

National Computer Policy Management in Singapore: Planning An Intelligent Island

Chun Wei Choo

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1 Informatization of a City-state

Singapore's multiracial population of 2.8 million live and work on a land area of less than 250 square miles to create a nation that enjoys one of the highest living standards in the world, with a per capita income of US\$16,500. On an island that is devoid of natural resources, Singaporeans have learned to combine their skills and diligence with education and technology to sustain the momentum of their economic growth. There was early recognition that information technology would be needed to leverage Singapore's intellectual capital in order for her to move into the ranks of developed nations. A concerted effort to harness computer power began in the early 1980s, and in a manner that has become a national formula, the government took the leadership reins of the race.

Singapore's information technology (IT) initiatives evolved in three phases, each framed by a national plan that clearly articulated goals, policies, resources and projects. The first phase from 1981 to 1985 saw the start of the Civil Service Computerization Programme and the establishment of the National Computer Board. The Programme's broad objective was to computerise government ministries so as to increase productivity and raise the quality of public services. An important subtext of the first phase was for Singapore to seed its own cadre of computer professionals. The application technologies exploited were mainly in areas such as transaction processing, data modelling, and database management systems. A 1988 audit showed that the government had obtained a return of nearly 2.8 dollars for every dollar spent on information technology in the programme, and that the need for some 5000 posts had been avoided or reduced (NCB 1992a). The second phase from 1986 to 1990 was the period of the National Information Technology Plan. The twin goals of the Plan were to develop a strong export-oriented IT industry and to improve business productivity through IT application (NCB 1986). The focus has shifted from the public sector to the private sector. The development of IT manpower evolved further into applied research endeavours. Principal enabling technologies included software engineering, expert systems, and electronic data interchange. By the early 1990s, Singapore had a thriving IT industry with a growing number of indigenous IT firms exporting to the region, the US, and Europe. At least one local company has become the international industry leader in its product segment. A network allowing traders and government departments to exchange documents electronically is said to be

saving Singaporean traders about one billion US dollars a year (Sisodia 1992). Research centers were established, developing advanced technologies and applications for industry and state-owned enterprises.

The third and current phase began in 1991 with the launch of the IT2000 masterplan. Singapore is to be transformed into an intelligent island, where IT permeates every aspect of the society - at home, work, and play. The stated goals are to apply IT extensively in order to enhance national competitiveness and to improve the quality of life of its citizens (NCB 1992a). Although a number of industry sectors participated in the planning and are likely to provide initial projects, the larger intent is for IT to reach out to every constituency in the country. The goal of a better quality of life provides fresh counterpoint to the familiar refrain of economic growth. An increasingly affluent society expects more leisure time as well as more creative and satisfying leisure options. At the same time, the way ahead to further prosperity depends on the ability of the people to learn new skills and master new technologies. IT is to create an advanced information infrastructure for the Singaporean businessman, clerk, engineer, housewife and student to access and assimilate information from diverse sources and in multiple formats. The technological elements now include broadband networks, multimedia, telecomputing, and technical standards.

Figure 1 compares the three phases of Singapore's computerization. Each phase is progressively more ambitious and builds upon the successes and expertise acquired earlier.

	IT Plan	Target Groups	Strategic Goals	Enabling Technologies
1980 - 1985	Civil Service Computerisation Programme	Public Sector: Government ministries, departments	<ul style="list-style-type: none"> • Raise productivity • Improve service • Develop IT manpower 	<ul style="list-style-type: none"> • Transaction processing • Data modelling • Database management systems
1986 - 1990	National IT Plan	Private Sector: IT industry Local companies	<ul style="list-style-type: none"> • Develop local IT industry • Promote business use of IT • IT R&D 	<ul style="list-style-type: none"> • Software engineering • Expert systems • Electronic data interchange
1991 - 2005	IT 2000	Industry sectors Communities Individuals	<ul style="list-style-type: none"> • Increase national competitiveness • Improve quality of life 	<ul style="list-style-type: none"> • Broadband networks • Multimedia • Telecomputing

Figure 1. Three Phases of Singapore’s Computerization

2 Singapore’s Vision of an Intelligent Island

According to IT2000, Singapore is to develop into intelligent island that will be one of the first countries in the world with an advanced nationwide information infrastructure interconnecting computers in nearly every home, school and workplace (NCB 1992a). The computer will become a multi-purpose information appliance that integrates the functions of the telephone, television, and computer to deliver sound, images, text and data. Through these information appliances, Singaporeans will draw upon a wide array of electronic information and services to improve their businesses, make their working lives easier, and enrich their personal, social and recreational activities. Singapore is to evolve into a developed nation by exploiting IT extensively to enhance its economic competitiveness and quality of life. Five strategic themes define the intelligent island vision.

Theme 1: Developing A Global Hub

Singapore aspires to be a global hub for businesses, services, and transportation. For many decades, Singapore has succeeded in attracting foreign firms to locate their manufacturing activities on the island because of its low-cost but high-quality labor. Now, Singapore is repositioning itself as a nerve centre and switching node for staging regional and international business operations. Its competitive assets will be an efficient and versatile information

infrastructure and a work force equipped with the skills and expertise to operate, manage, and get the most out of the infrastructure. For businesses, the availability of high bandwidth communications will induce them to shift more knowledge-intensive activities to Singapore. Through videoconferencing, electronic sharing of multimedia documents, electronic mail and so on, a company's engineers, designers, marketers and technical staff can collaborate and coordinate their work in near real-time even though they may be oceans apart. In a similar fashion, a wide range of educational and consultation services may be projected and supported from the island without the need for extensive travelling or the cost of setting up large branch offices. The new information infrastructure will also enable Singapore's air and sea ports to reinvent value in the movement of goods and passengers. The electronic sharing of data and documents through integrated port information systems will result in a smoother and even swifter handling of vessels, freight and passengers through air and sea ports that are already known to be among the busiest and most efficient in the world.

Theme 2: Improving Quality of Life

By using technology to reduce or simplify time-consuming chores, Singaporeans will have more discretionary time on their hands. Almost all transactions with government departments are to be made through computer and communication networks - school admissions, tax submissions, permit or license applications, bill payments, and so on will be processed electronically. Shoppers can compare products by selectively viewing images and video-clips on computer screens, and make purchases through cashless transactions. The choice and quality of recreational activities will be enhanced. Singaporeans and tourists alike will use multilingual and multimedia systems to preview cultural events and obtain admission tickets. At home, computers will be used to interactively browse the collections of art galleries, libraries and museums. Congestion on the roads will be tamed by computerised traffic control and electronic road pricing systems. Some Singaporeans can avoid commuting altogether by working at home via high-speed connections that bring them files and messages from the office and elsewhere. Those who work in office buildings find themselves inside intelligent structures that dispense advanced communication and control services. Everyone carries a smart card that stores essential information about her or his health and medical needs. The cumulative effect of these changes is that individuals will have the time and energy to engage in leisure activities that refresh their mental faculties or renew their social ties.

Theme 3: Boosting the Economic Engine

The pursuit of wealth has become the pursuit of information - the winning company is one that is able to obtain the best information in a timely manner and apply it in the production

of its goods or services. On the wired island, companies in the manufacturing sector will exchange information electronically to coordinate their activities. Linked up in well tuned networks, suppliers will be able to synchronize production and delivery with their buyers, and manufacturers can customise their products according to customer demands without losing economies of scale. In the commerce sector, Singapore plans to expand its highly successful TradeNet system into a larger system that draws together all members of the cargo handling community, allowing shipping agents, freight forwarders, ground handlers, airlines, banks, customs departments, and the aviation and port authorities to transmit and process forms electronically. Wholesalers and retailers would set up central distribution centres that use network applications to receive orders, schedule deliveries, plan routes, and issue shipping notices. In the construction sector, contractors and professionals will make electronic submissions to government departments, and share documents, drawings and maps on the new information infrastructure. The standardisation of procedures and interchange of information will also encourage firms to form consortia to bid for international projects. In the tourism sector, a leisure information and reservation system will help travel agents to promote Singapore as a destination and to individualize holiday packages.

Theme 4: Linking Communities Locally and Globally

IT2000 calls for the creation of a community telecomputing network to support civic and social networking at the local community level. Run by volunteers, each community net could cover the area of one of the larger townships on the island and will provide economical access to a wide range of services such as electronic mail, bulletin boards, electronic chats, and videoconferencing. Residents may use electronic mail to consult with volunteer experts for medical and legal advice. They can look up public information on education, cultural activities, and special events. They can communicate with their elected representatives, town council officials, and community leaders. Additional nets will be spawned by special groups such as alumni associations, hobby clubs, parent-teacher associations, professional societies, residents' committees, senior citizens, and so on. The availability of these networks is to prod citizens to participate more actively in collective activities that increase the social cohesiveness of the community. A special net will enable Singaporeans who are living or working abroad to keep in touch with news and developments at home. The same net will also supply information of interest to potential investors, visitors, and foreign talents considering working in Singapore.

Theme 5: Enhancing the Potential of Individuals

Learning and creativity are qualities of an intelligent society. Singaporeans will need to be re-tooled with new skills many times over during their working lives. The new information infrastructure will allow individuals to learn at their own pace and to choose the time and place for instruction. Working people, homemakers, senior citizens, and others will be able to participate in interactive distance education programmes that can bring them lectures and classes delivered from the best schools in the world. Computer-based learning will be enhanced by the coherent use of a variety of instructional media (animation, film clips, photographs, sound). Trainees may immerse themselves in simulated work environments to practise new skills. A media marketplace will connect media and publishing businesses, cultural institutions, broadcasting agencies and so on in an effort to attract and promote creative talents and services. In the marketplace, digital images and videos from the National Museum, the Singapore Broadcasting Corporation, the National Archives, and the national newspapers may be made available. Singaporeans with disabilities will be helped by adaptive technology - video conferencing could allow the deaf to communicate over distance, speech synthesis and recognition could allow the blind to interact with computers, and so on.

3 National Computer Policy Management for an Intelligent Island

From the Civil Service Computerization Programme in the early 1980s, through the National IT Plan in the mid-1980s, to the current IT2000 masterplan, Singapore provides an instructive case study of national computer policy management. Each national plan engages a somewhat different set of policy levers in order to achieve its distinctive goals. Singapore's policy trajectory is a result of the dynamics between the purpose and the function of governmental involvement. In a framework developed jointly by researchers at the University of California, Irvine, the Harvard Business School, and the National University of Singapore, governmental policy is analyzed according to two dimensions: the supply-push or demand-pull *goals* of the policy intervention, and the influence or regulation *role* of the government (King et al 1994, Kraemer et al 1992, Gurbaxani et al 1990). Supply-push policies stimulate national production of IT, including the growth of indigenous and joint-venture IT companies, research and development, and technology transfer. Demand-pull policies stimulate national use of IT, including the application of IT by the public and private sectors, and IT education and awareness programmes. Within each of these two goal orientations, the government may adopt influence or regulation roles. In the influence role, government promotes technology through various forms of funding, incentives and subsidies, informational or consultation assistance, and partnership projects. In the regulation role, government exercises its legal or statutory powers to abet IT diffusion by issuing directives, setting technical standards,

formalizing common procedures, protecting copyright, and so on. The supply/demand goals and influence/regulation roles form a four-by-four matrix for analysis.

In Figure 2, the policy themes of the National IT Plan (1986-1990) are plotted in the left matrix. To support the overall goal of nurturing a local IT industry and promoting business IT application, seven “building blocks” were identified: IT industry, IT application, IT manpower, IT culture, creativity and enterprise, coordination and collaboration, and information communication infrastructure. While these policy blocks articulated both supply-push and demand-pull goals, there was an emphasis on stimulating national IT production by encouraging local industry and research and development through influence-type policies (mainly financial incentives, partnership programmes, and research centers). Thus, the IT industry, creativity and enterprise, and coordination and collaboration blocks are placed in cell 1. The IT manpower and IT culture blocks are in cell 2 because they increase technology demand and use. IT application is between cell 2 and cell 4 because it requires both influence measures (assistance and hand-holding programs) and regulation activities (government directive and data interchange standards). Finally, information communication infrastructure is in cell 3 since it increases technology supply through networks conforming to telecommunication standards. Seen as a whole, the center of gravity of the National IT Plan would lie somewhere in cell 1, with its stress on stimulating national IT production through influence-type policies.

We may compare the National IT Plan’s policies with the current IT2000 masterplan’s five strategic themes (Fig. 2, right matrix). Again, the themes articulate both supply-push (IT production) and demand-pull (IT use) goals, but now the vision is more evenly balanced between the two. For the first time, improving the quality of life, linking local communities, and enhancing the potential of individuals, are no longer the implied benefits of computerisation but prominent objectives in themselves. These three themes are all demand-pull in orientation. Improving the quality of life by increasing citizens’ discretionary time through computer-mediated transactions, and increasing social cohesion by linking communities through telecomputing networks both require technology standardization and a comprehensive legal framework for secure, legitimate electronic interactions to take place. These two themes therefore belong in cell 4 of the matrix, while enhancing the individual’s potential is in cell 2. On the supply-push side, technology production will be stimulated by using IT to develop Singapore into a global hub and to boost the economic engine. Global hubbing will be promoted by incentives and indirect subsidies, local research, and education and training (cell 1). Boosting the economy through sector-wide IT applications will need

standards for document interchange, product barcoding, electronic funds transfer and so on, as well as integration of government and industry procedures for processing forms and submissions (cell 3). On the whole, the center of gravity of IT2000 is nearer to cell 4, where the drive is towards a pervasive use of IT in society, with government leading the development of a supportive technical and legal infrastructure.

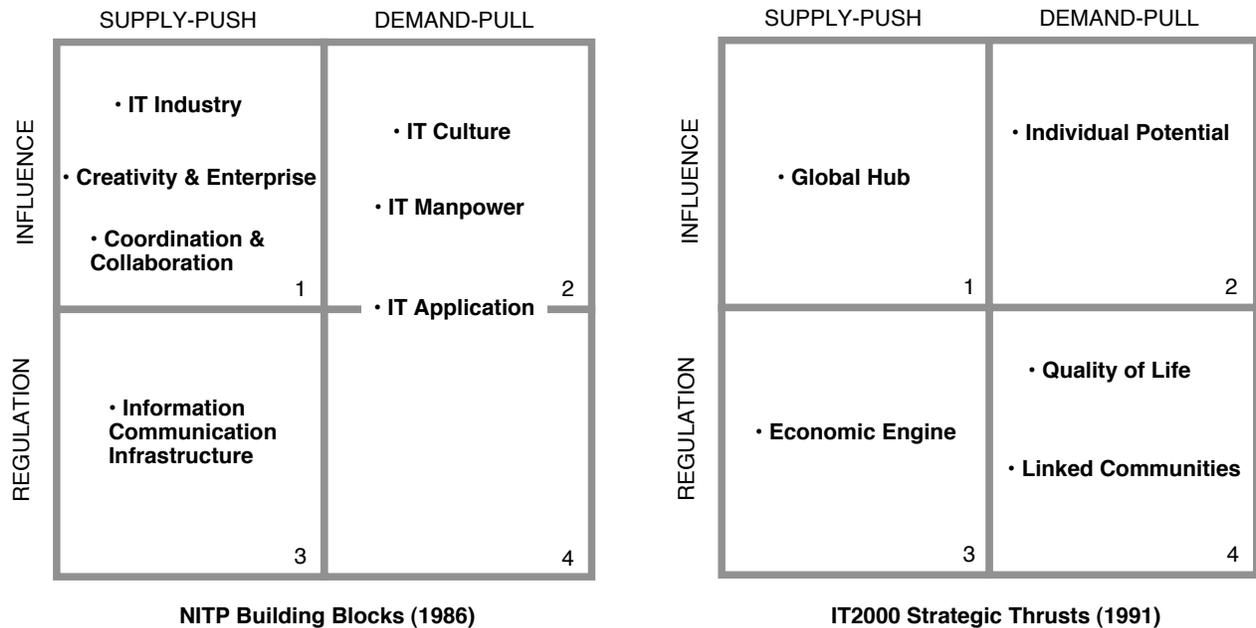


Figure 2. Singapore's National IT Policies (1986 and 1991)

Figure 2 suggests that Singapore has adopted a dual-track push-pull approach in its national IT policies. Supply-push goals that increase IT production are complemented by demand-pull goals that stimulate IT use. In pursuing these objectives, the government has applied both influence- and regulation-type policies, offering attractive incentives and building efficient infrastructures at the same time. While this balanced, broad-front policy management may be the general feature of Singapore's computerization effort, at a more detailed level, one may detect shifts in emphasis that are consonant with the progressive growth of Singapore as an information society. Recall the Civil Service Computerisation Programme of the 1980s to stimulate IT use in the public sector. Its goal was demand-pull and the policy interventions were mainly of the influence type. The ensuing National IT Plan had a stronger private sector orientation, and its primary goal was supply-push: to develop significant indigenous IT capability through influence- and regulation-type policies. The current IT2000 masterplan is aimed at the pervasive use of IT in industry, government, and society at large, and this

represents a return to the demand-pull goal of stimulating technology use, this time across all economic and social groups in the country. In an information-intensive economy, further growth must depend on expansion and enhancement of the information infrastructure (Jussawalla and Cheah 1988). To achieve this, government is undertaking more of the regulation-type activities in infrastructure planning. Figure 3 overlays Singapore's three national IT policies. It suggests a progression over time from stimulating IT use on a limited scale in government ministries (the CSCP), through the nurturing of local IT capabilities that pushed IT production (the National IT Plan), to the current vision of an intelligent island where IT permeates society (IT2000). Government role evolved in tandem - government provided seed-beds for CSCP applications, acted as national coordinator and catalyst for the NITP, and is now masterplanner and architect of the information infrastructure of the intelligent island.

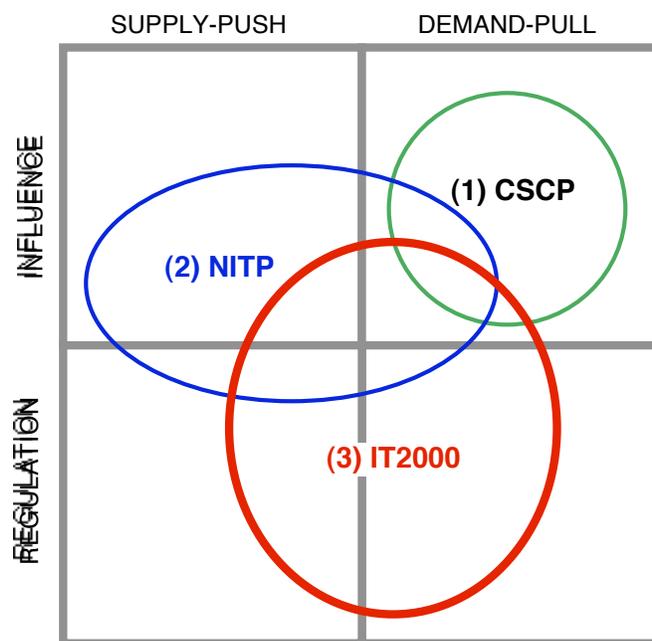


Figure 3. Evolution of Singapore's National IT Policies

4 Conclusion: Lessons from the Singapore Experience

To the extent that Singapore has become one of the most highly computerised nations in the world, with a burgeoning IT industry and a track record of sophisticated, sometimes world-beating IT applications in business and government, Singapore's computer policy management may be judged a success. What features characterize the Singapore experience?

(1) Singapore progressively developed its own *IT manpower* as a critical, top-priority objective. In the early days of the CSCP, Singaporeans worked alongside foreign consultants and software developers to design and build systems. Today, Singapore's software engineers in several local IT research centers are discovering ways to apply cutting-edge technologies to create international competitive advantage for industry and government.

(2) Singapore understood the principle of *critical mass*. When the CSCP was initiated, major application systems were developed in ten ministries at the same time. The corps of IT professionals working in the CSCP remains till today centrally managed by the National Computer Board. To present itself as an attractive international IT centre, Singapore worked hard to build up an initial base of multinational corporations which could showcase the value and quality of its IT work force and infrastructure. Singapore also creates critical mass by pulling together disparate players in government and industry to collaborate on strategic large-scale applications such as the sectoral information-sharing networks.

(3) Singapore weaves its IT policies in a latticework of multi-way *partnerships*. The CSCP was essentially a partnership programme between government ministries, statutory boards, and industry. The National IT Plan promoted collaboration between local industry and foreign IT companies, and between local industry and government. The IT2000 study was the work of eleven sectoral study groups, comprising some 200 senior executives and academics (NCB 1992a). The new information infrastructure is being jointly developed by local universities, research institutes, and multinational corporations. Already a Proof of Concept prototype of the new infostructure has been successfully demonstrated and a first version is to be rolled out in 1995 (NCB 1994). Thus, partnerships have been exercised at multiple levels involving many permutations of players from the private and public sectors. The density of partnerships is matched by the ability of the groups to cooperate and coordinate their interests and resources.

(4) Singapore shows convincingly that clear-sighted *government leadership* is a powerful force in driving IT diffusion. In challenging the received economic wisdom about the evils of government intervention, Singapore demonstrated the effectiveness of managing technology demand and supply with promotive and regulative policies. Cronin and Davenport (1993) observe that Singapore is "a recognized leader in leveraging and sustaining its competitive edge through far-sighted investments in information and communication technologies" and that its policies constitute "a plausible blueprint for other newly industrialized or developing

nations.” (p. 21) At the same time, Singapore needs to move beyond the building of an information infrastructure to the larger challenge of creating an intelligent society in which attitudes, values, social relations, and cultural structures can encourage its people to continuously learn and innovate (Dedijer and Jéquier 1987).

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