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Singapore

A key node for Electronics

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I. Introduction

Singapore (officially the Republic of Singapore) is a bustling cosmopolitan city-state that offers a world-class living environment, with her landscape populated by high-rise buildings and gardens. It comprises of 63 islands, summing up to a total land area of 714 km^2, and a population of around 5.3 million. It is separated from Malaysia by the Straits of Johor on the northern side and from Indonesia by Singapore Strait on the southern side.

Since establishment of Singapore as a trading post in 1819, migrants from China, India, Malaysia and Indonesia have been entering Singapore, bringing with them their cultures, languages, customs and festivals, giving Singapore a vibrant and diverse cultural heritage. It is emerging as a cultural center for arts, including music and theatre. It is also considered to have a unique blend of the best of the east and the west.

Although small in size, Singapore commands an enormous presence in the world. Singapore has been recognized as a leader in several ways. It is the world's fourth largest financial center. It is the world's second largest casino gambling market – next only to Macau. It is one of the three top oil refining centers of the world. It produces the maximum number of oil-rigs and is a major ship-repairer. Singapore is a major international transport hub in Asia, positioned on many sea and air trade routes. The World Bank has named Singapore as the easiest place in the world to do business and ranks Singapore the world's top logistics hub. Singapore has the world's highest percentage of millionaires with 1 in 6 households having over US$1m in disposable wealth.

II. World Class Electronic Hub

Singapore had a unique reputation of having the only TV assembly plant in Southeast Asia, back in the 1960s. Today, the electronic sector forms the backbone of Singapore economy providing as much as 25% of total GDP as value-add in manufacturing and employing over 80,000 workers. From research and development, manufacturing, integrated circuit (IC) design, supply-chain management, logistics and distribution, to HQ activities, Singapore offers a total solutions environment of shared services for players in the electronics industry [3].

It is also a global leader in many aspects in electronics. Singapore is a leading manufacturer of enterprise hard disk drives with Seagate and Hitachi Global Storage technologies having a significant presence in Singapore. Singapore is also a major hard disk media manufacturing location accounting for about 40 per cent of the world's hard disk media volume. Top players like Seagate, Showa Denko and Hoya are expanding their operations here.

Semiconductor companies have a huge presence here. Singapore accounts for 1 in 10 wafer starts in the world. There are 14 silicon wafer fabrication plants here including the world's top three wafer foundries. There are 20 assembly and test operations and about 40 integrated circuit design centers in Singapore. 15 of the world's top 25 fabless semiconductor companies, 11 of the world's top 20 device companies and 4 of the top 5 Electronics Manufacturing Services (EMS) companies are operating in Singapore.

III. Academia

There are two top ranked universities throughout the country apart from some others and recently established universities [4]. The two top universities National University of Singapore and Nanyang Technological University are ranked at 8^{th} and 22^{nd} respectively for computer science and information systems according to QS world university rankings [5]. These universities offer a wide range of faculties and disciplines:

Capital	Singapore
Largest city	Singapore
Language	English, Chinese, Malay, Tamil
Area Total	710 km^2
Population (2012 estimate)	5,312,400
Currency	Singapore dollar (S$) (SGD)
Time zone	**(UTC +8)**
Internet TLD	.sg

engineering, arts, science, law, education, medical and health sciences, and business. Specially, for health and business, there are independently running medical and business colleges within the universities. Towards a better productivity and become up to date with the state-of-the-art, the universities work in collaboration with other foreign universities such as MIT and Stanford. Additionally, Industries are also collaborating so that the developed ideas can be commercialized.

Although a relatively small country, the education system is highly recognized. This attracts many students around the globe to get high quality education in Singapore. Additionally, the high reputation and recognition of the universities attract tutors and researchers from different part of the world to Singapore. The Singapore universities are producing high-calibre graduates through a number of research-intensive universities, which are among the top portion in QS and Times Ranking.

In order to ensure that the Singapore's next generation engineers can meet the global challenges in the 21st century and onwards, a lot of government and university initiatives have been undertaken. These initiatives facilitate for cross-disciplinary courses and degrees. For instance, Singapore-MIT, Singapore-Stanford and Singapore-Imperial alliances have been established. The students are exchanged to become familiar with the state-of-the-art education systems and to get the benefit of the world's top education systems. Additionally, Yale-NUS College is expected to be opened soon so perform cross-disciplinary studies.

IV. RESEARCH

Singapore has a decent number of research centers by government, academia and industries. The government research agency ASTAR (Agency for Science, Technology and Research) has got quite a number of centers such as Institute for Information Research (I^2R), Institute for High-Performance Computing (IHPC), Institute for Micro-Electronics (IME), Data Storage Institute (DSI) to perform specialized research in different domains such as Green Electronics, Si Photonics, Miniaturized Medial Devices, Sensors & Actuators, Bioelectronics, 2.5D/3D ICs, GaN on Si Power Electronics, Ruggedized Electronics, Analog Front-End, Energy management, etc. The research centers employ strategic R&D investment to create critical mass, leverage of strategic partnership with end-users to quickly capture new growth opportunities, focus on technology platform (TSI/TSV, Si Photonics, MEMS) and MPW service for accelerating commercialization, and enabling spill-over impact.

The research centers are developing transferable production-worthy technology platform and demonstrating prototype and its integration into system and products. They also adopt Small scale pilot runs to enable customers to bring products to markets quickly. A multiple-party collaborative business model has been adapted so that fabless companies can actively engage chip equipment and materials suppliers to know what technologies would become available and how they could be implemented towards providing a cost-effective bridge to volume manufacturing.

To enhance the quality of research, the Thematic research programs in Embedded and Microelectronic domain were introduced to improve collaboration with universities. Additionally, A-STAR SINGA, a Singapore International Graduate Award scholarship is offered. Industry PhD Programs have also been setup to promote research in industry.

Universities in collaboration with Industries are involved in several projects such as Predictable Multi-Processor Design Flow, Partially Reconfigurable Multi-Cores, Fault-tolerant Multi-processor Systems, 3D Integrated Chip Research, FPGA Architecture Research, etc. These research activities are of paramount importance for the development of next generation electronic systems.

REFERENCES

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[5] http://www.topuniversities.com/university-rankings/university-subject-rankings/2013/computer-science-and-information-systems

Dr. Akash Kumar is an Assistant Professor in the Department of Electrical and Computer Engineering at the National University of Singapore in Singapore. He received the B.Eng. degree in computer engineering from the National University of Singapore (NUS), Singapore, in 2002, joint Master of Technological Design degree in embedded systems from NUS and the Eindhoven University of Technology (TUe), Eindhoven, The Netherlands, in 2004, and Ph.D. degree in electrical engineering in the area of embedded systems from TUe and NUS, in 2009.

In 2004, he was with Philips Research Labs, Eindhoven, The Netherlands, where he worked on Reed Solomon codes as a Research Intern. From 2005 to 2009, he was a researcher with TUe working on his Ph.D. Since 2009, he has been with the Department of Electrical and Computer Engineering, NUS, Singapore. He has published over 50 papers in leading international electronic design automation journals and conferences. His current research interests include analysis, design methodologies, and resource management of fault-tolerant embedded multiprocessor systems.