

# Green Island's Smart Footprint

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## Abstract

*The purpose of this work is to introduce, examine and provide a contextual overview for Taiwan's achievements in the IT sector and to outline a current context for future trends in Taiwan's IT evolution. To achieve this goal, this work analyzes the forces in play involving IoTs, Big Analytics, Open Data, and Smart City initiatives— and how these forces are merging in Taiwan today within a global arena. More specifically, this work examines both local and global industry partnerships, practices in sound governance, and current accomplishments in Smart City initiatives and how these forces will be a catalyzing force that embraces an emerging digital broadband environment and the market demands it brings.*

*Research shows that Taiwan has effectively established an environment conducive for continual success in Smart City development and forging global collaborations in IT development that buoy cross-border fertilization in innovation and know-how. For these things to happen in Taiwan specific precursors must be firmly established. Taiwan's building blocks in its IT sector are not exclusive to its OEM/ODM manufacturing and semiconductor know-how, but also extends to its ICT advancements, IT solutions and system service provider capacities, and a regulatory environment that has laid the foundations for the next epoch in its IT evolution— its burgeoning Smart City technologies, applications in digital services, and software development.*

*The implications from this examination are far reaching. Taiwan is in a position to leverage its current accomplishments in IT development and open governance to capture and harness future IT trends in the globally-driven IT marketplace. Taiwan's current regulatory environment and industry success will be a boon to accomplish next steps in its digital evolution and IT knowhow. Ongoing advancement in its “digital inclusion” strategies will be part of the mix in leveraging Taiwan's success in Smart City development and utilization of IoTs, Big Analytics, embedded sensor technologies, and a rapid expansion in APP creation promoting digital services for urban landscapes. In summary, the crux of this work demonstrates how Taiwan's IT sector is adapting and responding to new IT trends and developing innovative ways to cultivate global markets in IT development through both public and industry support mechanisms and Smart City initiatives.*

## 1. Introduction

Taiwan. Aka the Green Island or sometimes also aptly referred to as the “Green Silicon Island” are fitting names for a number of reasons. Beyond Taiwan's green splendors lies something very special— a highly adaptive, innovative, and creative force— its technology sector- imbued with “Smart Powers” stamped

not only in its OEM/ODM industrial base, but, also extending to its ICT business community, IT solutions and system service providers, green landscape, and urban fabric. Although Taiwan may be both nestled in and miffed by diplomatic isolation its place in the “Digital Age” is not. Taiwan's ability to capture trends in the global IT industry and harness innovation within those trends has been nothing

short of astonishing. In sync with the headwinds driving a dynamic weft of OEM/ODM manufacturing know-how, ICT innovation, and IT solutions and system service capacities, Taiwan is wisely turning its attention toward a new market taking shape within a rising global urban landscape involving applied technologies and digital services in the Internet of Things (IoT), Internet of Everything (IoE), and Big Analytics. Anchored in this triad of trends lies Taiwan's Smart City initiatives, an accelerator and platform for developing IoT (Internet of Things) and IoE (Internet of Everything) applied technologies (Scroxtton, 2015, p. 22). Taiwan's Smart Cities are a spark point for kindling the development and advancement of Smart City innovation and applied technologies. This event reflects an upward trend in a new market layered in a global broadband digital economy offering new opportunities for Taiwan's technology sector, city leaders, and urban citizens. To put this in a broader context, this unfolding economic development will not be exclusive to Taiwan's national economy but, rather, part of a larger global network composed of digitally-based urban centers. Within its minutiae, there are global stakeholders engaging in unique partnerships including software developers, infrastructure technocrats, public leaders, and manufacturing/ICT leaders. These partnerships will evolve within a "system of systems", a complex internet-wired environment where a new convention of interlinked intranets will emerge in urban landscapes facing shrinking public budgets. In this space, public private partnerships (PPPs) are converging to both support and promote cross-border fertilization in innovation and commercialization of new hardware technologies, embedded sensor technologies, software development, and open data services. In this dynamic, Taiwan will always do what it does best- adapt and thrive.

To illuminate how this emerging market will be a catalyzing force on the Green Island, and how Smart City initiatives will act as an axes for future achievements in digital frontiers, there

are a number of existing precursors that must be properly understood in order to enlighten forward looking perspectives. It is necessary to understand the techno-footprint in place there today. In broad contours, these precursors include- Taiwan's key industry initiatives, public policy success on federal and local levels in governance, strategic local and global partnerships, and, of course, the impetus of its cross-Strait relationship with its mainland counterpart. These precursors are a constellation of synergies mapping a new space for Taiwan's IT sector in Smart City technologies and its adjacent supporting industries.

## **2. The Stage, IoT, IoE, Big Analytics and Urban Development**

The idea of a Smart City encompasses a broad range of implications and meanings. But, fundamentally, a Smarty City is an urban center which utilizes its big data analytics through the power of IT to improve economic development, and the management of resources that elevate the quality of life for its city citizens and respective stakeholders. In more narrowly sculpted terms, this will mean advancing "digital inclusion" for public and private stakeholders to develop innovation in critical modern infrastructure, broadband technologies and applications, digital services, market growth, and cost saving strategies in public budget planning. Essentially, success in digital inclusion brings with it a makeover in upgrades at all levels of the urban and industrial fabric.

A Smart City is a corridor, a place for sand-boxing out-of-the box models, for the implementation and tinkering of Internet of Things by offering a space for applying automated technologies and innovation directly into an urban fabric via the development of digital services. The development of digital services and urban management strategies work in concert to improve transportation, public safety, emergency management, tourism, retail, smart buildings, production monitoring,

healthcare, smart agriculture, smart homes, and smart energy and water management systems (“Designing Roadmap,” Digitimes, 2014). To achieve “digital inclusion” within these urban enhancements, utilizing “Big Analytics” as a cornerstone to data driven-decision advantages in governance and public-private partnerships (PPPs) is at the forefront of this transformational event. However, for Big Analytics to be a well spring— there first needs to be an open data environment in place. On this front, Taiwan’s regulatory bodies have set the stage.

An open data policy is an integral part of the government’s regulatory regime. And according to the Global Data Index (GODI) Taiwan has achieved full marks in this area.

For data to find utility and become part of data driven decisions the data must be accessible, enabled, and usable to fuel creative opportunity for private and public stakeholders. According to the 2015 Global Open Data Index, Taiwan tops the list (Global Open Data Index, 2015). Taiwan is a case study in a freer open society and one where APP/services and telecom companies have an opportunity to try new things. Through Private-Public-Partnerships (PPPs) and initiatives put forward by the Ministry of Economic Affairs, the Industrial Technology Research Institute commissioned and co-funded by the Ministry of Economic Affairs, and Taiwan’s 4G carriers a creative platform has emerged to enable open broadband digital services in 4G. In parallel, by pursuing “Open Challenge” strategies to promote a more competitive environment, innovation, and market growth the government has incentivized an upward trend in 4G development and services through market liberalization strategies and funding opportunities within the telecommunications sector. Moreover, these type of national broadband plans have been instrumental in establishing trigger points for boosting broadband uptake in applications and services and utilizing open data as means to accomplish that end.

Another key point has been in federal leg-

islation. Legislation guided by enlightened policy prescriptions by public leaders has been a key factor in continuous commitment to an open data platform and open governance. For example, in 2005- Taiwan’s Freedom of Government Information Law enables public access to government agencies information, and on the media front, legislation in 2003 barred the government and political party officials from holding positions in broadcast media companies and requires all government entities and political parties to divest themselves from all broadcasting assets thereby staving off potential threats to an open and free society- *Fluctuat nec mergitur* (Freedom of the Press, 2015).

The implications as a whole mean a sandbox for APP developers to access data for endless innovation in digital services for Smart City development and urban planners. This opens pathways where end users, service providers, energy and waste companies, sensor network providers, data providers and developers merge in a creative nexus of possibility. Not stopping here, Taiwan’s Industrial Technology Research Institute (ITRI) plans for the upcoming “Smart City Expo Summit in March 2016” to review and explore the possibility of implementing Smart CitySDK (“ITRI Host,” 2016). A programming package supported by EU policy initiatives to put in place Application Programming Interface (API) Harmonization strategies among EU cities currently involving Barcelona, Rome, Helsinki, Istanbul, and Lisbon. Harmonizing APIs enables the possibility of interoperability as a means to expand city APP/service capabilities. For this vision to gain ground in Taiwan, ITRI, through government support, is cradling PPP arrangements among private stakeholders such as the 4G Carriers and city governments as a field to consider CitySDK in a 4G context. If this approach is adopted and proves successful, this framework will potentially enhance feedback loops beyond Taiwan’s federal and local context and rather one married to a globally charged knowledge based economy.

In terms of future buddings there are many things to consider, one area of Smart city technology development will be in GSMA-Low Powered Wire Area (LPWA). According to Machina Research and Strategy Analytics it is anticipated that there will be 2.7 billion LPWA connections by 2022 (“GSMA Countless Low Power,” 2015). Global investments are expected to soar more than USD \$27.5 billion by 2023 (Willis, 2015). By 2019, BI Intelligence forecasts IoT technologies are expected to generate USD \$421 billion in economic value to cities (Neiger, 2016). In parallel, within the same timeframe, a growing interconnected Smart City market is expected to reach a staggering USD \$1.1 trillion dollar market valuation according to Markets and Markets (Ibid). And by 2025, it is expected there will be 88 cities worldwide that have adopted smart city technologies to support and accommodate shifting demographics moving toward urban areas (Willis, 2015). As an example, today in the US alone 82.3% of the population reside in urban centers/communities and in China in the coming years 70 percent of the population is anticipated to be part of the urban landscape, according to China’s software division of the Ministry of Industry and Information Technology (Peeples, 2015). And most urgently, by 2040 global energy demand is expected to rise by 56 percent, and 50 percent of the world’s population will be living in areas facing water scarcity issues (Willis, 2015). On a whole, all of these trends will demand better public service strategies to more effectively manage both energy and water resources, emergency response systems, and transportation concerns. Effective “smart powers” will become a crucial component in managing these dynamics by integrating technology applications into the urban fabric. In simple economic terms, smart city technologies will fuse with commercial trends in supply and demand side economics.

### **3. Taiwan’s Green Achievements and Smart City Scorecard**

Taiwan’s green achievements and success in

Smart City initiatives are Siamese Twins. One event cannot occur without the other. In the area of green achievement, in the face of rising environmental conflict and urban growth Taiwan is advancing its future with resolve. As proof, true to its alias name “Green Island”, New Taipei City has become the first municipality in Asia to achieve full compliance with the “Directives of Compact of Mayors” (Her, 2015). The “Directives of Compact of Mayors” was launched in the 2014 U.N. Climate Summit. It represents a coalition of cities working to achieve adaptation and resiliency in climate change and specific commitments in lowering its carbon footprint. This achievement reflects a remarkable accomplishment between central and local governments to incorporate innovative public planning strategies. This serves as a vivid illustration for a nation working to blend innovation with urban and environmental challenges – and a milestone for others in Asia to follow.

In the area of Smart City success, according to the ICF (Intelligent Community Forum) Taiwan has soared in its ranking system (“Top7,” 2016). In 2006, Taipei ranked first on ICF’s intelligent community rankings and again in 2013 Taichung City placed first. In the past two years Taiwan’s intelligent communities have achieved a high number of placements on the ICF Smart 21 listings. In 2015, Most Intelligent Communities Finalist 21 List included New Taipei City, Taitung County, Taoyuan County, and Changhua County, and for its highest scoring- the Top 7 List Taiwan’s New Taipei City found its way on that list (Ibid.). For 2016, the Smart 21 list has already been published and so far includes Taiwan’s- Kaohsiung, New Taipei City, Hsinchu County, Taitung County, and Taoyuan County (Ibid.).

### **4. Partnerships: Cross-Border Fertilization in Innovation**

Taiwan’s ability to attract international partnerships is a prerequisite to effectively ride global technology trends and house local and international incubation strategies. Tai-

wan's IT engineering talent pool, local partnerships in semiconductors, business friendliness, and know-how in managing mainland China makes it a hotspot for international partnerships. These partnerships are key in innovation strategies and capturing market shares in an underlying emerging digital economy. Some of these partnerships include, UK's cutting edge microprocessor designer ARM, Apple Inc., and Cisco Systems Incorporated.

ARM established a world-class CPU Design Center in Hsinchu, Taiwan. The new design center will focus on IoT and an embedded device market focus. The center will focus on design verification, and delivery of the Cortex-M Processor series. This technology has enormous implications for Smart City applied technologies (Scroton, 2015, p. 22).

Apple recently opened a new laboratory in the Longtan Science Park in Northern Taiwan. The purpose is to develop new display technologies for their iPhones and iPads for thinner and more energy efficient applications (Culpan, 2015). In parallel, Apple has also shifted its custom mobile chipset for A10 chipsets sourcing from Samsung in favor of Taiwan's semiconductor giant TSMC as a strategic move to enhance value-added to its supply chain strategies (Balanci, 2015).

In terms of strategic footing in Smart City infrastructure, Cisco Systems is advancing its business relationships in Taiwan's Smart City projects. This past year, local governments in Taichung and Keelung put in place MOUs with Cisco Systems Inc. to create smart city solutions in the two cities that focus on managing traffic, environmental, business, and energy control systems ("Taichung, Keelung partner Cisco", 2015).

## 5. Taiwan's National and Local Industry Collaborations & Initiatives

Taiwan's local industry initiatives to advance smart city technologies is a key ingredient for building effective collaborations to support of local and federal government pol-

icy mandates. Industry organizations such as the Taipei Computer Association, the Taiwan Smart City Solution Alliance (TSSA), and the Smart City & IoT Industry Alliance, and Taiwan's Telecom sector's 4G Carriers promotion reflects a composite of industry leaders working together to support the development of IoT industry within the context of Smart City initiatives. Serving as an example, their efforts to sponsor the Taipei "Smart City Summit & Expo" in 2016 is a testament to Taiwan's wherewithal to foster synergy among global players in IT and kindle new development opportunities in Smart City technologies ("ITRI," 2016).

At the tiller of its digital revolution sits Taiwan's Telecommunications sector- its 4G Carriers- Chunghwa Telecom, Taiwan Mobile, Far EasTone Telecom, Asia Pacific Telecom, and T Star. Taiwan's 4G Carriers are pushing the envelope in new digital services with an urban-centric focus. Through the support of the Ministry of Economic Affairs, Taiwan's 4G Carriers have agreed to a memorandum of understanding with city governments to expand 4G digital services. As part of that support, MOEA is extending partial project budget support to 4G Carriers for pilot projects island wide in digital services. As part of this framework, 4G Carriers will offer open service data to the APP community. This will give independent developers an opportunity to build on existing service data already in place thereby catapulting applications in digital services in new directions.

In one showcase, Taiwan Mobile is working with Kaohsiung, Pingtung County, Tainan City, New Taipei City, and Taipei City to create two application platforms- "Wisdom Video" and "Wisdom Micro Business." Wisdom Video is an application platform built on civil society offering services such as instant online polls. "Wisdom Micro Business" is another application platform commerce driven that aims to empower local businesses to find opportunities within their local markets (Mr. S.J. Peng, ITRI, Communication, 2016).

On a more local industrial city level, Taichung industrial city flagship initiatives- Industry 4.0 Initiative Fourth Industrial Revolution is a city plan that aims to capture and harness trends relating to smart factories, smart productions utilizing cloud, IoT, big data management, and optimization of smart devices for value added product development and services.

On a national level, one case study that is noteworthy involves a project called HeadStart launched by Taiwan's National Development Council (NDC). This project is part of a broader national agenda to create a local silicon valley in Taiwan. The project, through public support, offers an environment conducive for start-ups and entrepreneurship with relaxed regulations and funding assistance for local start-ups. This past year HeadStart was successful in attracting USD \$430 million in investment for IT start-ups (Wu, 2015).

Taiwan's IT industries, through collaborations and focused initiatives, seem ever poised to continually gain traction in an emerging global digital economy underpinning the development of Smart City applied technologies and IoTs.

## **6. The Taiwan-China cross-Strait Urban Link**

From a purely technical point of view, Taiwan's future IT business opportunities, in sync with mainland China's ambitions in urban development, are projected to grow. To understand this potential, one must consider the environmental and urban challenges mainland China is facing today. China's future is concerned with reconciling the environmental damage its industrial development has brought while also grappling with growing urban populations. This dynamic is a window of opportunity for Taiwan's IT companies to develop 'Smart City' applied technologies in supporting these type of trends.

In terms of technology trends, although in absolute terms there are more people wired in China than any other country, in environmen-

tal terms- China is facing a bleak situation. Green achievement and Smart City success, in contrast to Taiwan, has not been mutually inclusive. China today is facing a very different situation than Taiwan, however China does offer a third leg for Taiwan's future IT expansion. To bring China's environmental concerns into sharper focus, it is an understatement to say China's environmental conflicts are truly pressing, according to the World Health Organization air pollution kills 656,000 people annually, and water pollution 95,600. And according to China's Ministry of Water Resources estimates about 300 million people, two-thirds in rural areas rely on water containing 'harmful substances.' (Babones, 2011). With this environmental gloom in mind, China's rising urban jungles must overcome daunting challenges to get "Smart" on the urban front. Its rising shanti towns on city outskirts coupled with urban center population explosions add to the complexity and features of its urban expansion. Smart city initiatives and success in China will prove to be a much longer and more difficult narrative given these current settings. Urban projections estimate that by 2030 seventy percent of China will be urban (Peeples, 2015). And in terms of energy demands, by 2050, China's urban populations are projected to account for 20 percent of total energy consumption. In terms of water resources and scarcity, China has only 7 percent of the world's fresh water while sustaining 20 percent of the world population and in more than half of the country's largest lakes and reservoirs are unsuitable for human consumption (Ma & Adam, 2013).

In bundling these trends, it is reasonable to assume Taiwan's current strengths in urban smart community development and its achievements in establishing a green footprint will place Taiwan in a strategic position in cross-Strait trade where it will be able to leverage its accomplishments in smart city technologies. This will aid mainland China's long term goals to manage their urban growth, rising energy demands, and to effectively navi-

gate the environmental damage it has come to suffer in recent decades. Taiwan's smart city technologies will be a big part of China's end game in finding viable solutions.

## 7. Reverse flows of Investment from mainland China

There are some interesting trends occurring in cross-Strait investment. There is a rising trend of a reverse flow of investment coming from mainland China's National IT industry.

Tsinghua Unigroup, a mainland State Owned Enterprise (SOE), has recently committed USD \$20 billion in overseas investments this past year (Dou, 2015). Some of this investment strategy has taken a shine to Taiwan's semiconductor industry. Recent investments this past year by Unigroup have committed investments to Taiwan's semiconductor industry leaders Powertech Technology, Chipmos, and Siliconware Precision (Ibid.) It is important to point out these investments reflect a green light from the mainland government authorizing and prioritizing direct government investment in Taiwan's semiconductor industry as a state priority. Taiwan, it could be argued, has become a national strategic financial investment for the People's Republic of China.

And Taiwan's government manages these

type of investments with efficacy and resolve by enacting government regulation which restricts these investments to noncontrolling shares of Taiwan's semiconductor firms thereby safeguarding its national economic interests.

Taiwan's ability to attract and harness the next technology revolution is not misguided "Techno-Optimism". But, rather, it reflects a citadel in smart policy incentives and a technology sector that has consistently proven to be adaptive and resilient. Smart City development and its automated associated technologies envisioned are part of a larger framework aimed at supporting ongoing trends and opportunities in an evolving globally driven IT marketplace. Taiwan's Smart City accomplishments carve out a new context that embraces an emerging market of digital opportunity coupled with urban needs. As shown above, the precursors in place are highly enabling for cultivating Smart City projects and industry development, these trends will bolster both cross-border commercialization of information and innovation in an emerging urban digital economy. All of this can only mean Taiwan's smart footprint is scheduled to deepen as an emerging urban digital economy continues to take hold.

## References

- Babones, Salvatore, "The Middle Kingdom, The Hype & The Reality of China's Rise." *Foreign Affairs*, 90;5, Sept/Oct 2011
- Balanci, Mary. "Apple to Ditch Samsung For TSMC as Their Chipset Maker." December 3, 2015. Retrieved from <http://www.mobilenapps.com>
- Culpan, Tim. "Apple Opens Secret Laboratory in Taiwan to Develop New Screens." *Bloomberg*. December 14, 2015. Retrieved from <http://www.bloomberg.com>
- "Designing Roadmap for Smart Cities: Seeking Opportunities for Taiwan's ICT Industry to Drive Structural Transformation through Smart Services." *Digitimes*. May 12, 2014. Retrieved from <http://www.digitimes.com>
- Dou, Eva. "China's Tsinghua Unigroup Plans to Buy Stakes in Taiwan Chip-Packaging Companies, China Chip maker plans to buy stakes in SPIL and ChipMos for more than \$2 billion." *The Wall Street Journal*. December 11, 2015. Retrieved from <http://www.wsj.com>
- "Freedom of the Press-Taiwan 2015" *Freedom of the Press*. 2015 Retrieved from <http://www.freedomhouse.org>
- "Global Open Data Index 2015-Taiwan" *Open Knowledge Taiwan*. December 10, 2015. Retrieved from <http://www.okfn.tw>

- Her, Kelly. "Grassroots Greening." Taiwan Today. December 1, 2015. Retrieved from <http://www.taiwantoday.tw>
- "ITRI host 'Smart City Common API Innovative Technologies' forum to promote Smart CityS-DK." Press Release. February 2, 2016 Retrieved from [http://smartcity.org.tw/press\\_center\\_en.php](http://smartcity.org.tw/press_center_en.php)
- ITRI. Taiwan 2016 Smart City Summit & Expo. [http://smartcity.org.tw/press\\_center\\_en.php](http://smartcity.org.tw/press_center_en.php)
- Ma, Damien & Adam, William. "If You Think China's Air is Bad." The New York Times. November 7, 2013. Retrieved from <http://www.nytimes.com>
- Neiger, Chris. "Smart City Projects: 3 Tech and Telecom Companies Building the Future of Connected Cities." January 22, 2016. Retrieved from <http://www.mysanantonio.com>
- Peeples, Doug. "China's big plans to be the global leader in smart city technology." November 20, 2015. Retrieved from <http://www.smartcitiescouncil.com>
- Scroton, Alex. "Taiwan: The Engine Room of the Internet of Things." ComputerWeekly. November 17-23, 2015. Pg. 22
- "Taichung, Keelung partner with Cisco to build Smart Cities." November 21, 2015. Retrieved from <http://www.chinapost.com.tw>
- "Top7 By Year." Intelligent Community Forum (ICF). 2016. Retrieved from <http://www.intelligentcommunity.org>
- Willis, Audrey. "The Benefits of Becoming a Smart City-Infographic" Datafloq. November 13, 2015. Retrieved from <http://www.datafloq.com>
- Wu, J.R. "Taiwan courts tech start-ups to drive economic growth." Reuters. July 11, 2015. Retrieved from <http://www.reuters.com>