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# Smart City Report:

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## Asia Puts Smart Cities to the Test

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## Executive Summary

Rapid urbanization in Asia has put intense pressure on Asian city planners to improve daily life for residents. Governments in Asia are attempting to meet this challenge by creating sustainable, Smart City environments. This paper focuses on two Smart City initiatives currently under development in the Asian market. Both seek to improve the quality of life by reducing energy usage and applying internationally developed Smart City measures in ways that address local needs.

First, we highlight a Smart City project in the Republic of Singapore, a city-state that serves as the very model of a modern major urban environment. Second, we take a close look at pilot cities under development in the People's Republic of China, undertaken as part of a broad national urbanization plan managed by the Central Government in Beijing.

By highlighting how urban centers in other countries are creating effective Smart City landscapes, perhaps cities in the U.S. and elsewhere will find examples of methods they can employ to support their own Smart City goals, inspiring them to create their own unique strategies for Smart City success.

## Republic of Singapore

Singapore has a highly developed and successful free market economy. It enjoys a remarkably open and corruption-free environment, stable prices, and a per capita GDP higher than that of most developed countries. The local economy depends heavily on exports, particularly in consumer electronics, information technology products, pharmaceuticals, and a growing financial services sector.

Real GDP growth in Singapore averaged 8.6% between 2004 and 2007. The economy contracted a scant 0.8% in 2009, as a result of the global financial crisis, but enjoyed a robust rebound to 14.8% in 2010. GDP growth slowed again, to 5.2%, in 2011, and then again to 1.3% in 2012. The most recent slowdown is largely the result of soft demand for exports from Europe, which was in the midst of its second regional recession in 2012.

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Over the longer term, the Singapore government hopes to establish a new growth path that focuses on raising productivity, which has suffered an average decline of about 1.0% annually during the last decade.

Singapore has attracted major investments in pharmaceuticals and medical technology production and will continue efforts to establish itself as Southeast Asia's financial and high-tech regional hub.<sup>1</sup> Industry giants GlaxoSmithKline, Novartis and Takeda are leveraging Singapore as a key home base to drive innovation, growing the nation's biopharmaceutical industry by more than 30% in 2011.<sup>2</sup>

## Challenges

Singapore is an island nation and has a limited amount of land and fresh water. The government has three main authorities that assist in guiding the growth of Singapore in its use of these limited resources: the Singapore Land Authority (SLA), the Urban Redevelopment Authority (URA) and the Building Construction Authority (BCA). These three authorities provide checks and balances for how a proposed building is processed, from design review to obtaining a Certificate of Statutory Completion (CSC) or a Temporary Occupation Permit (TOP). Some good processes and online solutions like Corenet (<http://www.corenet.gov.sg/>) for e-Submissions and the new BIM e-Submission (<http://www.bca.gov.sg/bim/bimlinks.html>) are helping to streamline data transmission among the authorities, but as advanced as these solutions are, there is still much work to do.

Consistently viewed as an exemplary model for a modern urban environment by the outside world, Singapore has had to come to terms with its leadership role when it comes to Smart City development. To set benchmarks and begin a process that will lead to Singapore cementing its

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<sup>1</sup> CIA World Factbook <https://www.cia.gov/library/publications/the-world-factbook/geos/sn.html>

<sup>2</sup> Singapore Economic Development Board 2013, <http://www.edb.gov.sg/content/edb/en/industries/industries/pharma-biotech.html>

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reputation as a leader in the Smart City movement, the Infocomm Development Authority (IDA) created the Smart Cities Programme Office (<http://www.ida.gov.sg/Infocomm-Landscape/Infrastructure/Smart-City-Programme-Office>) (SCPO) to assist in developing solutions for urban environments designed to optimize the use of resources, provide a better environment for Singapore's residents, and attract international investment and talent. SCPO's focus is to identify, explore and improve key indicators and measures of Smart Cities, such as: transportation; infrastructure; energy; water; waste; public safety; education; healthcare; green/smart buildings; and citizen services.<sup>3</sup>

The challenge for the SCPO and the government of Singapore is to manage the expectations of what is achievable while promoting what is possible and enhancing the way it delivers Smart City services. In order to balance the aspirations of Smart Cities, the office has identified a new real estate development in the western area of the nation state called Jurong Lake District, which will be an incubator for many of Singapore's proposed Smart City initiatives.

### **Smart City Solutions: Jurong Lake District**

Jurong Lake District (JLD) was planned as an example of a Smart City, a place where the IDA's SCPO could test innovations through a series of smaller steps. Each step was meant to control the goals and expectations of the solutions and provide an opportunity for the government of Singapore to partner with providers when it comes time to sell their tested solutions to other markets.

JLD is one of the new growth areas created in the Singapore URA's master plan for 2008. The idea is to support Singapore's economic growth by dispersing commercial activities away from the city's Central Business District (CBD), thereby bringing jobs closer to where people actually live. JLD is the largest commercial and regional centre outside the CBD.

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<sup>3</sup> All of these measures align with the Smart City goals outlined in McGraw-Hill Financial Global Institute's Smart City Whitepaper titled, "How to Build Sustainable and Resilient Environments In an Increasingly Urbanized World".

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Surrounding JLD is a resident population of over 1 million people, and the largest concentration of industrial space in Singapore. The goal is for JLD to be a leading model for Singapore in developing a Smart City that satisfies the following two Smart City criteria. The district must be:

- **Sustainable** – A place where new developments are built with an eye toward reducing environmental impact, utilizing resources efficiently and reducing the carbon footprint – a place where vitality and the resilience of local communities and businesses are all enhanced; and
- **Smart and Connected** – An urban area where pervasive Information Communication Technology (ICT), connectivity and real-time large data collection lead to greater awareness and insight, translating into improved livability, more efficient operations, and better informed planning for agencies and organizations.

To achieve these objectives, the creation of a Call for Collaboration (CFC) is currently being conducted, making the JLD a “living laboratory.” By agreeing to be the first adopter/reference site, JLD will be the home and testing ground for many Smart City innovations, giving Singapore a unique, leading role in determining what really works and what does not on the day-to-day level. Employing a framework of test beds, test cases and test areas allows the IDA to assist different agencies and authorities in Singapore that wish to test innovations by sharing large amounts of data – i.e., “Big Data” – that can be analyzed and acted upon.

The framework’s guiding principles are focused on innovation, national need, capability building and scalability/exportability. By centering industry and government efforts on the JLD, the CFC will create a collection of tried and tested solutions to showcase Singapore’s Smart City capabilities. The solutions of the CFC will be considered for full-scale government-wide and synergistic deployment of Smart Cities in Singapore.<sup>4</sup>

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<sup>4</sup> IDA Singapore <http://www.ida.gov.sg/Collaboration-and-Initiatives/Collaboration-Opportunities/Store/Smart-and-Connected-Jurong-Lake-District-Pilots-and-Trials-CFC>

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The first group of Test Case innovations at JLD will include:

- Taxi cue optimizer
- Crowd/activity finder
- Ubiquitous library
- Library management
- 3D map
- Smart walking
- Mall navigator
- Energy efficiency
- Conducive environment
- Maintenance/cleanliness
- State land management
- Positioning in an urban environment
- Smart car park
- Logistic management
- Smart traffic management
- Automated car parking charges

These test cases will be implemented throughout 2014 and are scheduled to conclude in 2015.

The majority of test cases at JLD will be supported by test bed implementations of sensors and multimedia capturing equipment for light, air quality, temperature, noise, video and audio. The initial test cases will be implemented in two of the JLD's districts that are already linked by the existing Singapore MRT (Subway) system:

1. Jurong Gateway: A 172-acre (70 Ha) commercial district
2. Lakeside: A 720-acre (290 Ha) residential district

Perhaps the most interesting outcome from this ambitious and well thought out CFC program by the IDA will be the connections made possible between data, people and ideas. These connections will form naturally through the daily use of each test case. By using the test case model, Singapore is shying away from the uber-platform Smart City solutions promoted by many of the large IT companies, focusing instead on incremental, real world results. This mature process encourages innovation and provides a "living lab" to work through the multitude of issues that disruptive innovations often bring. By using a model based upon "little wins," all the

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while working towards the “big win” of being a true Smart City, Singapore is positioning itself to become one of the world’s foremost leaders of sustainable, smart urban development. Singapore’s JLD is a good example of Smart City innovation, implementation and scalable solutions that ensure Singapore’s role as a model for Smart Cities far into the future.

## **People’s Republic of China**

Since the late 1970s, China has moved from a closed, centrally planned system to a more market-oriented economy, one that plays a major global role. In 2010, China became the world's largest exporter. Reforms began with the phasing out of collectivized agriculture and expanded to include: the gradual liberalization of prices; fiscal decentralization; increased autonomy for state enterprises; creation of a diversified banking system; the development of stock markets; rapid growth of the private sector; and a greater opening to foreign trade and investment.

China has implemented its reforms gradually. In recent years, China has renewed its support for state-owned enterprises in sectors it considers important to "economic security," explicitly seeking to foster globally competitive national champions. After keeping its currency tightly linked to the U.S. dollar for years, China revalued its currency by 2.1% against the U.S. dollar in 2005, and moved to an exchange rate system that references a basket of currencies. From mid-2005 to late 2008, cumulative appreciation of the renminbi against the U.S. dollar was more than 20%. But the exchange rate remained virtually pegged to the dollar from the onset of the global financial crisis until June 2010, when Beijing allowed resumption of a gradual appreciation.

The restructuring of the economy and resulting efficiency gains have contributed to a more than tenfold increase in GDP since 1978. Measured on a purchasing power parity (PPP) basis – an assessment that adjusts for price differences -- China is now the second-largest economy in the

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world after the U.S., having surpassed Japan in 2001. The dollar value of China's agricultural and industrial outputs each exceed those of the U.S. China is second to the U.S. in the value of services it produces, although the nation's per capita income remains below the world's average.<sup>5</sup>

In 2011, China reached a population milestone – more than 50% of its population reported living in an urban environment. The rate of absorption of new residents in Chinese cities is about 3% each year. With the Chinese cities of Shanghai (17 million), Beijing (16 million), Chongqing (9.5 million), Shenzhen (9 million) and Guangzhou (8.9 million) beginning to show signs of wear with regard to infrastructure, the Chinese government has created pilot programs to learn what is the best urban development model for all Chinese cities. The most recent, interesting and widespread pilot adoption is in the form of Sustainable Transit Development, which uses Smart City fundamentals as its base.

## Challenges

The Chinese government faces numerous economic challenges, including: (a) reducing its high domestic savings rate and correspondingly low domestic demand; (b) sustaining adequate job growth for tens of millions of migrants and new entrants to the work force; (c) reducing corruption and other economic crimes; and (d) containing environmental damage and social strife related to the economy's rapid transformation.

Economic development has progressed further in coastal provinces than in the interior. By 2025, more than 250 million migrant workers and their dependents will have to relocate to urban areas to find work, leaving behind their agricultural roots.<sup>6</sup>

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<sup>5</sup> CIA World Factbook <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>

<sup>6</sup> New York Times, June 15, 2013, China's Great Uprooting: Moving 250,000 into Cities



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An additional challenge is that China is now one of the most rapidly aging countries in the world, which according to two Citigroup economists, Nathan Sheets and Robert A. Sockin, will result in a loss of 3.25 % of GDP growth.<sup>7</sup> This new reality has provided the first easing of China's unpopular One Child Policy, which China needs to maintain its manufacturing power base.

Another long-term problem is deterioration of the environment, most notably air pollution, soil erosion, and the steady fall of the water table, especially in the north. China continues to lose arable land because of erosion and economic development. The Chinese government is seeking to add energy production capacity from sources other than coal and oil, focusing on nuclear and alternative energy development.

In 2010-11, China faced high inflation, resulting largely from its credit-fueled stimulus program. Some tightening measures appear to have controlled inflation, but GDP growth consequently slowed to under 8% for 2012. An economic slowdown in Europe contributed to the one in China, and has been a further drag on Chinese growth in 2013. Debt overhang from the stimulus program, particularly among local governments, and a property price bubble continue to challenge policy makers. The government's 12th Five-Year Plan, adopted in March 2011, emphasizes continued economic reforms and the need to increase domestic consumption in order to make the economy less dependent on exports. China has made only marginal progress toward these rebalancing goals.<sup>8</sup> In addition, rapid urbanization and increasing income levels continue to present policy makers and planners in China with considerable challenges.

Recent reports estimate that over 250 million people will migrate from the western provinces to the eastern Chinese cities to find work. The mechanization of farming and massive efficiencies in the food supply chain has created unemployment in rural areas. Seeing the trend over 10 years ago, the Chinese government began an urban planning process similar to that of many Western cities: building micro-cities around existing urban centers, approximately 10km concentric from the Central Business District, and connecting them through mass and regional transit.

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<sup>7</sup> Wall Street Journal, October 23, 2013, Aging Population Could Trim 3% Off China GDP Growth,

<sup>8</sup> CIA World Factbook <https://www.cia.gov/library/publications/the-world-factbook/geos/ch.html>

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Like most Chinese policy programs, prototypes of this type of urban planning were conducted in a systematic manner. After testing a number of prototypes, the program was halted due to a lack of inhabitants in many of the “micro cities”. Western media caught wind of these “ghost cities” and the Chinese government decided to take a different approach in 2011: dense urban planning through the implementation of sustainable transit development. Under the 12<sup>th</sup> Five-Year Plan, this became the prime directive of how to create new Chinese Smart Cities.

### **Smart City Solutions: Sustainable Transit Development**

How can governments, planners and communities create functional, integrated and sustainable transportation systems? This was the question on many minds as the planning for the next phase of Chinese Smart Cities began. The answer came in March 2011 with the Sustainable Transit Development policy, which identified 20 city clusters throughout China where the state would attempt to spearhead economic development. Each cluster contains a number of cities, ranging from a minimum of three to as many as 20, forming coordinated markets and economic development zones. The five main ones are the Yangtze Delta, Pearl River Delta, Beijing-Tianjin Region, Chengdu-Chongqing Region, and the Yangtze Mid-Stream Region (which includes Wuhan, Changsha and Nanchang). After these top five clusters come nine second-tier clusters, and then six emerging clusters. Together, these 20 clusters (known as the "5+9+6") represent a collection of 170 of the highest growth cities in China, accounting for 49% of China's population in 21% of its land area, nearly 80% of its GDP and approximately 99% of its Foreign Direct Investment (FDI).

Tying this together is China's high speed national rail network, which connects 30 core cities within the 20 clusters. New regional rail networks will link the cities within each cluster and subway systems will provide efficient mass transit at the city level. These three systems are being seamlessly integrated to drive maximum benefit. Forty-seven of the 50 cities currently operating, building or planning mass transit systems fall into the 170 cities that make up the 20 clusters. According to a study by the McKinsey Global Institute, these mass transit systems should be in place and operational by 2025.<sup>9</sup> Building on these development policies and

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<sup>9</sup> McKinsey Global Institute [http://www.mckinsey.com/insights/urbanization/preparing\\_for\\_urban\\_billion\\_in\\_china](http://www.mckinsey.com/insights/urbanization/preparing_for_urban_billion_in_china)

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frameworks, a focus on dense urban development projects has taken center stage in China, all designed to pursue transit-oriented, smart, low-carbon, green development. The Chinese plan of dense urban growth centered on sustainable transportation offers a highly scalable, replicable, modular development model. Focusing on a one square kilometer (1skm) district around major transit nodes, the following strategic advantages are expected:

- Each station (“node”) of a subway will be developed as an independent eco-system, where the real estate above the station will be the most valued within a city, requiring significantly less development time and capital than large-scale "Eco-city" projects. Each station’s development will be a platform for "innovation, rapid prototyping and knowledge capture".
- Each node will have a functional station, retail sectors, commercial office sectors and high rise residential sectors, all supported by an energy micro-grid, its own economic eco-system, and Smart City solutions designed to enhance the resident experience.
- Developments around transit nodes offer higher market value, a faster absorption rate, and lower investment risk.
- Instead of an independent, stand-alone project involving isolated technologies, the Chinese model provides a platform to incorporate smart, low-carbon and green technologies over the long term. The attendant expertise, services and products will generate sustainable economic growth and business opportunities for local communities. This is in alignment with China’s economic development and sustainable agendas, ensuring there will be strong and consistent policy support by central and local governments alike.<sup>10</sup>

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<sup>10</sup>Transit Synergized Development, Lee, James <http://www.urbanchinainitiative.org/transit-synergized-development-framework-for-a-smart-low-carbon-eco-city/>

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The economic focus of sustainable transportation is on energy and its corresponding data. Each sector of development (station, retail, commercial, and residential) must rise to the challenge of becoming and operating as a Smart Building (or group of buildings). Smart Buildings in this program are defined as those that capture data, usually through sensors, and adjust energy usage for each situation.

There is also the challenge of providing clean, consistent and sustainable energy at the building and district level (1skm). The types of energy technologies employed (clean tech, low carbon, low emissions, etc.) will be decided by each developer, but each is strongly urged to seek innovative technologies as their primary solutions. As each district implements its energy creation and consumption plan, the main goal is to be as self-sufficient as possible, creating a hub that connects to a micro grid.

If a micro grid has more energy than it can use, the goal is to provide excess energy to the overall city Smart Grid. The key to success of this model is in the efficiencies gained through lower transmission resources, having proper and timely analytics for adjustments, and 3D visualization of the entire development for better decision-making.

Interconnection with the transit system will ensure a continuous stream of people coming to shop, work, live and play at each node. The high density of people created by this model challenges designers to create beautiful, functional and creative spaces to provide a fulfilling urban experience for residents and visitors. Celebrating density while allowing for the discovery and ownership of individual spaces is a challenge Chinese cities will need to address.

China's sustainable transportation development model is a next-generation initiative, enabling its existing East Coast mega-cities to pivot and absorb the hundreds of millions of migrating citizens from the Western provinces. It is important for these efforts to be successful, or else China will risk falling into a severely unbalanced and potentially volatile situation, with too many people crammed into over-stressed urban environments.

This is just not a Chinese domestic issue but an issue for us all; the world does not want an unbalanced or volatile China. Making adjustments along the way, China is learning more quickly than other cities in terms of what synergies can form between energy districts and transportation nodes in designing dense urban environments. In learning from the initial pilot programs in Kunshan, Suzhou, Foshan, Wuhan and Chongqing, China is paving the way to identify and adopt the proper balance of smart, low carbon and green technologies that will enable its cities to achieve an unprecedented level of urban sustainability. This will not only help China address its own domestic issues, it will offer the world a benchmark for the development of true Smart Cities everywhere.

## Summary

The Asian Market is leading the world in the implementation of Smart City projects and programs. Like all early adopters, there will be much to learn from these pioneering ventures. Will China's model of a dense, interconnected urban environment be replicated by other cities? Or will the Singapore model of a living laboratory, using a mosaic of interconnected Smart City projects, be the path other cities decide to take?

The next 24-36 months are crucial for benchmarking, best practices and lessons learned. As long as Singapore and China use their own measures for success, in alignment with the key performance indicators of lower energy use, localizing international measures, and improving the quality of life for their urban dwellers, there could be unlimited potential for the future of these Asian Smart Cities as role models for the rest of the world.

## About the Author

Paul Doherty, AIA, is the president and CEO of the digit group, inc., ([www.thedigitgroupinc.com](http://www.thedigitgroupinc.com)) a market-leading Cloud software incubator for Smart City products. He is an author, educator, analyst and advisor to Fortune 500 organizations, global government agencies, prominent institutions and architectural, engineering and contracting firms. He is a frequent guest writer for numerous publications and has authored or edited nine books. Widely quoted in the media, Paul is a licensed architect who brings a global industry perspective and is a highly rated speaker at numerous industry events around the world each year.