Smart cities

The Singapore case

Arun Mahizhnan

The Institute of Policy Studies, Kent Ridge, PO Box 1088, Singapore, 911103

Singapore, as an island state with no natural resources, has always lived by its wits. Its inexorable shift from an industrial economy towards an information economy makes it all the more important for Singapore to embrace Information Technology. Defining Singapore's future as an Intelligent Island, the government has embarked on a massive programme to build up the necessary infrastructure. But, significantly, the final goal is not just economic growth but an enhancement of the quality of life for all people, making Singapore not just a smart city but a quality city-state. © 1999 Elsevier Science Ltd. All rights reserved

Introduction

America is often called God's Country. Australia calls itself Lucky Country. Singapore wants to be called an Intelligent Island. These labels are perhaps reflective of the ethos of the countries themselves. In the case of Singapore, the label is partly factual and partly aspirational.

Singapore is an island, roughly 20 miles across and 15 miles wide. No two destinations are more than 40 minutes apart by car. Singapore is not just small but almost without any natural resources. Apart from its geographic advantage of being located on the intersection of international air and sea routes, it has no other gifts from nature. Even the water Singaporeans drink is piped from neighbouring Malaysia. The one—in fact the only—resource Singapore has is its people. For most of its modern existence, Singapore has lived by its wits, and the future looks even more, not less, demanding of its wits. It is understandable, then, why Singapore has a certain partiality towards the "Intelligent" part of the above mentioned label.

This paper attempts to set out the rationale behind Singapore's vision of itself as an Intelligent Island, why it has so enthusiastically embraced the new information technology (IT) and how it plans to carry the whole population into cyberspace.

The road to the Intelligent Island

When the British East India Company's emissary Stamford Raffles bought the fishing island of Singapura from a Malay princeling in 1819, he did have some idea that the island would be a valuable trading post in the Malacca Straits between the Indian and Pacific oceans. But not even in his wildest dreams could he have imagined the city-state of Singapore into which the island eventually transformed. But Raffles' vision of a trading post already held the seeds for the birth and the growth of the international business hub that it is today. Then, as now, the real currency in Singapore was information. Raffles' Singapore became an Emporium of the East within a short period, not because it had abundant harvests of spice or silk (which always came from elsewhere) but because it had the great fortune of attracting smart and shrewd traders and middlemen who knew how to exploit the differential in information between people and between places. That was, and has been, the secret of the competitive edge of Singapore.

Even when Singapore became independent in 1965,[1] entrepot trade was the mainstay of its econ-

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*Corresponding author. Tel.: + 65-779-2633; Fax: + 65-777-0700.

[1]Singapore was accorded a self-government status in 1959 by the British, and the People's Action Party came to power that year and has remained in office todate. Singapore gained independence from the British in 1963 when it became part of Malaysia, but the merger did not last long. In 1965, Singapore separated from Malaysia and become a sovereign state on its own.

omy. By then, Singapore had had nearly a century and a half of trading experience on an international basis, had plugged into a vast network of traders around the world and had acquired an enviable knack for international trade. However, such business savvy was confined to a small community of traders who could not provide enough jobs for a fast growing population. The post-colonial government recognised the dire need for rapid and large scale expansion of the jobs market and embarked on an industrialisation programme.

The start of the industrialisation programme in the early 1960s was propitious for Singapore and for the kind of approach it took. For, this was the time the world was experiencing a wave of multinational corporations (MNCs) reaching out to the far corners of the globe from their home bases to seek new markets and to establish new production bases. In the Third World countries, especially in the more politically aware and active post-colonial independent states, there was resentment against MNCs as neo-colonisers and new exploiters. The Singapore government thought otherwise. It saw MNCs as a means to kick-start its industrialisation programme and as a source of jobs, capital, technology, management know-how, and, equally important, as a link to world markets. MNCs were looking for cheap land and cheap labour. Singapore had plenty of unemployed labour and was willing to trade its swampland for factories. It was, as some observed then, a marriage made in heaven. Over the next 20 – 25 years, this marriage led to the kind of economic development of Singapore that many outsiders have called an "economic miracle".

However, towards the latter half of the 1980s, Singapore's economic planners began to emphasise the need for the development of the services sector in addition to the manufacturing and trading of goods. It was becoming increasingly evident that Singapore's competitive edge in producing and trading in low tech, low skill and low margin products was being eroded by a number of emerging economies in the region. If Singapore were to maintain its economic lead over its competition, there was little choice but to go upscale in technology and know-how, and particularly into areas which required information, knowledge and creativity. Thus the thrust towards IT in Singapore represents a strategic thrust that will be a determinant factor in its current and future well-being. In the case of Singapore, the economy of the pre-1960s could be characterised as a trading economy, and the economy of the pre-1990s as an industrial economy. What is emerging since the beginning of this decade is an economy that is perhaps best described as an information economy. It is the entry into this information economy that has prompted Singapore's conception of an Intelligent Island.

The vision of an Intelligent Island

Singapore was perhaps one of the first developing countries to recognise the tremendous advantages of IT as well as telecommunications. It understood that IT will change the way we live, work, and play, but more importantly, it would make the vital difference between being an advanced nation and a developing nation. The government set up the National Computer Board (NCB) in 1981 to spearhead Singapore's entry into the Information Age. NCB's stated mission is "to drive Singapore to excel in the information age by exploiting IT extensively to enhance our economic competitiveness and quality of life". The first National IT Plan was launched in 1986. Since then there has been a sustained effort towards developing both public as well as private sector IT capabilities, enhancing Singapore's overall economic competitiveness. It was also the intention of this effort, from the outset, that the quality of life for the ordinary citizen be improved as well.

In NCB (1992) released a major document that outlined its strategic vision for Singapore's IT development in the future. Entitled *A Vision of an Intelligent Island: IT2000 Report*, it examined how IT can create new national competitive advantages and how it can further enhance the quality of life in Singapore. The report is the work of the IT2000 Committee which included some 200 members from the private and public sectors and the academia. The report set out its vision of Singapore as an Intelligent Island in the following terms:

> In our vision, some 15 years from now, Singapore, the Intelligent Island, will be among the first countries in the world with an advanced nation-wide information infrastructure. It will interconnect computers in virtually every home, office, school, and factory (NCB, 1992).

The report added that if Singapore were to maintain its lead position in the region in the next century, it has to realise the full potential of its small population, maintain a world class infrastructure and become a major hub city of the world. These three elements have indeed become the pillars of the Singapore IT strategy.

IT education

Singapore's economic success between the 1960s and 1980s could be partly attributed to the industrial skills the schools and vocational institutes developed in those years. In the new era, IT skills will be required not only by specific industries or businesses but practically in everything people do, whether at work or play. In fact computer proficiency is becoming as basic as the three Rs: reading, writing and arithmetic. The Ministry of Education in Singapore launched its Masterplan for IT in Education in 1997, which lays out a comprehensive strategy for creating an IT-based teaching and learning environment in every school. It will not only ensure that every school-going child is computer-literate, but also trained in creative thinking, in the ability to learn independently and continu-

ously, and in effective communications. To equip them for this transformation, the Ministry is planning to provide one computer for every two children in their schools by 2002 and about 30% of curriculum time will be allocated to computer-based learning. Even the teachers are IT facilitated in their teaching efforts—there will be core training for every teacher and one computer for every two teachers.[2] These efforts are costing the Ministry billions of dollars, but the government sees the expense as investment. Ultimately, the objective is to make sure that every Singaporean is able to use IT as a matter of course and to take maximum advantage of the web world.

IT education will also be stepped up at the vocational and professional levels. The 1997 IT Manpower and Skills Inventory Survey by NCB found that there are significant imbalances between demand and supply of IT manpower. At the end of 1997, Singapore's IT professionals numbered about 30 000, an increase of 15% over the previous year. And there is still an expected demand for about 3000 more each year over the next two years. In response, the tertiary institutions have been increasing their intake by the hundreds. Foreign professionals with appropriate qualifications are also pouring into Singapore to meet the growing demand. Despite the economic gloom that has cast its spell over the whole region, many private sector companies see this as the time to retrain and reskill its workforce to be in position for the expected upswing in a few years.

In addition to formal education, IT awareness and IT training are also being initiated among segments of the population that are older and less amenable to new technologies. And this is being done in some innovative ways. For example, the National Trades Union Congress (NTUC), which is the parent body of most unionised workers in Singapore, launched an IT Coach to bring IT to the doorsteps of factory workers and to explain IT in very simple terms. NCB joined NTUC in carrying out this outreach project. The IT Coach is equipped with multimedia computers, printers and digital cameras. The coach is scheduled for 200 days of visits to factories to reach some 16 000 workers. The IT Coach is only one of many such outreach programmes currently underway in Singapore.

IT infrastructure

Another strategy centres around building and maintaining a world class information technology infrastructure. Singapore has long been a believer in the virtues of infrastructure advantages. Very early in its economic development, it learnt that infrastructure is a competitive edge as well as being part of the vital support system. Since the 1960s, the government has

always paid close attention to developing the appropriate infrastructures for each stage of economic development, whether they be purpose-built factories, roads, utilities, air and sea ports, or telecommunication facilities. Even before the deluge of IT demands, Singapore has distinguished itself as the site of some of the world's best telecommunication, air and sea port facilities. In the same spirit, Singapore is now on its way to becoming an Intelligent Island. Singapore will be one of the first countries in the world to have a national information infrastructure (NII). It will be a pervasive network through which every home, school and office will be interconnected. In doing so, it will provide broadband capacity—through wired or wireless connections—that will virtually remove any constraints on bandwidth. Singaporeans will be able to conduct a wide range of transactions—business-, government- or leisure-related—from their own home, office or public kiosks. While the NII will be a world first, it must be said that as a tiny island, internal infrastructure development has been relatively easier for Singapore than for many other large countries.

The NII will be the backbone of common services and applications for public use. Examples of common services include electronic identification, secure services, payment services and the national directory service. One interesting and useful application of the national directory service is the National Contact Information Service (NCIS), which helps the public find people, organisations, products and services. It brings together many directories in existence and provides a comprehensive base of basic data. It also acts as a directory of directories—telling the user which directory will best serve his/her needs. Thus, NCIS does not negate the aims or commercial potential of the other directories but acts more as a gateway.

Before 2000, every household in Singapore will have at least a coaxical connection to a national optical fibre network, which in turn is linked to worldwide networks. The building regulation now requires that every new home must have built-in broadband connections in the same way as it is required to have water and electricity connections. The planned broadband integrated services digital network (B-ISDN) will have transmission speeds of 150 million bits per second. In addition there will be wireless networks that would make tetherless computing an easy option for many IT users.

The success of the information infrastructure cannot be measured just in terms of what the planners are providing. It is equally important that the users take to the facilities with ease and comfort. Some statistics provide a clue to the level of receptivity among the public in Singapore: the percentage of companies with more than 10 employees using computers has increased from 13% in 1982 to 90% in 1994 (NCB, 1994). As for homes, over 40% of households now have a personal computer (PC),[3] which is quite

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[2]Masterplan for IT in Education—Key Points: www.moe.edu.sg/iteducation

[3]Cited in speech by Minister George Yeo at EMASIA 1998 conference in Los Angeles, 4 June 1998. The IT Household Survey 1996 by NCB found that over 35% of households have at least one PC.

remarkable considering that PCs came in quantity into the local market less than a decade ago.

The Singapore Civil Service has a reputation for being clean. What is not as well known is its efficiency and customer-friendliness. All government ministries now have their own websites on the Internet and most departments within the ministries do too. Many transactions and search for information could be conducted through cyberspace with minimal effort and at no cost. In a recent exercise by the inland revenue department, tax payers were encouraged to submit their returns by e-mail. Since this was the first time, the expected number was 50 000. The actual number of returns was more than three times higher— 160 000 (Straits Times, 1998). Another example of the extensive use of IT is the recently introduced electronic road pricing (ERP) system for motor vehicles. Every vehicle is or will be fitted with a transponder and as they use the main thoroughfares, a fee will be deducted from cashcards inserted in the transponder. While costing hundreds of millions of dollars, the ERP system has saved on the cost of hundreds of inspectors at the check points and, more importantly, on the thousands of manhours motorists were spending in purchasing daily coupons. People may and do gripe about the fees collected by the new system, but hardly anyone complains about the convenience it has brought about.

All the above examples should not, however, lead to the conclusion that all Singaporeans embrace IT and its applications with relish and without reservation. They do not. There are still segments of the population, especially among the older generation, whose trust in the impersonal—indeed non-human—electronic systems is very low. But it is mainly because of unfamiliarity rather than unsavoury experience with such systems. The eagerness with which the school children and young adults take to their computers, cash cards, pagers and handphones paint a very different picture. However, there are other non-technical areas of concern with IT which are discussed later in this paper.

IT economy

As mentioned earlier, Singapore is moving inexorably into the information economy. If it wants to maintain its competitive position as an international business hub, it is inevitable that Singapore also excels as an electronic hub. The world's adoption of electronic commerce, or E-Commerce as it is popularly known, is putting the pressure on business hubs to be E-Commerce-ready. What is needed is not just an electronic communication system but a host of other support systems. For example, the local legal system needs to be geared up for recognising electronic identification of individuals, contracts, transactions, etc. Protection of intellectual property rights in cyberspace has to be secured. The electronic security system needs to be tamper-proof.

In order to prepare for the era of E-Commerce, NCB set up in 1996 the Electronic Commerce Hotbed (ECH) programme to jumpstart the process. The next year, the Electronic Commerce Policy Committee (ECPC) was officially established. In April 1998, ECPC completed its review and made its recommendations to the government. It listed six guiding principles (NCB, 1998a):

- the private sector should take the lead (in developing electronic commerce);
- the government should put in place a legal framework which provides for certainty and predictability;
- the government should provide a secure and safe environment;
- the government, through joint venture pilots and experiments with the private sector, should expedite E-Commerce growth and development;
- the government should pursue innovative, liberal and transparent policies proactively; and
- consistency with international regimes, international cooperation and interoperability are necessary for EC to thrive.

The above principles reflect a characteristically Singaporean approach: the government is very proactive in greenfield business developments while nudging the private sector to take the lead. This approach is quite different from many other countries where the government is usually uninvolved in business developments and the private sector often takes the initiatives and would prefer the government to stay out of such areas. The notion that the government should invest directly in new businesses as joint ventures or even solely is anathema to many in the private sector. But in Singapore it is a fairly common occurrence. The government takes the view that it should go into business where the private sector is unable or unwilling to enter such uncharted areas. The cardinal principle it says it observes is that government intervention should be market-enabling and not market-distorting. However, it should be added here that the debate on this issue, even in Singapore, is not settled.

Another important recommendation of the ECPC is the proposal to introduce new legislation to facilitate electronic transactions and E-Commerce. One such legislation, the Electronic Transactions Act (ETA) was passed by Parliament in July 1998. ETA focuses on matters such as authentication of transacting parties, recognition of electronic and digital signatures, and the validity of electronic contracts. In regulating E-Commerce, there is a consciousness among the committee that Singapore should conform to international standards and models, that it should not over-regulate and that it should remain technologically neutral and flexible so as to be able adapt quickly to the fluid global environment (NCB, 1998a).

Some progress has already been made in these areas. An NCB-linked organisation, NetTrust, has

been given the certification authority to verify and secure electronic signatures. Laws and regulations relating to electronic transactions are being reviewed. It is also noteworthy that the first secure electronic transaction in the world was conducted in Singapore last year, by the credit card company Visa International.

One major challenge in developing an E-Commerce hub, in addition to the systems, is the building and maintenance of trust. In much the same way Switzerland became pre-eminent in banking trust and security, Singapore will have to compete with many other hubs to establish itself as a high trust environment. Another challenge is that to remain a hub, the hub must be able to serve others better than they can serve themselves. This depends on the system reliability and flexibility that a hub can provide. As an example, the Singapore Teleport which provides links to all major regional and international satellites is built with a 99.99% reliability and ample redundancy capacity.

Quality of life

Singapore's vision of an Intelligent Island, as mentioned at the outset, is not confined to economic excellence. An integral part of this vision is its concern for the quality of life for the ordinary citizen. Much of the developments and improvements discussed above undoubtedly bring benefits to the public. In terms of time, effort and cost, there are numerous instances of efficiency and comfort achieved through IT. For instance, paying bills, shopping, booking concert tickets, reserving places at restaurants, accessing videos and libraries, browsing through world's leading museums and art galleries, communicating with friends and family, studying for higher degrees and even doing high level research and development could all be done at unprecedented levels of comfort and efficiency. It has been said many times, and it is worth repeating here, that IT will change the way we work and play and even the way we think. However, it will not be all rosy. IT is as likely to bring positive influences as negative ones. Like all other technologies, IT is a double-edged sword as well. There *is* a price to pay. Many countries in this region are deeply concerned that the new technologies, most of which are flowing from the West, bring in their wake trends and influences that challenge and subvert long established traditions and beliefs, ways of organisation and governance, and the very culture and ethos of these recipient countries. One salient example of such double-edged effects is in the area of censorship.

IT, the Internet in particular, challenges the existing censorship regime in Singapore. For a country that boasts of one of the most open economic systems in the world, and for a country that is considered the most advanced of the developing nations, Singapore exercises one of the strictest censorship systems. The system is particularly wary of foreign media influence and highly sensitive to sexual and political expressions. But this strictness is imposed by a freely elected government and is supported by a large conservative segment of the population. The Internet, which is virtually uncontrollable by any one state, now makes the current censorship system unsustainable. This situation poses not only a challenge to the political supremacy of the party in power but also to many parents whose primary concern is pornography. Only three Internet Access Service Providers (IASPs) have been allowed by the government to operate in Singapore and they are advised on which sites to be blocked off for public access. They are also now obliged to provide what is called Family Access Network (FAN) as an alternative to the existing networks. The FANs will have built-in screening software such as NetNanny and SurfWatch so parents can rest easy in allowing children access to these networks. The Singapore Broadcasting Authority (SBA), which is the regulator of the Internet, readily acknowledges that the Internet is not fully controllable by the state and relies on industry- and self-regulation for the protection of the young from the unsavoury. SBA has also made it clear that it does not pry into personal mails or place constraints on legitimate business transactions. The Singapore Internet regulatory regime could be characterised as a light-touch approach to censorship. However, this light-touch has not been applied to objectionable materials in the physical realm such as films, video-tapes, magazines and newspapers. But the discrepancies between cyberspace and physical space will have to be reconciled soon or else the system runs the risk of becoming a strawman. Governments with a conservative or an authoritarian bent will have to face up to the reality that the liberal members of the cyberworld will not accede to the same controls of sexual and political expression.

On the other hand, there is reason to believe that many governments may collaborate with each other and collectively fight against what they consider to be major cybercrimes such as violation of intellectual properties, child sex, terrorism and so on. Where there is global consensus on undesirability, there is a good chance of global supervision and counteraction. Singapore is already working on several fronts in fighting against cybercrime.

The biggest challenge is perhaps what all technologies have always posed: dividing people into haves and have-nots. Both internally and internationally, there will be growing numbers of information-haves, but there will also be a residual information-have-nots everywhere. And conflicts are sure to arise between these two groups. Some point to the outcome of the industrial revolution and how it elicited ferocious responses in the form of communism and socialism. The prognosis is that the information revolution will bring in its wake similar chasms between the information "classes". However, there is still a fundamental difference between the world of "things" and the

world of "bits"—when one gives away things one is the poorer by that quantity, whereas with bits one can give and retain the same. The former, in most cases, is a zero sum game. The latter, in most cases, could be a case of having and eating the cake at the same time. While information at the right time and right place will decidedly be the competitive edge in many instances, it is also possible to think of many other instances where the same information can be reused over and over again without any one losing value. Singapore's position at the leading edge of the information economy will be affected, to some extent, by how it manages the differentials between the information-haves and the have-nots within Singapore.

Singapore ONE

Before concluding this paper, it might be useful to highlight a specific example of a cutting edge application of IT in Singapore. Singapore ONE (One Network for Everyone) is a nationwide broadband network that delivers interactive and multimedia applications and services. It is jointly spearheaded by NCB, the National Science and Technology Board, the Telecommunication Authority of Singapore, the Economic Development Board and the Singapore Broadcasting Authority—all of them government or quasi-government organisations. Singapore ONE was first launched as a pilot programme in June 1997. Exactly one year later, it has gone commercial. The network now offers more than 120 applications to more than 10 000 users. They include entertainment, news-on-demand, distance learning, shopping, music downloads, multi-user games, video conferencing, and video e-mail. The service is also available at schools, public libraries and community centres. NCB estimates that more than 100 000 users will be on-line by the end of 1999 and the number is expected to increase to 400 000 by 2001 (NCB, 1998b). That would amount to nearly half the households in Singapore.

The level of official support this initiative enjoys was reflected in the statement made by Singapore's Prime Minister: "The Singapore Government will continue to give strong support to the industry in this phase. It will invest directly where necessary to create a critical mass of applications and users for Singapore ONE."[4]

Singapore's approach to building the national information infrastructure is not confined to purely domestic needs. As in its economic strategies, Singapore's IT strategies are regional and global. Singapore One has already established broadband links with Canada, Japan and the United States and is in the processes of extending this network to other countries.

Singapore has also been playing an active role in developing the Asia-Pacific Information Infrastructure which will link the national information infrastructures within APEC and those of other countries. APEC political leaders are already talking of an Asia-Pacific Information Society, which, given the enormous diversity of the region, is a truly remarkable concept.

While there is much scepticism about such a concept, it is clear that IT is helping to clear the way at least to the extent of free and unfettered exchange of information within this region. Whether it will in the long run evolve into a cohesive "society" remains to be seen.

Conclusion

One of the most frequently heard terms in discussions of information technologies is "bandwidth". Bandwidth in fibre optics, bandwidth in frequencies, bandwidth in networks—these are major concerns for everyone involved in IT. However, all these are not nearly as critical as the one bandwidth that should matter most—the bandwidth of the mind. Ultimately it is the people, not the hardware and the software, who make IT work and work for the good of the people. The challenge of converting the ignorant or sceptical onlookers to the new technologies is already a major challenge. But an even greater challenge is to put IT in the service of humankind instead of using it for the subversion or the destruction of the values and ways of life people hold dear. As with the nuclear energy, IT can be a force for good or evil. The smart community should be smart enough to make the right choice.

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