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TECHNOLOGY DEVELOPMENT – HONG KONG'S HISTORICAL CONTRIBUTION AND ITS ROLE FOR THE FUTURE

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Dimensions of technology

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Technology Development – Hong Kong's Historical Contribution and its Role for the Future

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Executive Summary

Hong Kong established itself with a manufacturing-based economy during 1950s with a rapid industrialization development through 1970s. In 1980s the economic reforms in Mainland China opened up favorable conditions for Hong Kong industrialists to relocate their factories into the Pearl River Delta ("PRD") region and successfully transformed Hong Kong from labor intensive industries into capital and technology intensive industries. In recent years, the Chinese Government introduces new policies that strategically lead PRD into a high value-adding technology sector. Hong Kong was ranked by Forbes in 2013 as the first amongst the world's top four technology capitals right after Silicon Valley and New York, which will have another role to play in this new era of technological development in China. In this paper, we will delve to articulate the way-forward technology focuses and collaborations Hong Kong can develop in becoming a sustainable technology development catalyst.

Collaboration history of Hong Kong and China

Hong Kong established itself with a manufacturing-based economy during 1950s with a rapid industrialization development through 1970s, bringing itself, together with Singapore, South Korea and Taiwan, to the well-known status of *Four Asian Tigers*.

In 1980s the economic reforms in Mainland China opened up favorable conditions for Hong Kong industrialists to relocate their factories into lower land rate and labor cost areas, particularly in the Pearl River Delta ("PRD") region. This relocation has successfully led Hong Kong into the transformation of labor intensive industries into capital and technology intensive industries. Furthermore, with the influx of capital, knowledge and talents from Hong Kong, the strategic setup of PRD as one of China's main Economic Zones[1], together with Chinese Government's encouragement of investment on light manufacturing for export-led growth, the PRD region has quickly evolved into one of the most densely urbanized regions in the world. All have built a closely collaborative foundation and business model between Hong Kong and China in the past 30 years.

Today, China's manufacturing (industry) sector is the largest contributor to the nation's GDP[2] and a preferred destination for the relocation of global manufacturing facilities. Hong Kong played a pivotal role in building up China's world factory position. In recent years, the Chinese Government continuously introduces new policies that strategically lead PRD into a high value-adding ("HVA") technology sector. Hong Kong ranked by Forbes in March 2013 as the first amongst the world's top four technology capitals right after Silicon Valley and New York, and has another role to play in this new era of technological development in China.

In this paper, we will delve into different dimensions of business, social, economic and government initiatives, to articulate the way-forward technology focuses and collaborations Hong Kong can develop in becoming a sustainable technology development catalyst.

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1 There were initially five Economic Zones setup in Mainland China since 1979: Shenzhen, Zhuhai, Xiamen, Shantau and Hainan. In 2010, Kashgar from Xinjiang province is appointed as the sixth Economic Zone.

2 "Forecasts in Focus", Ernst & Young, 2013

Energy and Environmental Protection

In the 2013 Pacific Energy Summit[3], it was mentioned that "Over the past decade, mounting concerns over global climate change have made the emission mitigation potential of energy-efficiency investments a declared core benefit for many policymakers. In its 2012 World Energy Outlook, the International Energy Agency (IEA) predicts that if a reduction occurs in global carbon dioxide (CO_2) emissions from the business-as-usual path, it is likely to be driven largely by energy-efficiency measures. In IEA projections, energy-efficiency policies by 2035 will account for 68% and 70% of the cumulative global reduction in energy use and CO2 emissions, respectively, in the 'new policies scenario' relative to the 'current policies scenario', and thus will have a much more significant effect than either renewables or nuclear energy. If energy security and dependence on imports of fossil fuels were the initiating policy concerns for energy efficiency during the 1970s and 1980s, emission mitigation and the 'green growth' aspects of efficiency improvements now occupy a central place in the rationale for energy-efficiency policies across the Asia-Pacific region. Most countries now implement a range of policy instruments targeted at improving energy efficiency across various economic sectors. A 2007 survey conducted by the World Energy Council in 76 major countries (accounting for 83% of the world's energy consumption) found that two-thirds of the countries have set up energy-efficiency agencies, while almost half of the countries have adopted national energy-efficiency programs. Close to half of the countries surveyed by the World Energy Council have adopted laws with quantitative targets for energy efficiency."

China's 12th Five-Year Plan has identified clean energy as its key industry. Analysts projected that China will be investing over RMB11 trillion in the next ten years on power industry (plant / grid construction and incentives to facilitate investments)[4]. This is seen as bringing positive momentum to home-grown technologies, particularly those still in R&D stage.

Hong Kong Science Park currently houses 13% of partner companies in green technology (renewable energy, green transport, energy efficiency, new lighting, solar, clean air, water and waste treatment). Furthermore, its upcoming Phase 3 is one of Hong Kong's largest showcases of sustainable construction practice, with facilities designed to be carbon neutral over lifetime, and buildings incorporating sustainable green technologies, focusing on cost-effective energy-saving measures.

This section describes how our 13% partner companies in the green technology sector emerge their technologies from the park into the society.

1. An alternative to fossil fuel energy – solar energy

   Our partner companies[5] include both home-grown as well as with origins from Italy, China, US and UK, offering a wide dimension of technologies such as photovoltaic systems, solar power plant design, solar system integration, sun tracking technology, material analysis, manufacturing solutions for solar cells and thin-film solar modules, solar products for green building development, and solar power LED etc.

   "Cook Anything Under the Sun"[6] is a good example of how we have applied the solar technologies into the daily life in our society:

   - SolSource received the gold award from International Exhibition of Inventions of Geneva
   - SolSource is a high-performance parabolic solar cooker that harnesses the energy of the sun for outdoor cooking. The SolSource solar cooker was inspired by the problem of indoor pollution from household stoves faced by rural families in China. Perfect for garden, balcony, backyard or rooftop, it is an innovative way to BBQ, grill, steam, bake, boil or fry.

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3 http://nbr.org/downloads/pdfs/eta/PES_2013_summitpaper_Doshi_Zahur.pdf

4 "Invest in China", KPMG, 2013

5 www.asmac.com.hk, www.beghelliasia.com, www.DuPont.com, www.greenfuture.com.hk, www.oneearthdesigns.com, www.sanwatechnologies.com, www.trony.com, www.wastech.com.hk, www.xinyiglass.com.hk, www.zetafareast.com, China Solar PTY

6 www.oneearthdesigns.com

- On sunny days, it can boil 1 liter of water in 10 minutes, and reach grilling and baking temperatures in 5 minutes and searing temperatures within 10 minutes.
- The technology brought not only an alternative of clean energy to the society, but also cost efficiencies - as it operates purely on solar energy and does not require burning fuels that release carcinogenic fumes, there is no running costs involved.

2. An alternative to fossil fuel energy – Green Transport

   Our partner companies[7] provide solutions to the new Green Transport ecosystem. Some focus on the design, development and manufacturing of high quality pure electric vehicles ("EV"), while some dedicate in the EV charging system from hardware infrastructure to software application design.

   "PARK and CHARGE – a new concept of driving"[8] is the largest EV charging online platform in Hong Kong that aims to serve four stakeholder groups: private EV owners, car park management companies, EV charger owners and fleet management. This all-in-one platform provides EV information, charging station location, charging access and management function, charging usage and payment record. User can access the platform via mobile apps (iOS and Android) with any Internet device.

3. Energy Efficiency

   Our partner companies[9] from Hong Kong, China, Germany, UK, US, Singapore, each excels in different dimension of technologies for energy efficiency: LED lighting, energy efficiency monitor & control system, air-conditioning, carbon management, flue gas environmental emission system, vapour reuse system, dynamic lighting energy saving system, manufacturing of solid-state lighting power supplies:

   - Cree LED street lights[10] transformed California and cut city's annual energy consumption by 65% after replacing 2,000 outdated HPS street lights with LED.
   - Valta[11] received the gold award from International Exhibition of Inventions of Geneva in 2014 as well as Good Design Award in 2013. It is a remote energy management system that can detect unused devices, identify energy waste and notify user to help conserve energy. The technology takes guesswork out of energy efficiency by letting user understand how each device adds up to the energy bill. The system goes beyond total consumption and shows how much energy is used against how much is wasted.
   - Innovative air-conditioning technologies[12] which has been patented worldwide across mainland China, Hong Kong, Japan, Singapore, Australia and across the American and European continents; capable of saving at least 40% energy while attaining the same or even comfort level based on ASHRAE 55-2010 standard compared with traditional air-conditioning systems.

4. Green Buildings[13]

   Hong Kong Science Park Phase 3 is our new eco-friendly development exemplifying our commitment to a sustainable future.

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7 www.amos.com.hk, www.detroit-electric.com

8 www.hkev.com.hk

9 www.airstarhk.com, www.carbonexchange.com.hk, www.sienergyhk.com, www.liricco.com, www.aztech.com.hk, www.cree.com, www.globalefs.com, www.goldenregent.com, www.grealpha.com, www.iwatt.com, www.linkco.com.hk, www.lumanlighting.com, www.traxontechnologies.com, www.vdegs.com, www.zetafareast.com

10 http://www.cree.com/News-and-Events/Cree-News/Press-Releases/2014/April/San-Luis-Obispo-install

11 www.liricco.com

12 www.airstarhk.com

13 http://www.hkstp.org/en-US/Facilities/Hong-Kong-Science-Park/New-Phase-of-Development/Phase-3-Overview.aspx

The new development provides a dedicated facility for nurturing environmental and renewable energy technologies. The development is itself one of the largest showcases of sustainable construction practice in Hong Kong. The facilities at Phase 3 have been designed to be carbon neutral over its lifetime, using the key design principles of reduction, efficiency and generation.

Every building incorporates the latest green technologies and sustainable building design, with a focus on cost-effective energy-saving measures, making it easy for businesses there to adopt green practices. The new development has already gained recognition in the industry, winning the Grand Award in the New Building category at the prestigious Green Building Awards 2012, among many others.

Healthcare

Health care can contribute to a significant part of a country's economy [14]. In 2011, the health care industry consumed an average of 9.3 percent of the GDP or US$ 3,322 (PPP-adjusted) per capita across the 34 OECD countries members. The USA (17.7%, or US$ PPP 8,508), the Netherlands (11.9%, 5,099), France (11.6%, 4,118), Germany (11.3%, 4,495), Canada (11.2%, 5669), and Switzerland (11%, 5,634) were the top spenders.

However life expectancy in total population at birth was highest in Switzerland (82.8 years), Japan and Italy (82.7), Spain and Iceland (82.4), France (82.2) and Australia (82.0), while OECD's average exceeds 80 years for the first time ever in 2011: 80.1 years, a gain of 10 years since 1970.

With the aging population growing across the world, Health Information Technology (HIT) will be playing an important role to better support the health care needs, example: transforming some hospital healthcare capabilities to home healthcare, mobility of health informatics, quicker turnaround time for analysis and testing etc.

Hong Kong and China are facing the challenge of aging population. By 2033, Hong Kong elderly is forecasted to be 25% of total population; while by 2050, elderly in China will reach one-third of its population. How do we prepare for future challenges of increasing demand for health services with diminishing resources and manpower? Can innovative technologies boost up the productivity of healthcare providers?

With the 11% partner companies in biotechnology residing in Hong Kong Science Park, this cluster has a wide portfolio of origins including Austria, Canada, China, Denmark, Germany, Hong Kong, Japan, New Zealand, Singapore, Taiwan, UK and US, with the dimension of technologies in pharmaceuticals, medical devices, cord blood bank, clinical rehabilitation, biosensors, medical simulation engineering solutions, enzymatic production, DNA analysis, scanning and image analysis, clinical trial management, food safety, vascular and interventional radiology technologies, biochemical testing.

Below describes some showcases of success from some of our home-grown biotech companies:

- "Hand of Hope"[15] – A wearable, portable and patient-controlled, therapeutic robot for re-teaching hand movement. It facilitates muscle re-education by both amplifying and rewarding a patient with desired motion in concert with his or her own muscle signal. The system continuously monitors and senses, but does not stimulate, the affected muscles. The patient can self-initiates movement through their often very weak voluntary EMG signals that indicate intention to move. Clinical research showed that it could help to recover 50% of patient's movement. Hand of Hope received multiple awards including the Grand Prix Award 2012 in the International Exhibition of Inventions of Geneva, and 2013 Hong Kong Awards for Industries.
- "Transgenic Fish"[16] - award winning, world leading innovative transgenic fish, fish embryo toxicity (FET) test and chemosensing technologies focused on in vivo toxicity and low cost

[14] http://en.wikipedia.org/wiki/Health_care
[15] www.rehab-robotics.com
[16] http://vitargent.com

chemosensing methods screening of both specific and unknown toxic chemicals in food, cosmetics and pharmaceuticals. Fish wins Korean Woman Inventor Gold Award 2010, HSBC Young Entrepreneur Asian Champion 2010. It is also the first company in Asia to introduce such a technology in compliance with European Union Directive.

- "Kiss & Tell"[17] - Biosensors concepts aiming to detect diseases such as diabetes before any suggestive symptoms are manifested. Real-time results can be provided anywhere anytime by using drops of saliva. The technology-in-development has recently received the gold award from International Exhibition of Inventions of Geneva in 2014.

Post-digital Mobile Ecosystem

Wireless is one of the most dynamic and fast-growing industries on the planet. Mobile is also influencing nearly every sector in technology: cloud, big data, enterprise software, digital media, advertising, commerce, and payments.

In 2012, an estimated six countries (South Korea, Norway, Sweden, Australia, the United Kingdom and the United States) saw smartphone user penetration rates among mobile phone users rise above 50 percent for the first time. The worldwide smartphone penetration rate among mobile users will approach the halfway point by 2017, according to a report from digital marketing, media and commerce specialist eMarketer[18].

Deloitte also reported that in 2012, both Apple and Google Play have surpassed 25 billion apps download, 13% internet traffic is from mobile devices, and Square has processed USD8 billion (8 times prior year). By mid of 2013, the total global install base of smartphones and tablets has already exceeded those of PCs[19].

The mobile ecosystem is moving at lightning speed. Apps are just the beginning and smartphones / tablets are not the only targets. Embedded sensors are driving powerful machine-to-machine (M2M) use cases. Pattern recognition and contextual analysis, ambient access and connectivity, and mass adoption of natural user interfaces – voice, gesture and beyond – are creating new modes for user engagement[20].

The opportunity goes beyond what people are doing or what we can see now, with a future requiring social reengineering supported by innovative technologies both in software and hardware. It is estimated that by 2030, 60% of world population will be living in cities[21] – significant challenge for each city to handle its expansion wisely.

In view of the vital role IT will play in the future, Hong Kong Science Park offers a specific Incu-App programme to nurture start-ups which focused in mobile application development. Throughout the years, various applied technologies emerged covering point-of-sales, event management, social media, games, education, retail management, online marketing, wearable healthcare monitoring, mobile CRM/ERP, mobile payments.

Social media has one of the most visualized impacts resulted from this cluster of technologies. Recently this year, a mobile game "Tower of Saviors"[22] (a combination of a match 3 game and an RPG, with characters from various mythologies and cultures) developed by our Hong Kong-based mobile application partner company has gained high popularity in the Hong Kong and Taiwan markets, where it is one of the top grossing apps and has been downloaded over 11 million times worldwide. The success of this mobile game subsequently led to a USD70M investment from Forgame Holdings Limited (HKEx 0484) for a 25% share.

Towards the Future of Smart City

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17 www.enanohealth.com
18 http://www.eweek.com/mobile/smartphone-adoption-growing-rapidly-worldwide/
19 "2013 Tech Trends", Deloitte, 2013
20 "Elements of Postdigital", Deloitte, 2013
21 "How to Make a City Great", McKinsey, 2013
22 www.madheadapp.com

The concept of the Internet of things [23] first became popular through the Auto-ID Center at MIT and related market analysis publications. Radio-frequency identification (RFID) was seen as a prerequisite for the Internet of things in the early days. If all objects and people in daily life were equipped with identifiers, they could be managed and inventoried by computers. Besides using RFID, the tagging of things may be achieved through such technologies as near field communication, barcodes, QR codes and digital watermarking.

Hong Kong Science Park currently houses 45% of partner companies in IT & telecom, 21% in electronics and 8% in precision engineering. Collaborative contribution for collective success is vital, where the Internet of Things ("IoT") concept quickly moves from visionary into reality. Hong Kong Science Park is developing IoT infrastructure support as a catalyst in this new era for a smart city. With circa 45% partner companies in the IT & Telecom cluster, IoT technologies such as RFID, Bluetooth, NFC, QR codes, AR, WiFi, GPS, Global Tracker, Home Automation, motion sensing, facial recognition, Cloud are well-grown in our community. To name a few:

- "5 Right Systems"[24] - By integrating Barcode, RFID and Wireless technology into E-health application, the company has successfully implemented "5 Right System" (right patient, right medication, right dosage, right time, right route) to eliminate human errors happened frequently in current hospital system.
- "Telemedicine"[25] – By integrating wireless solution with sensing technologies, solutions such as In-Hospital Patient Monitoring, Tele-Healthcare System are developed. The company has recently won gold award from the International Exhibition of Inventions of Geneva in 2014.
- "Smart Shelves"[26] – By integrating UHF RFID devices and middleware software including RFID reader, handheld device and antenna, the company's innovative products include Smart Drug Cabinet, Smart Retail Hanger and Shelves, serving in retail and pharmaceutical industries. The technology can be applied to deliver a real-time data platform capable of capturing real-time information on customer buying behavior, inventory movements, operational efficiency and in-store security. It can also be used to alert for drug replenishments, provide tighter monitoring and control in the drug dispensary, and provide better drug supply chain visibility. They also allow the tracking of drug usage through the clinical-phase testing protocol, as well as tracking the location of patients in hospital, medical devices and assets.

Mature ICTs infrastructure, quality knowledge communications and strong social capitals are the key urban competitiveness for a smart city. Malmö is aiming to be Sweden's most climate smart city by 2020 by implementing IT infrastructure that reduces the environmental impact of technology and city operations[27]. Amsterdam initiated its smart city with five themes[28] in three of its metropolitan areas[29].

Digital 21 Strategy was first promulgated by the Hong Kong government in 1998 as the blueprint for its overall ICT development. Since then Hong Kong has become one of the forerunners in using ICT to drive social and economic developments, with Asian rankings of 1st in Data Centre Risk Index[30], 3rd in Cloud Readiness Index[31], and 4th in Networked Readiness Index[32]. Hong Kong is among the

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23 http://en.wikipedia.org/wiki/Internet_of_Things
24 www.ewell.hk
25 www.medisen.com.hk
26 www.scanmega.com
27 http://tcodevelopment.com/news/malmo-sweden-a-climate-smart-city
28 Amsterdam Smart City focuses on the five themes of living, working, mobility, public facilities and open data. (http://amsterdamsmartcity.com)
29 Amsterdam Smart City has established the Amsterdam Metropolitan Area as an urban living hub that allows businesses the potential to both test and demonstrate innovative products and services. (http://amsterdamsmartcity.com)
30 Published by the Cushman & Wakefield and Hurleypalmerflatt
31 Published by the Asia Cloud Computing Association
32 The Global Information Technology Report 2013 published by the World Economic Forum and INSEAD

highest in the world for penetration rates[33] of household broadband (85%) and mobile (231%), as well as average internet connection speed[34]. Hong Kong will become a smarter city under the new 2014 Digital 21 Strategy[35].

Further to its contribution to Mainland China's world factory status in 1980s, Hong Kong has a new dimension to participate in Mainland China's cut-throat speed urbanization in the 21st century, where smart city is the way forward for the quality of life and endowing the community in a truly knowledge-based and sustainable future.

[33] Figures as at May 2013 from the Office of the Communications Authority

[34] 10.9Mbps; The State of the Internet (1st Quarter, 2013 Report) published by Akamai

[35] "Public Consultation on 2014 Digital 21 Strategy – Smarter Hong Kong, Smarter Living", Commerce and Economic development Bureau, HKSAR Government, 2013