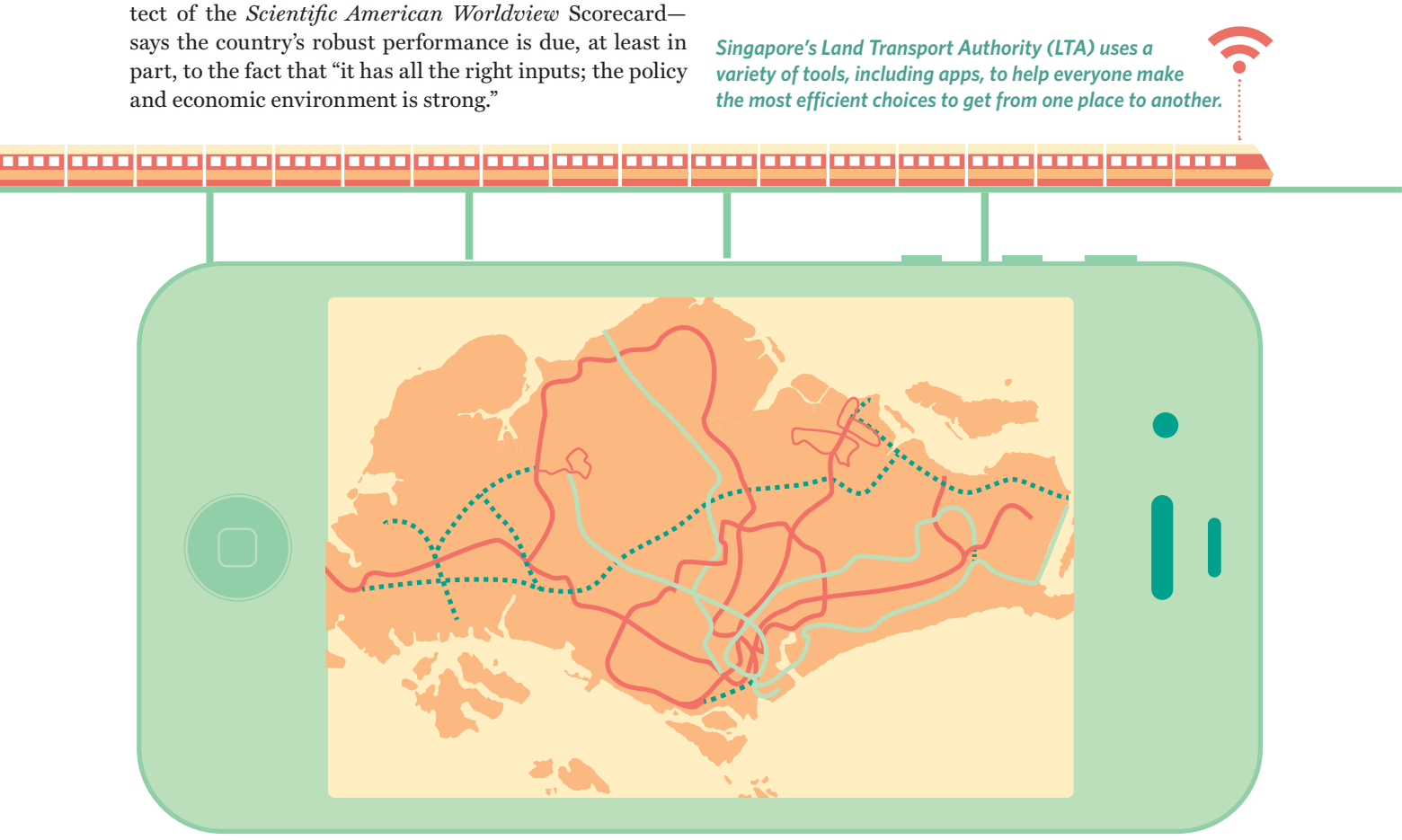
For example, on the *Scientific American Worldview* Scorecard, which measures the biotechnology innovation potential of countries around the globe, Singapore always ranks near the top. Since the start of this index in 2009, Singapore has been in the top five every year, except for 2011 when it came in eighth. Asked about Singapore's consistently high scores, Yali Friedman—head of data analytics for Scientific American Custom Media, publisher of the *Journal of Commercial Biotechnology* and architect of the *Scientific American Worldview* Scorecard—says the country's robust performance is due, at least in part, to the fact that "it has all the right inputs; the policy and economic environment is strong."

Today, Singapore serves as an archetype for other advanced nations worldwide tackling similar challenges. Below are a few of the forward-thinking initiatives that have helped to establish this undersized country as a big player on the world stage.

DATA-DRIVEN PUBLIC TRANSPORT

While Singapore's testing of self-driving cars has generated international buzz, the nation has been covering ground with other public-transport initiatives designed to improve efficiency and convenience. With 12% of Singapore's land already used for roads, a "key for us is to build and operate a public-transport system that provides a high level of connectivity, speed and comfort, [such] that Singaporeans feel less of a desire to drive," says Rosina Howe-Teo, group director of innovation and infocomm technology for the Land Transport Authority (LTA).

More than 2 million people in Singapore take the bus or train at least twice a day—amounting to a total of 6.9



Singapore's Land Transport Authority (LTA) uses a variety of tools, including apps, to help everyone make the most efficient choices to get from one place to another.

million daily trips. To expand the nation's rail system, the government is building 1 kilometer of rail per month and one station every two months from now until 2030. When completed, the majority of Singaporeans will be no more than a 10-minute walk to a station.

Meanwhile, data analytics tools are driving other advances, with location-tracking sensors on vehicles and the data mining of anonymized bus fare–card transactions helping to predict commuter behaviors and forecast crowding. All Singapore-registered vehicles will soon have a navigation system to transmit data and provide real-time traffic advisories to drivers. In addition, its "Take the Train Earlier for Free" system uses analytics to ease traffic during crunch times.

Behind the scenes, LTA is working with telecommunications companies to leverage mobile-phone data that can be aggregated to provide mobility patterns of those who walk or cycle to their destinations. "Moving forward, we also aim to make walking, cycling and riding public transport the way of life for the people in Singapore," says Howe-Teo.

A SMART TOWN FRAMEWORK

In September of 2014, Singapore's Housing & Development Board (HDB) announced its Smart HDB Town Framework, outlining efforts to leverage information and communications technology to "make HDB towns and estates more livable, efficient, sustainable and safe for our residents," HDB's chief executive officer Cheong Koon Hean said. The foundation of the initiative is built on four pillars: smart planning, smart environment, smart estate and smart living.

Computer simulations and data analytics are helping to shape the way HDB plans and designs towns, precincts and buildings and meets sustainability goals. Technologies include smart planning tools that simulate wind flows, shading effects of buildings and solar irradiance. These simulations help planners to harness breezes that cool and improve air quality and to locate greenery in the right places for reducing the urban heat island effect. They can also help select the best sites for installing solar panels that maximize the generation of renewable energy. A decision-making tool will enable planners to choose the most effective and viable combination of solutions to achieve their desired sustainability targets. Smart car parks will be integrated with an intelligent parking-demand monitoring system.

In estates, a network of sensors will capture and respond to real-time environmental factors. Smart fans, for example, will be activated by human traffic, temperature and humidity to improve thermal comfort levels for residents, according to HDB.

In addition, HDB will be developing smart-enabled flats, so that residents can seamlessly integrate a vast array of smart home devices offered by commercial companies. Examples of applications include a home energy–management system, in which residents will be able to know and manage their energy consumption and home appliances in real time, from anywhere, even if they're miles away.

"We develop homes with a key focus on people. Harnessing the potential of information and communications technology to develop smart applications will help us to design and build towns that will provide a more comfortable living experience for our residents," said Cheong.

"Moving forward, we also aim to make walking, cycling and riding public transport the way of life for the people in Singapore." —ROSINA HOWE-TEO

A SMART PATHWAY TO SUCCESS

Singapore's smart initiatives and friendly business environment have attracted many of the world's leading universities and medical facilities, as well as a large stream of research and development capital and a rapidly growing community of tech start-ups. Leading biopharmaceutical companies, including Abbott, Novartis, Pfizer and Sanofi-Aventis, are betting on the region as a global hub, and researchers from institutions like the Massachusetts Institute of Technology are working with the National University of Singapore in state-of-the-art laboratories, where inventions such as stingray-like robots that collect data to prevent ocean algae and smart labs addressing the complexities of infectious diseases are in the works.

At Human Longevity Inc.'s Singapore location, scientists are endeavoring to increase lifespan using stem cells and digitized DNA. On a mission to reverse the regenerative changes seen in aging, the company is harnessing the power of human genomics, informatics, stem-cell advances and next-generation DNA sequencing technologies. Human Longevity cofounder Robert Hariri credits Singapore's "very technologically progressive jurisdiction, where the workforce is highly educated and has a strong work ethic." Government support, investment dollars and valuable human capital provide all the makings of a "really, really exciting place," he adds.

Meeting the challenges of sustainable urban living through the Smart Nation model, Singapore shows the world what's possible for us all.

Innovation Ecosystem

Singapore's innovation-friendly initiatives attract next-generation entrepreneurs from around the world

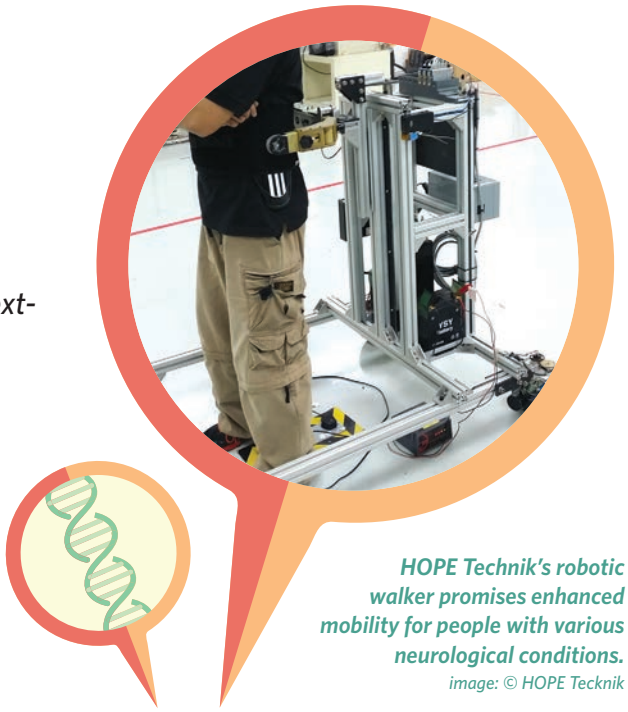
By Karyn Hede

A visit to Block 71, the nexus of Singapore's vibrant start-up scene, reveals a 50-year-old industrial estate that has been refurbished to bring out the vibe of entrepreneurship. The JTC LaunchPad @ One-North, as it is officially known, overflows with more than 500 start-up companies. So many, that in January the government agencies charged with industrial development and economic growth announced a mega-expansion expected to double its current size along several city blocks, including the well-known Block 71.

Watching the current generation eager to seize the entrepreneurial reins, it's easy to forget that a decade ago Singapore was still exporting most of its would-be technology entrepreneurs to Western markets like the famed Silicon Valley. Since its birth as a city-state, Singapore has culled the best ideas from around the globe to fashion a thriving economy in which its primary resource is its people, all 5.5 million. Its lack of natural resources, combined with extreme population density—first among sovereign nations with more than a million inhabitants—present unique challenges that the island nation is solving by encouraging innovation from within. But creating a milieu in which starting a business with global aspirations is not only possible, but also expected, required quite a shift in attitude.

That change in mindset is what Steve Leonard, executive deputy chairman of the Infocomm Development Authority of Singapore (IDA), believes is happening. "Innovation means ensuring the ecosystem understands and is ready to look not just at local solutions, but disruptive ideas which can scale globally, and are nimble enough to change course when things do not work as hoped for," he says.

For example, BASH@Block 79—Singapore's largest integrated start-up space run by Infocomm Investments Pte Ltd (IIPL), the investment subsidiary of IDA—does exactly what its acronym spells out: Build Amazing Startups Here. BASH is thematically zoned for networking and exchanging ideas, and it includes open areas for accelerators, incubation space and a place to relax. In a year, BASH housed six successful runs of IIPL-invested acceleration programs, which provide mentorship, training and education and networking opportunities. In that year, 65 start-ups were accelerated in BASH alone, out of about 230 start-ups accelerated across Singapore. Of the accelerated start-ups, about three-quarters raised funds to move on to their next stage of development.



HOPE Technik's robotic walker promises enhanced mobility for people with various neurological conditions.
image: © HOPE Technik

As a next step for start-ups, the Accreditation@IDA programme is available to assist. In over a year since the programme's inception, it has helped accredited companies create more than S$27 million worth of project opportunities, with over S$3.3 million won. To date, venture capitalists have invested over S$16.4 million in its our accredited companies. "By working with the startups to strengthen their products, processes, team and financials, we are lowering the risk for buyers and investors," says Edwin Low, director of Accreditation@IDA.

With the built-in intellectual capital at the National University of Singapore (NUS), the government of Singapore helped create fertile ground for business start-ups by connecting researchers and inventors with investors and providing matching grants. For every S$1 invested, the National Research Foundation can add S$5, up to a maximum of S$500,000. Entrepreneurs can get matching grants of up to S$50,000 to further develop their companies. Some of them choose to stake a claim in Block 71, where venture capitalists mix with CEOs and innovators in an ecosystem where risk is expected, change happens daily and inventors aim global.

"Singapore enjoys a fantastic workforce that is highly educated and skilled, and has exposure to many sectors that are demanding high-tech solutions," says Peter Ho, CEO of HOPE Technik, a bootstrap engineering firm that exemplifies Singapore's ambitious attitude. "This combination of supply-and-demand together means solutions get to market and can be test-bedded and refined in Singapore, before they become market-leading global exports."

Ho's company worked with NUS assistant professor Yu Haoyong and his colleagues from the department of biomedical engineering to develop a robotic walker for stroke patients and others with neurological conditions to regain a natural gait. The prototype is now moving into clinical studies supported by a National Medical Research Council grant, and conducted at National University Hospital. If successful, HOPE Technik plans to commercialize the device.

"HOPE Technik's success stems from how we, as a small company, are able to provide nimbleness, reasonable cost structure and a can-do attitude to our clients while delivering gold-standard documentation and certification—things which are hallmarks of the big boys," Ho says.

NATION AS LABORATORY

Singapore presents an almost perfect laboratory for testing technology concepts that require a high degree of coordination among government, research institutions and industry. For instance, Singapore's relative scarcity of fresh water has made it a leader in desalination and filtration systems. Neal Chung Tai-Shung and his colleagues from NUS's department of chemical and biomolecular engineering—entrepreneurs with rich industry experience—have successfully developed some of the world's best-performing membranes for forward osmosis and membrane distillation, including the Hyflux Kristal ultra-filtration membranes that now make up a family of solutions for water recycling and wastewater treatment, and they are in use around the world. In short, this technological advance made it easier and more affordable to purify water on a wide range of scales.

Singapore presents an almost perfect laboratory for testing technology concepts....

Such public-health improvements with water reveal Singapore's overall interest in healthy living and aging. "Singapore has led in water management and transport, and that leadership will now extend to health and wellness," says Sir David Lane, chief scientist at the Agency for Science, Technology and Research (A*STAR). "The area of health monitoring and prevention is especially exciting." He adds, "The potential impact of big data computing and new monitoring devices to predict and prevent disease is huge."

The marriage of information technology and biomedical research is the culmination of a strategic plan put in place as the new millennium dawned. With virtually no presence in biomedical research, the government began a major push and funding for biomedical science and technology, from basic research to clinical trials, product and process development, full-scale manufacturing and healthcare delivery, says Ho Teck Hua, deputy president of research and technology at NUS. "We are now at the stage where we are ready to intensify our pace of development," says Ho.

At the university level, NUS is partnering with École Polytechnique Fédérale de Lausanne in Lausanne, Switzerland, and Technische Universität München in Germany, to develop a new generation of engineers trained in design-thinking, high-tech research translation and venture formation. "This program is specifically targeted at postgraduate students interested in 'deep tech' commercialization," says Lily Chan, CEO of NUS Enterprise, which has helped spin-off more than 60 companies from the university's research, and commercialized more than 350 technologies, raising more than S$200 million in equity funding in 2015 alone.

In addition, the government recently announced the new Research Innovation Enterprise 2020 (RIE2020) Plan, where S$19 billion has been allocated to develop Singapore as a knowledge-based, innovation-driven economy over the next five years.

Already recognizing the need for skilled manpower in fast-growing fields like data analytics, cybersecurity and software development, IDA has partnered with companies to train young professionals in these skills. Recently, for example, IDA and Google launched the third run of a data analytics–training program for new professionals. IDA and NCS, a subsidiary of Singtel Group, collaborated to train 100 new professionals in advanced software development to design and develop smart city solutions in transportation, healthcare and energy.

DRIVING FORWARD

In Singapore's overall ecosystem, roads take up considerable room, so competing interests are pressing every inch of space. Moreover, the issue intersects with Singapore's aging population, because public-bus and freight drivers tend to be older and will be in short supply in coming years, according to Lam Wee Shann, director, futures division, Ministry of Transport (MOT).

Lam envisions surface travel on foot and bicycle, supplemented by self-driving vehicles or pods. Freight delivery and mass public transport would be relegated underground. Long-term planning is underway, led by MOT's Committee on Autonomous Road Transport for Singapore (CARTS), which includes thought leaders from Toyota, Continental, ST Kinetics, CISCO, MIT and the UK Behavioural Insights Team.

In 2015, the Ministry of Transportation put four self-driving vehicles to work at Gardens by the Bay. Experiments like this and ongoing projects at Block 71 promise to continue fueling Singapore's innovation ecosystem.

Business Opportunities Ahead

With financial and entrepreneurial support, Singapore is committed to turning great ideas into great companies **By Zach Goldberg**

Trial and error, followed by fast-tracked adjustments, best describes Singapore's business plan. In the late 1960s, the country's fledgling government pursued industrialization through importation—positioning itself as a supportive base camp for multinational corporations and value-added manufacturing. Singapore's newly formed business-courting apparatus, the Economic Development Board (EDB), created an enticing environment for foreign business, and Western companies—including Texas Instruments, Hewlett-Packard and General Electric—started pouring in. This fueled huge business and economic growth, until difficult times drove that to a halt early in this century. In one of many adjustments, Singapore is rapidly evolving from borrowing innovation to seeding and attracting the brains to create it.

"Many governments don't know it, but they are in competition with one another for the great minds, people, entrepreneurs and businesses of the world," says Tim Draper, founding partner of California-based leading venture capital firms Draper Associates and DFJ. "Singapore has, under the leadership of Lee Kuan Yew, truly understood the competitive nature of government and has become one of the shining lights, as they lead with one of the most accommodating business climates in the world." He adds, "With the death of this great leader, Singapore needs to continue to lead with a light-touch government to continue to attract business and drive innovation in the face of an open world of citizens with choices." He looks forward to seeing how innovation in Singapore continues to evolve. "Some areas of potential innovation could be in a more unregulated private company stock market or in their acceptance of Bitcoin as a currency and an asset," Draper points out. "They could innovate with healthcare data and maybe a streamlined FDA. They could innovate with new schools like Draper University. They could innovate with a basic income to efficiently replace welfare and social security in the country." As he notes: "The next 10 years will tell whether the country will lead toward a brave innovative country, or be pulled back by special political interests as many countries have."

By streamlining both the discovery and commercialization of scientific breakthroughs, the government, explains Yeoh Keat Chuan, managing director of EDB, aspires to "make Singapore the location where the world's most promising billion-dollar businesses are created." Key to its strategy is the pooling of resources and knowledge through intimate synergies between public research institutes, universities, multinational corporations, small to medium-sized enterprises, established and new entrepreneurs, and government agencies.

Securing diverse sources of funding for academic and entrepreneurial undertakings allows the government to foster potentially groundbreaking advances in otherwise neglected fields. Yeoh makes this clear: "Singapore will continue to focus on quality investments—those that are capital-, knowledge- and innovation-intensive that will bring our economy to the next level of competitiveness."

For example, Singapore's government teamed up to create SG-Innovate, which was launched in 2016 to accelerate the growth of Singapore's startup ecosystem by supporting startups in partnership with accelerators and incubators. SG-Innovate also matches start-up entrepreneurs with mentors and facilitates their access to technology, talent, markets and investors. Working under SG-Innovate, Infocomm Investments Pte Ltd (IIPL)—the investment subsidiary of IDA—will expand its scope of work beyond the digital and information and communications technology to grow other new and innovative areas, including financial technology, digital health, smart energy, digital manufacturing and "Internet of Things" devices.

"Singapore has ... truly understood the competitive nature of government and has become one of the shining lights, as they lead with one of the most accommodating business climates in the world."

—TIM DRAPER

SkyGreens increases food production by 10 times by growing up.

MOVING UP

Advanced material manufacturing is one of many areas in which the country hopes to gain a global edge by addressing local problems with broader market relevance. "Like other densely populated cities," explains Seeram Ramakrishna, director at the National University of Singapore's Center for Nanofibers and Nanotechnology, "Singapore needs to find ways to make the best use of its limited space while further improving the quality of life." He adds, "Advanced materials that meet the requirements of a certain application in terms of strength, durability, self-repair, noise mitigation, thermal management and security, while limiting the use of raw materials, are fundamental to this strategy."

Economic development means more businesses, more people and thus more buildings. In Asia alone, an estimated 55% of the population will live in cities by 2030. Given Singapore's dwindling landmass, sustainable long-term growth will depend on going vertical.

ceEntek, a local start-up that makes nano-engineered Ultra-High Performance Concrete (UHPC), is a determined pathfinder on this front. Carbon nano-fiber materials have long tantalized the construction industry. These supernaturally robust yet lightweight materials promise taller, more efficiently assembled structures. Until recently, however, engineers toiled to figure out how to homogenously disperse these fibers in a concrete paste. Now, with its new UHPC concoction, ceEntek believes that it's finally solved the riddle. At half the mass and one-tenth the carbonation rate of normal concrete, UHPC offers superior strength, multi-elemental impermeability and a useful life expectancy of 100+ years.

From bigger skyscrapers and readily transportable prefabricated homes to lagoon cities, material pioneers—like ceEntek—are placing Singapore at the forefront of a looming global battle against overpopulation.

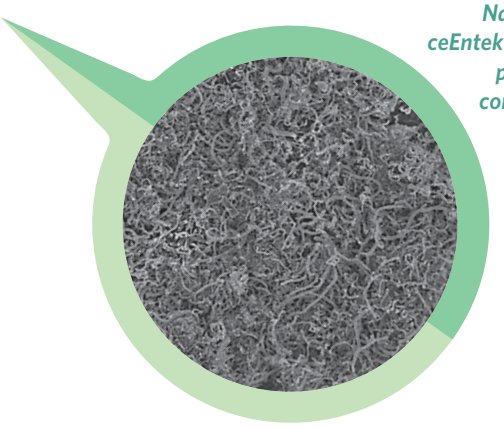
POWER TO THE PEOPLE

Buildings won't be the only things shooting for the sky. Originating as an experiment in the backyard of his aluminum factory, Jack Ng's company, Sky Greens, offers the world's first ever low-carbon, hydraulic water-driven vertical farming system. Occupying just one hectare, these agricultural towers yield 10 times the amount of crops as conventional cultivation at just a fraction of the cost. For a country that has to import 90% of its food and—more broadly—for a world in which future climate change and urbanization are increasingly consuming our acreage, Sky Greens promises new ways to ensure a healthy supply of food.

The assistance of International Enterprise (IE) Singapore, one of the government's many economic agencies, was integral to Sky Green's fruition. As Ngiam Tong Tau, chairman of parent company Sky Urban Solutions, told IE Singapore: "Whenever we received overseas interest from, for example, China or the US, IE would refer us to their officers on the ground. They helped make the necessary connections." IE also provided funding for marketing consultants, lawyers and patenting—all the ingredients that Sky Green needs to grow from small-time start-up to global corporation.

The success stories of ceEntek and Sky Greens illustrate how Singapore's corporate matchmaking and diffusion of capital allows anyone with a good idea a chance to flourish in the marketplace. Supportive communities also help. The Growing Enterprises with Technology Upgrade (GET-Up) program, for instance, features a brain-loan component that sends precious university—often student—talent to fill the knowledge gaps of skill-deficient businesses.

Whether it's helping companies upgrade their production capabilities or walking novice entrepreneurs through the trademarking process, Singapore's government has truly created a "city of opportunity" where promising ideas are nurtured locally, but blossom globally.



Nano-fibers in ceEntek's ultra-high performance concrete could make it last more than a century.

Creative Communities

Singapore's skilled workforce shines everywhere from art to science **By Gerardine Donough-Tan**

The breadth of innovation spans many disciplines in Singapore. Meet three millennials—each under 35 years old—who are combining technology with artistic creativity, and loving it.

ROSHNI MAHTANI, 33, founder and CEO of Tickled Media

With a bachelor's degree in mass communications and marketing from Upper Iowa University in the United States, Mahtani could have stuck to magazine publishing or advertising sales. But in 2009, she became a technopreneur, setting up TheAsianParent to "express my creativity," she says. "I saw two separate opportunities—the lack of good, Asian-centric parenting resources, and the emergence of digital media—and put the two together." Her media tech start-up focuses on the parenting space in Southeast and South Asia, and its four sites now reach over six million parents monthly.

Mahtani believes technology can improve the modern parenting journey. "We want to provide a parenting experience that is sensitive to local cultures and customs, while making sure that the information is medically accurate and expert vetted," she explains.

In 2012, Mahtani cofounded the Female Founders Network, which aims to increase the number of female-led organizations in Singapore from 5% of tech start-ups to 20% by 2020. "We plan on doing this primarily through research and policy advocacy," she says confidently.

LENNARD ONG, 31, co-director of L+Lx

An architect turned "spatial designer/artist" is how Ong describes his creative installations that decorate properties as diverse as a dental clinic and a wedding chapel.

Ong grew up in his grandfather's carpentry workshop making contraptions like sling guns and mechanical toy cars. This interest bloomed when he trained as an architect in Los Angeles, and he dabbled in software, robotics and computation. "Thinking about bits and atoms has helped me pick up some skills over the years: how to write code, build machines, use 3D-animation software, and now, the challenge of building a creative studio in the grey area between art and architecture," says Ong. Through the L+Lx studio, he aims "to create fresh human experiences and perspectives."

A winner in Singapore's Affordable Art Fair Young Talent Programme in 2013, Ong followed up this success with an exhibition, *Filament Forest*, at Singapore's ION Art Gallery in 2014.

JEANLE KOH, 34, lead rotoscoping /paint artist, Lucasfilm Singapore

From childhood, Koh wanted to work in visual effects and animation. With self-study and a local polytechnic diploma in computer engineering, he left a small studio in 2009 for Lucasfilm Singapore's Jedi Masters Program apprenticeship for digital-asset creation.

In 2010, he worked on visual effects on various films, including *Pirates of the Caribbean* and *Transformers*. Most recently, he worked on *Star Wars: The Force Awakens*, and he now teaches new apprentices.

"As artists," Koh says, "we always want to take on the next tricky shot, looking for new problems to solve. It's interesting how different people solve similar challenges." He adds, "As long as the results look aesthetically correct, I try to see and support the artists' leanings."

The avid science-fiction reader continues: "I can imagine other worlds in the words of Asimov, Clarke and Herbert, and with the work we do at the studio, we manifest these visions to share with the world."

As Steve Leonard, executive deputy chairman of the Infocomm Development Authority of Singapore (IDA), says, "Singapore's Smart Nation needs everybody in order for us to be successful. This means including designers, architects, everyone, and seeing how not just tech, but everything, comes together. Smart Nation intends to ensure that tech is expressed in ways citizens can use and understand, whether it is user-experience design or use cases, through the confluence of art and science."