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A Comparison of Two Smart Cities: Singapore & Atlanta

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A COMPARISON OF TWO SMART CITIES: SINGAPORE AND ATLANTA

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INTRODUCTION

Worldwide, we are experiencing a dramatic population shift from rural areas to city centers. In 1950, most of the world's population lived in rural areas, with only 30% residing in urban areas.[1] Today, 55% of the world's population lives in urban areas, and is expected to reach 68% by 2050."[2] There are now 33 megacities with populations of ten million or more around the world, and another six megacities are predicted by 2030 - Chicago, Bogotá, Luanda, Chennai, Baghdad, and Dar es Salaam.[3] This global urbanization trend is placing a myriad of burdens on cities, including but not limited to housing, transportation, infrastructure, environmental, economic and social burdens.

Simultaneously, we have entered the "Fourth Industrial Revolution," a term coined by the World Economic Forum's founder and executive chairman Klaus Schwab in his 2016 book by the same name. The unprecedented speed of technological innovations such as the Internet of Things (IoT), artificial intelligence (AI), machine learning, robotics, etc. are disrupting every industry and all aspects of daily life. But much like the industrial revolutions of the past shifted wealth, power and people, how nations, states and cities respond to this technological transformation will determine their ability to compete and thrive in this new era.

Becoming a smart city will require investments in high-speed fiber networks and smart city technologies to improve the delivery of services, a strategy for how data will be shared, managed and secured, and a smart city master plan to guide decision-making and investments. However, most importantly, becoming a

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[1] *Population Facts: The speed of urbanization around the world*, United Nations Department of Economic and Social Affairs Population Division, No. 2018/1 (Dec. 2018) available at: https://population.un.org/wup/Publications/Files/WUP2018-PopFacts_2018-1.pdf

[2] *2018 Revision of World Urbanization Prospects*, United Nations Department of Economic and Social Affairs (May 16, 2018) available at: https://www.un.org/development/desa/publications/2018-revision-of-world-urbanization-prospects.html

[3] Wood, J., *Here's what you need to know about the megacities of the future*, WORLD ECONOMIC FORUM, (Oct. 10, 2018) available at: https://www.weforum.org/agenda/2018/10/these-are-the-megacities-of-the-future/

smart city will require adopting new technology that meets the needs of its citizens, ensuring that cities do not lose sight of being inclusive, equitable and sustainable as they strive to be smart.

This paper will compare Singapore's top-ranked smart city strategy to Atlanta, Georgia, a city that does not make a top smart city ranking but boasts internationally recognized smart city projects.

SMART CITIES: A GROWING INDUSTRY

What is a smart city? No single definition of a smart city exists, but as CNBC explains, a smart city is one that infuses technology into every aspect of its operations, including public transportation, IT connectivity, water, power supply, sanitation, solid waste management, urban mobility, e-governance, and citizen participation.[4] It is most often characterized as a place where sensors, meters, and other internet of things technologies collect data, analyze it, and even adapt/optimize to improve services. At the heart of a smart city is citizen involvement, an aspect Singapore has placed at the top of its smart city strategy.

Going hand-in-hand with the improved delivery of services, smart city innovations have the power to improve the daily life of people. A recent global study on smart cities conducted by Juniper Research addressed the unique question, "how can smart cities' technology and strategies be used to 'give back' time to citizens?"[5] Using four indices to evaluate cities - mobility, healthcare, public safety and productivity, the results of the study were significant. The study concluded that "smart cities have the potential to 'give back' each city dweller three working weeks' worth of time every year" or 125 hours; it was calculated that smart traffic systems could save residents 60 hours, public safety innovations could yield 35 hours, healthcare apps, telehealth, and improved administration could save nine hours, and improved productivity through apps and other digital innovations could save 21 hours.[6] In the hurried lives of the 21st century, reclaiming 125 hours annually is an appealing prospect to most people, and will ultimately drive demand for smart cities both by citizens and corporations.

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[4] *What is a Smart City*, CNBC INTERNATIONAL (Feb. 8, 2017) https://www.youtube.com/watch?v=bANfnYDTzxE

[5] *Smart Cities – What's in it for Citizens, Juniper Research,* https://newsroom.intel.com/wp-content/uploads/sites/11/2018/03/smart-cities-whats-in-it-for-citizens.pdf. This study was sponsored by Intel.

[6] *Id.*

It should come as no surprise then that smart city technology is a rapidly growing industry. The International Data Corporation (IDC) reports that "spending on smart cities initiatives is predicted to reach $95.8 billion in 2019, an increase of 17.7% over 2018."[7] However, investment in smart city technologies varies greatly around the world. This year, Singapore is projected to invest over $1 billion in smart cities programs, whereas only four U.S. cities – New York City, Los Angeles, Washington, D.C., and Chicago – are projected to spend more than $300 million this year.[8]

As reported by IDC, the greatest spending in 2019 will occur for "initiatives related to data-driven public safety, intelligent transportation, and resilient energy and infrastructure; however, "economic development and civic engagement, and sustainable planning and administration will also see considerable investments."[9] Specifically, five uses comprise 34% of worldwide smart city spending in 2019: fixed visual surveillance, advanced public transit, smart outdoor lighting, intelligent traffic management, and connected back office; by 2020, intelligent traffic management solutions will exceed spending on smart outdoor lighting.[10]

SINGAPORE: A SMART CITY LEADER

Singapore is a smart city leader. The IMD World Competitiveness Center indexed 102 global smart cities, ranking Singapore as number one and giving it the highest rating, AAA; Zurich was the only other city to receive the highest AAA rating.[11] IESE Cities in Motion Index 2019 ranks Singapore as the seventh smartest city in the world.[12] In November 2018, Smart City Expo World Congress awarded

[7] *IDC's Smart Cities Spending Guide Expands its Coverage to More than 100 Cities*, BUSINESS WIRE (Jan. 30, 2019) available at: https://www.businesswire.com/news/home/20190130005075/en/IDCs-Smart-Cities-Spending-Guide-Expands-Coverage

[8] *Id.*

[9] *Id.*

[10] *Id.*

[11] Pyzyk, K., *No US cities to make top 10 of global smart city ranking*, SMART CITIES DIVE (Oct. 4, 2019) https://www.smartcitiesdive.com/news/no-us-cities-make-top-10-of-global-smart-city-ranking/564330/

[12] IESE Cities in Motion Index 2019, https://www.ieseinsight.com/doc.aspx?id=2204&ar=&idi=2&idioma=2

Singapore the Smart City of 2018 title.[13] In the previously mentioned Juniper Research study, asking "how can smart cities' technology and strategies be used to 'give back' time to citizens," Singapore ranked number one in every index.[14] In the mobility index, Singapore's smart traffic solutions and strict car ownership policy enabled it to the garner the top spot. In healthcare, Singapore was recognized for its focus on using technology to better serve the elderly population. In the area of public safety, Singapore's use of smart video surveillance earned it the top spot. And lastly, in the area of productivity, Singapore ranked number one for its use of digital services, open data, and encouragement of technological innovations to improve city services.

Singapore's leading role in the smart cities movement should not be a surprise. For nearly forty years, Singapore has demonstrated it is not just adapting to technological developments, but rather is embracing them for competitive advantage. Beginning in the 1980s and 1990s with the adoption of three national master plans (National Computerisation Plan, National IT Plan, and IT2000), Singapore set its sights on creating government efficiencies through computer software, developing basic IT infrastructure and data networks, creating e-commerce frameworks, and expanding the tech talent pool.[15] Singapore continued to respond to the digital transformations occurring globally through the 2000s with three more national master plans (Infocomm 21, Connected Singapore, and Intelligent Nation); these plans, focused on infocommunications, led to increased integration of data, processes and services within the public and private sector.[16]

In November 2014, Singapore launched its Smart Nation initiative, seeking to build a "digital economy, digital government and digital society," driving transformation in "health, education, transport, urban solutions, and finance."[17] Under Smart Nation Singapore, the government has identified six key strategic

[13] *Singapore awarded as Smart City of 2018 at Smart City Expo World Congress* (Nov. 15, 2018) http://www.smartcityexpo.com/en/the-event/media-center/press/-/prensa/detalle/13645836/singapore-smart-city-award-2018

[14] *Smart Cities – What's in it for Citizens*, Juniper Research, https://newsroom.intel.com/wp-content/uploads/sites/11/2018/03/smart-cities-whats-in-it-for-citizens.pdf.

[15] *Smart Nation: The Way Forward, Executive Summary*, Smart Nation and Digital Government Office, pg. 6, https://www.smartnation.sg/docs/default-source/default-document-library/smart-nation-strategy_nov2018.pdf

[16] *Id.*

[17] *Id.* at 7

national projects: CODEX, e-payments, moments of life initiative, national digital identify (NDI), smart nation sensor platform, and smart urban mobility.[18]

- CODEX, Core Operations Development Environment and eXchange, is a "digital platform that will enable the Government to deliver better digital services to citizens faster and more cost efficiently."[19]
- Singapore's focus on e-payments allows secure digital transactions without bank account information; participants register to receive payments through their mobile phone numbers or NRIC number (government issued ID number for Singapore citizens or permanent residents) and FIN number (government issued ID number for foreign individuals who work or reside in Singapore and hold a Work Pass Card). Started as PayNow for retail customers, digital transactions have now been expanded through PayNow Corporate to a wider variety of sectors such as businesses, corporations, and Singapore government agencies through their Unique Entity Number.[20]
- The Moments of Life Initiative is a digital platform designed to deliver information and services to Singaporeans at significant life milestones; for example, parents can register the birth of their child through the platform, and seniors can use the platform to find active aging programs or get information on government benefits.[21]
- National Digital Identity (NDI) is currently being developed as "a digital identity system for Singapore residents and businesses to transact digitally with the government and private sector in a convenient and secure manner."[22] As part of this project, the MyInfo platform, a "tell us once service" is being developed to store personal information for auto-form filling, eliminating the need for repetitive form-filling and verification documents for things like credit card applications, bank accounts and loans, and property transactions.[23]

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[18] Smart Nation Singapore, Strategic National Projects, https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects

[19] Smart Nation Singapore, Codex, https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/codex

[20] PayNow Fact Sheet, https://abs.org.sg/docs/library/paynow_factsheet.pdf

[21] Moments of Life Initiative, https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/moments-of-life-initiative

[22] National Digital Identity (NDI), https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/national-digital-identity-ndi

[23] *Id.*

- The Smart Nation Sensor Platform seeks to "improve municipal services, city-level operations, planning and security" through the use of sensors and data collection.[24] Sensors are already widely used throughout Singapore, collecting a variety of urban data: monitoring air quality, traffic and pedestrian movement, water usage, energy usage, and even inside the homes of elderly residents.[25]
- Smart Urban Mobility seeks to use technology to improve public transportation and reduce demand for cars.[26] Examples of projects include autonomous shuttles as a mobility solution, particularly for the elderly or disabled; contactless, e-payments for transit fare; and on-demand shuttles.[27]

In June 2018, Singapore's Digital Government Blueprint was published, defining how the government and its public officers will create a digital government that supports its citizens and businesses, advancing the Smart Nation Initiative. Singapore is guided by the vision to be a government that is "digital to the core, and serves with heart," defined as:

- Digital to the Core – using "data, connectivity and computing decisively to re-engineer business processes, re-architect technology infrastructure and transform services for citizens, businesses, and public officers;"
- Serves with Heart - automating "processes where possible so we can better serve citizens with a personal touch in a way that enriches the experience."[28]

At the center of all of Singapore's smart city strategies are its citizens. This fact is further evident in Singapore's Digital Readiness Blueprint, a roadmap developed by the Singapore government's Ministry of Communications and Information (MCI) to help Singaporeans "get digitally ready" through four main strategies: 1) expand and enhance digital access for inclusivity; 2) infuse digital

[24] Smart Nation Sensor Platform, https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/smart-nation-sensor-platform

[25] Poon, L., *Singapore, City of Sensors*, CITYLAB (Apr. 21, 2017) https://www.citylab.com/life/2017/04/singapore-city-of-sensors/523392/

[26] Smart Urban Mobility, https://www.smartnation.sg/what-is-smart-nation/initiatives/Strategic-National-Projects/smart-urban-mobility

[27] Transport, https://www.smartnation.sg/what-is-smart-nation/initiatives/Transport

[28] *Digital Government Blueprint Summary*, https://www.tech.gov.sg/files/digital-transformation/dgb_summary_june2018.pdf

literacy into national consciousness; 3) empower community and businesses to drive widespread adoption of technology; 4) promote digital inclusion by design.[29]

Examples of Singapore's smart city innovations abound; however, a few projects stand out for their innovation and impact on Singapore – Marina Barrage, a flood control system that also plays an important role in Singapore's water independence and the city-state's extensive police surveillance program that helps Singapore maintain its status as one of the safest cities in the world.

Marina Barrage, designed as a flood control system, is also Singapore's 15th reservoir. It was created by the construction of a dam across the Marina Channel, and is fed by five rivers: Kallang River, Geylang River, Singapore River, Rochor Canal and Stamford Canal. The idea of constructing a dam first emerged after a devastating monsoon in 1978 that dropped 20 inches of water in one day; the flooding was so severe that more than one thousand people were evacuated from their homes and seven died.[30] Marina Barrage took decades to plan and required cleaning up the nation's polluted rivers as a first step; however, it only took three years to construct (2005-2008) at a cost of $226 million Singapore dollars.[31] Today, Marina Barrage prevents floods in low-lying areas of the city including Chinatown, Boat Quay, Jalan Besar, Geylang, and Shenton Way.[32] The barrage has nine crest gates that can release stormwater to the sea during low tide, and seven drainage pumps to drain excess water from the reservoir during high tide.[33] Relying on a large network of sensors to feed data into the Operational Management System (OMS), a real-time modelling platform, operators of Marina Barrage are given strategies to deal with storm events based on actual rainfall, water levels in drains, canals and reservoirs and water flow in the catchment area.[34] Furthermore, its catchment area of 10,000 hectares comprises one-sixth of the island, and has played

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[29] *Digital Readiness Blueprint*, https://www.mci.gov.sg/en/portfolios/digital-readiness/digital-readiness-blueprint

[30] En, S., *The Big Read: A decade on, Marina Barrage is now key to S'pore's water management*, TODAY (Mar. 17, 2018) https://www.todayonline.com/singapore/big-read-mere-idea-icon-marina-barrage-10-years

[31] *Id.*

[32] *Id.*

[33] *Id.*

[34] *Innovation in Water Singapore*, An R&D publication of PUB, Singapore's National Water Agency, Volume 8 (June 2016) https://www.pub.gov.sg/Documents/PUB_Innovation%20in%20Water%20Singapore%2008_web%20%2016%20June%202016.pdf

an integral role in the nation's water independence.[35] Marina Barrage is also an amenity to the community, enabling recreational activities on both the water and the green roof of the pump station, serving over 15 million people since opening.[36] The site also boasts the Sustainable Singapore Gallery, a museum that provides hands-on learning about Singapore's sustainability initiatives.

Singapore is one of the safest cities in the world, despite a slight increase in crimes due to scams. Singapore reports that in 2018 it experienced 165 days with no cases of snatch theft, housebreaking and robbery combined; the rates are even higher when evaluating each crime type individually – snatch theft (322 days free), housebreaking (227 days) and robbery (303 days).[37] Why is Singapore so safe? It is a highly surveilled nation. In a recent study by technology research company Comparitech comparing the number of government and privately owned cameras in 120 major cities around the world, Singapore ranked eleventh in the world with 86,000 cameras for 5.6 million people, or 15.25 cameras per 1000 people.[38] Singapore's cameras also have features such as pan-tilt-zoom functions, and 360-degree views.[39] Furthering the city-state's surveillance efforts, in April 2018, the Lamppost as a Platform (LaaP) pilot project was announced, which uses facial recognition software with surveillance cameras on 100,000 lampposts, enabling the city to "perform crowd analytics and support anti-terror operations."[40] Singapore is also conducting a one-year pilot on the use of drones equipped with thermal

[35] En, S., *The Big Read: A decade on, Marina Barrage is now key to S'pore's water management*, TODAY (Mar. 17, 2018) https://www.todayonline.com/singapore/big-read-mere-idea-icon-marina-barrage-10-years

[36] *Id.*

[37] *Annual Crime Brief 2018*, Singapore Police Force, https://www.police.gov.sg/news-and-publications/statistics

[38] Lin, J., *Singapore is 11th most-surveilled city in the world – but it doesn't even come close to China: Report*, BUSINESS INSIDER SINGAPORE (Aug. 20, 2019) https://www.businessinsider.sg/singapore-is-the-11th-most-surveilled-city-in-the-world-but-it-doesnt-even-come-close-to-china-report/

[39] Baharudin, H., *More police cameras to be installed to keep Singapore safer*, THE NEWS PAPER (Sept. 9, 2017) https://www.tnp.sg/news/singapore/more-police-cameras-be-installed-keep-singapore-safer

[40] Aravindan, A. and Geddie, J., *Singapore to test facial recognition on lampposts, stoking privacy fears*, REUTERS (Apr. 13, 2018) https://www.reuters.com/article/us-singapore-surveillance/singapore-to-test-facial-recognition-on-lampposts-stoking-privacy-fears-idUSKBN1HK0RV?utm_source=applenews

imaging to assist in aerial surveillance.[41] Singapore is also exploring smart glasses, a form of wearable technology, for its police officers; smart glasses would provide the officers with facial recognition analytics on the spot.[42]

ATLANTA'S SMART CITY SOLUTIONS

Although you will not find Atlanta at the top of any smart city list, like Singapore, the city is adopting smart city solutions that are garnering international attention. Three recent projects include the North Avenue Smart Corridor, the city's extensive camera network, and the first biometric terminal at a U.S. airport.

In 2017, Atlanta announced its first smart city transportation project - the North Avenue Smart Corridor, a 2.3-mile project running along North Avenue from the Georgia Tech campus at Northside Drive to Freedom Parkway just past Ponce City Market. The $3 million project funded by the Renew Atlanta Infrastructure Bond was designed to ease congestion and improve safety along North Avenue, a street that carries 29,000 cars a day and had a crash rate three times higher than the state average for similar corridors.[43] Along the corridor, smart city technologies "facilitate and promote safety for pedestrian and bicycle traffic; use the latest technology adaptive traffic signals for a safer, more efficient flow of bus and vehicular traffic in real time conditions and prioritize fire engines and ambulances traveling along the corridor on emergency response calls."[44] For example, the adaptive traffic signals monitor the traffic congestion in real-time, and allow the traffic light timing to be adjusted to move cars more efficiently through the corridor; surveillance cameras also allow traffic lights to adjust to pedestrians crossing the street, delaying the change to a green light;[45] a newly created travel safely app that can be downloaded to smart phones provides audible warnings of upcoming dangers identified through networking to intersections, school beacons, and other

[41] Co, C., *Singapore police roll out drone-equipped surveillance vehicles*, CHANNEL NEWS ASIA (Apr. 11, 2019) https://www.channelnewsasia.com/news/singapore/police-drone-security-aerial-surveillance-vans-singapore-11432160

[42] *Id.*

[43] Levine, B., *Atlanta's Smart Corridor to Serve as "Living Lab" for Smart Transportation*, GOVERNMENT TECHNOLOGY (Oct. 13, 2017) https://www.govtech.com/civic/Atlantas-Smart-Corridor-to-Serve-as-Living-Lab-for-Smart-Transportation.html

[44] *City of Atlanta and Georgia Institute of Technology Announce Expanded Research Partnership for Smart City Initiatives*, City of Atlanta Press Release (Aug. 24, 2017) https://www.atlantaga.gov/Home/Components/News/News/7105/1338?backlist=%2F

[45] Wickert, D., *Atlanta's 'smart' North Avenue sports the latest traffic technology*, ATLANTA JOURNAL CONSTITUTION (Sept. 14, 2017) https://www.ajc.com/news/local-govt--politics/atlanta-smart-north-avenue-sports-the-latest-traffic-technology/iVY4eUnVTJHipSa03CzSTJ/

roadway users.[46] The North Avenue Smart Corridor has been a tremendous success proving that technology can improve street safety – accidents along the corridor have been reduced by 25 percent.[47]

The North Avenue Smart Corridor Project has received numerous awards, including the National Recognition Award from the American Council of Engineering Companies 2018 Engineering Excellence Awards competition; State Award Winner, Technology Systems by ACEC at the 2018 EEA State Competition; 2017 Project of Significance Award from the Georgia Intelligent Transportation Society; and the ACEC People's Choice Award.[48] At the Smart City Expo World Congress in 2018, the North Atlanta Avenue Smart Corridor Project received the Mobility Award, one of seven awards given; Singapore was awarded the Smart City of 2018 award.[49]

Atlanta is well-known for its traffic congestion problems. In April 2019, *U.S. News & World Report* released the "Best Places to Live" ranking, which utilizes a survey to evaluate several factors such as quality of life, commute times, job market, etc. Atlanta, Georgia ranked number 6 for the worst commute time in the country, with an average commute time of 31.4 minutes; [50] it ranked number 57 for "Best Places to Live," ranking far below competitor cities such as Austin, Texas (#1), Raleigh/Durham, North Carolina (#10), Nashville, Tennessee (#15), Charlotte, North Carolina (#20), and Dallas-Fort Worth, Texas (#21).[51] Furthermore, in February 2019, INRIX Research released a "Global Traffic Scorecard,"[52] ranking more than 200 cities in 38 countries based on congestion and mobility; the scorecard is based on big data collected from 300 million sources

[46] Travel Safely, https://travelsafelyapp.com/how-it-works/

[47] *One Year Later: North Avenue Smart Corridor*, Georgia Tech Institute for People and Technology (Oct. 29, 2018) http://ipat.gatech.edu/news/one-year-later-north-avenue-smart-corridor

[48] Miller, P., *Atlanta North Avenue Smart Corridor Earns national recognition award*, ATLANTA JOURNAL CONSTITUTION (Mar. 1, 2018) available at: https://www.ajc.com/news/local/atlanta-north-avenue-smart-corridorearns-national-recognition-award/i6D6DSos5T8OunRWD1dS1K/

[49] *Seven awards were announced last evening at the leading international summit on smart cities* (Nov. 15, 2018) http://www.smartcityexpo.com/en/the-event/media-center/press/-/prensa/detalle/13645836/singapore-smart-city-award-2018

[50] Hess, A., *The 10 cities with the worst commutes, according to U.S. News* (Apr. 9, 2019) available at: https://www.cnbc.com/2019/04/09/the-10-cities-with-the-worst-commutes-according-to-us-news.html

[51] *125 Best Places to Live in the USA*, U.S. NEWS & WORLD REPORT https://realestate.usnews.com/places/rankings/best-places-to-live?src=usn_pr

[52] *INRIX Global Traffic Scorecard*, INRIX (Feb. 2019) available for download at: http://inrix.com/

covering 90% of the world's roads across 80 countries. Although Atlanta did not rank in INRIX's list of the "Top 25 Most Congested Cities in the World," it did rank number 11 on the list of the "Top 25 Most Congested Cities in the U.S.," with 108 hours lost per commuter in congestion. Interestingly, Singapore ranked number 14 on the "Top 25 Most Congested Cities in the World" list with 105 hours lost per commuter in congestion, reportedly due to its population. As Atlanta seeks to remedy its traffic congestion problems and improve its reputation on this front, smart city transportation solutions present a real opportunity.

Another significant component of Atlanta's Smart City Strategy is its vast network of closed circuit television (CCTV) cameras, used for both smart transportation solutions as well as crime fighting and prevention, and public safety. In the previously mentioned Comparitech study, Atlanta was determined to be the most heavily surveilled city in the United States, ranking number ten in the world (just ahead of Singapore) with 7800 cameras for 501,178 people, or 15.56 cameras per 1000 people; [53] however, the Atlanta Police Foundation now reports the number of cameras in the city to be even higher at 10,600 cameras. [54] Not only is Atlanta the only city in the United States to make the top ten most heavily surveilled cities, it has significantly more cameras than the other U.S. cities ranking in the top 50: Chicago has 35,000 cameras or 13.06/1000 people, Washington D.C. has 4000 cameras or 5.61/1000 people, San Francisco has 2753 cameras or 3.07/1000 people, San Diego has 3600 cameras or 2.48/1000 people, and Boston has 1552 cameras or 2.23/1000 people.[55]

Atlanta's extensive camera network is part of its Operation Shield initiative, "a network of advanced technologies that create more efficient policing including the citywide network of surveillance cameras and license plate readers, predictive policing platform and criminal analytics software," all housed in the Loudermilk Video Integration Center, a facility which is monitored 24 hours per day, 7 days per week.[56] Businesses and residents in the city can integrate their cameras into the

[53] Bischoff, P., *The world's most-surveilled cities*, Comparitech (Aug. 15, 2019) https://www.comparitech.com/vpn-privacy/the-worlds-most-surveilled-cities/?fbclid=IwAR2885rUmMnY5gA_rDE6j8mtSYFURYpt6eDvkewoY8curg9GqYV7JPyQaN4

[54] Atlanta Police Foundation, Operation Shield, https://atlantapolicefoundation.org/programs/operation-shield/#operationbluelight

[55] Bischoff, P., *The world's most-surveilled cities*, Comparitech (Aug. 15, 2019) https://www.comparitech.com/vpn-privacy/the-worlds-most-surveilled-cities/?fbclid=IwAR2885rUmMnY5gA_rDE6j8mtSYFURYpt6eDvkewoY8curg9GqYV7JPyQaN4 (Eight of the top 10 most heavily surveilled cities were in China; London ranked number 6.)

[56] Atlanta Police Foundation, Technology Innovation https://atlantapolicefoundation.org/programs/technology-innovation/

network, and even purchase cameras for the network. The Atlanta Police Foundation reports that crime is down 50% in areas where cameras are installed.[57]

In November 2018, Delta Air Lines launched the first biometric terminal in a U.S. airport in Atlanta – considered a "blueprint for the industry."[58] Passengers flying directly to an international city from Hartsfield-Jackson Atlanta International Airport at Terminal F on Delta, Aeromexico, Air France-KLM, and Virgin Atlantic can now opt in to the use of facial recognition technology to streamline their check-in, TSA security, and boarding process. Passengers simply scan their passport at check-in, and then a camera takes a picture of their face, matching the images to verify identity; cameras at the other checkpoints (TSA and boarding) continue to verify identity without further use of the passport. Delta Air Lines reports that of the 2.2 million passengers departing from terminal F each year, 1.9 are Delta, Aeromexico, Air France-KLM and Virgin Atlantic customers.[59] While this technology is only estimated to save an average of two seconds per passenger at boarding, it is predicted to save nine total minutes of boarding time per flight.[60] Despite concerns over the use of facial recognition software, Delta Air Lines reports that 72% of travelers prefer the biometric terminal to standard boarding.[61] Delta has now expanded the biometric technology to final boarding at four additional airports – Detroit, Minneapolis-St Paul, Salt Lake City and Los Angeles.[62]

LOOKING AHEAD

As cities seek to develop smart solutions to their problems, a lot can be learned from the approach in Singapore, which focuses on the needs of its citizens

[57] Atlanta Police Foundation, Operation Shield, https://atlantapolicefoundation.org/programs/operation-shield/#operationbluelight

[58] Gailey, A., *Delta takes lead in facial recognition technology at Atlanta airport*, ATLANTA BUSINESS CHRONICLE (Nov. 29, 2018) https://www.bizjournals.com/atlanta/news/2018/11/29/delta-takes-lead-in-facial-recognition-technology.html

[59] *Id.*

[60] *Id.*

[61] Gailey, A., *Facial recognition tech at Hartsfield-Jackson wins over most international Delta customers*, ATLANTA BUSINESS CHRONICLE (June 25, 2019) https://www.bizjournals.com/atlanta/news/2019/06/25/facial-recognition-tech-at-hartsfield-jackson-wins.html

[62] Gailey, A., *Delta expands facial recognition technology to 4 airports*, ATLANTA BUSINESS CHRONICLE (Sept. 9, 2019) https://www.bizjournals.com/atlanta/news/2019/09/09/delta-expands-facial-recognition-technology.html

foremost. As Jacqueline Poh, managing director of the Infocomm Development Authority of Singapore, stated in Sidewalk Talk, the blog associated with Alphabet company Sidewalk Lab, "We wanted to go a bit beyond the idea of the city as a machine — of 'smart' being applied to the city alone."[63] "If we wanted to be a citizen-centric, business-centric, smart city, what really are the applications that would make sense? That would best define and improve the lives of our citizens and businesses? And then, working backwards, what are the kinds of technologies, what are the kinds of data that need to be collected and shared, and then made into tools to be able to enable that experience?"[64]

However, Singapore is also somewhat uniquely poised to become a smart city leader. In Singapore, citizens are less concerned about a surveillance state or the invasion of privacy than are citizens in the United States. The Singapore government reports that its research has shown citizens are willing to trade privacy for utility, predictability and transparency.[65] Furthermore, in a recent study of 30 countries by Boston Consulting Group, *The Citizen's Perspective on the Use of AI in Government*, Singapore was found to have a "net positive perception of AI" which the researchers state correlates to trust in the government.[66] Although emotional and ethical uses of AI such as in healthcare decision-making or assessing guilt or innocence in criminal proceedings was not supported by Singaporeans, AI use was supported in other contexts such as traffic optimization (44% support), machinery maintenance (42% support) and tax assessments (39% support).[67] In February 2019, Singapore announced that it will "double down" on its investments in artificial intelligence as it seeks to "become a trusted global hub for test-bedding, deploying and scaling AI solutions."[68] Programs have been introduced in schools and the workforce to introduce AI to Singaporeans.

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[63] Jaffe, E., *What smart cities can learn from Singapore's Smart Nation*, MEDIUM (Apr. 15, 2016) https://medium.com/sidewalk-talk/what-smart-cities-can-learn-from-singapore-s-smart-nation-e19a7efefa3a

[64] *Id.*

[65] *Id.*

[66] Tan, M., *Trust, transparency must form pillars of Singapore's AI success*, THE BUSINESS TIMES (May 10, 2019) https://www.businesstimes.com.sg/garage/trust-transparency-must-form-pillars-of-singapore's-ai-success

[67] *Id.*

[68] Kwang, K., *Singapore to 'double down' on artificial intelligence efforts, say Vivian Balakrishnan*, CHANNEL NEWS ASIA (Feb. 28, 2019) https://www.channelnewsasia.com/news/singapore/singapore-double-artificial-intelligence-efforts-balakrishnan-11298028

In the United States, however, there is growing concern about the use of artificial intelligence with its known bias and questionable ethics by programmers. In 2018, Amazon made headlines that its AI recruitment tool was found to discriminate against female candidates; as a male dominated industry, more resumes from men were input into the system and it learned to prefer male candidates.[69] Amazon had been designing the tool since 2014, but ultimately scrapped it in 2017 when the bias could not be unlearned. A University of Washington study recently determined that Google's 2016 AI algorithm designed to "monitor and prevent hate speech on social media platforms and websites" was biased against black people, flagging their content twice as often because it was written in African-American Vernacular English.[70] A study by MIT Media Lab researcher, Joy Buolamwini, assessed the accuracy of "three leading face recognition systems — by Microsoft, IBM and Megvii of China — by classifying how well they could guess the gender of people with different skin tones."[71] The results were alarming. Gender recognition was 99% accurate for white men, but significant errors were revealed the darker the skin color: 7% misidentification for light skin females; 12% misidentification for darker skin males; and 35% misidentification for darker skin females.[72] Just last week, news broke that a subcontractor to Google was targeting the homeless and college students to collect data from dark skin people to improve its AI facial recognition algorithms.[73] Atlanta was among the cities where this occurred.[74] Reportedly, five dollar gift cards were given to participants in exchange for pictures of their faces, and in some

[69] Meyer, D., *Amazon Reportedly Killed an AI Recruitment System Because It Couldn't Stop the Tool from Discriminating Against Women*, FORBES (Oct. 10, 2018) https://fortune.com/2018/10/10/amazon-ai-recruitment-bias-women-sexist/

[70] Martin, N., *Google's Artificial Intelligence Hate Speech Detector Is 'Racially Biased,' Study Finds*, FORBES (Aug. 13, 2019) https://www.forbes.com/sites/nicolemartin1/2019/08/13/googles-artificial-intelligence-hate-speech-detector-is-racially-biased/#7496f63f326c

[71] Lohr, S., *Facial Recognition Is Accurate, if You're a White Guy*, THE NEW YORK TIMES (Feb. 9, 2018) https://www.nytimes.com/2018/02/09/technology/facial-recognition-race-artificial-intelligence.html

[72] *Id.*

[73] Wong, J., *Google reportedly targeted people with 'dark skin' to improve facial recognition*, THE GUARDIAN (Oct. 3, 2019) https://www.theguardian.com/technology/2019/oct/03/google-data-harvesting-facial-recognition-people-of-color

[74] Nicas, J., *Atlanta Asks Google Whether it Targeted Black Homeless People*, THE NEW YORK TIMES (Oct. 4, 2019) https://www.nytimes.com/2019/10/04/technology/google-facial-recognition-atlanta-homeless.html

cases, participants were not even aware their data was being collected for this purpose.[75] Google is investigating.

As more and more examples of the bias and discrimination in AI is exposed, pressure is mounting in cities across the United States to address the issue. In May 2019, San Francisco became the first city in the United States to pass an ordinance banning the police and city agencies from using facial recognition software; local businesses may still use the technology.[76] Somerville, Massachusetts was the second U.S. city this summer to pass an ordinance banning the use of facial recognition technology in police investigations and municipal surveillance.[77] Oakland, California followed suit becoming the third city to pass an ordinance banning the use of facial recognition by city departments, including the city police.[78] In September 2019, the California Senate voted to place a three-year moratorium on using facial recognition software in police body cameras, calling AI "not ready for prime time"; the bill is still pending full approval by the state legislature, and if passed would be largest state to pass such a ban.[79] New Hampshire and Oregon have already passed state laws.[80]

As concerns mount over the use of smart technologies in the United States and laws are increasingly passed to restrict their use, how will the competitiveness of American cities be affected? Will countries like Singapore that are rapidly moving forward with smart city solutions tailored to citizen's needs become the most attractive, most competitive cities? Will these smart cities, which offer operational efficiencies and thus "more time back" to their citizens be better

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[75] *Id.*

[76] Harwell, D., *San Francisco becomes the first city in the U.S. to ban facial-recognition software*, THE WASHINGTON POST (May 14, 2019) https://www.washingtonpost.com/technology/2019/05/14/san-francisco-becomes-first-city-us-ban-facial-recognition-software/

[77] Wu, S., *Somerville City Council passes facial recognition ban*, BOSTON GLOBE (June 27, 2019) https://www.bostonglobe.com/metro/2019/06/27/somerville-city-council-passes-facial-recognition-ban/SfaqQ7mG3DGulXonBHSCYK/story.html

[78] Ravani, S., *Oakland bans use of facial recognition technology, citing bias concerns*, SAN FRANCISCO CHRONICLE (July 17, 2019) https://www.sfchronicle.com/bayarea/article/Oakland-bans-use-of-facial-recognition-14101253.php

[79] Thebault, R., *California could become the largest state to ban facial recognition in body cameras*, THE WASHINGTON POST (Sept. 11, 2019) https://www.washingtonpost.com/technology/2019/09/12/california-could-become-largest-state-ban-facial-recognition-body-cameras/

[80] Martin, N., *The major concerns around facial recognition technology*, FORBES (Sept. 25, 2019) https://www.forbes.com/sites/nicolemartin1/2019/09/25/the-major-concerns-around-facial-recognition-technology/#6d8a7a2b4fe3

positioned to attract top talent and the businesses that employ them? Singapore is counting on it.