



Singapore TradeNet: Beyond TradeNet to the Intelligent Island

By 1995, Singapore had captured significant world attention because of its economic success, technology-driven “intelligent island” vision, shrewd use of IT to enhance economic competitiveness, and individual approach to dealing with social issues. Successful IT applications like TradeNet, an industry system allowing traders electronically to submit import and export permit applications to government agencies, were widely studied and cited. The country could boast of being the first with a fully digitized telecommunications and ISDN network. Singapore, according to the *World Competitiveness Report*, issued by the Institute for Management Development in Lausanne, Switzerland, and the World Economic Forum of Geneva, had the best telecommunications infrastructure in the world, and was second to the United States in the league of competitive nations in 1994. Singapore-grown Creative Technology and Aztech were the world leaders in sound card technology, an important piece of the growing multimedia market. Singapore was also the leading manufacturer of disk drives, accounting for more than 45% of worldwide volume.

A small city state of about 640 square kilometers with a population of about 3 million, Singapore was founded by the British in the early 1800s. Because of its strategic location for ships traveling from Europe to the Far East, Singapore developed into an important trade and transportation hub for South East Asia. Its independence from British rule in 1959 and subsequent merger (1963) and then separation from Malaysia (1965), and the withdrawal of British naval forces in 1971, forced Singapore to look to multinational corporations to provide the technologies, skills, management expertise, and markets for its industrialization drive. The country’s success in attracting MNC investments (3,000 MNCs currently had substantial operations there) for enhancing its citizens’ skills and economic well-being was reflected in per capita income, which grew from US\$800 in 1965 to about US\$22,000 in 1994. The U.S. Department of Commerce estimated that U.S. companies achieved a rate of return of 31% in Singapore, compared to an Asian average of 23% and a world average of 14%.¹

In both 1993 and 1994, the Singapore economy grew 10.1%, with inflation kept at less than 4%. Civil service employees, whose bonuses were tied to the economy’s performance, received a total of three and a half months of salary as bonus for 1994. The Ministry of Trade and Industry forecast 1995 growth at about 8%.² Moreover, such high growth rates had been achieved despite expectations of slower growth (6% to 8%) as the economy matured. Singapore was widely recognized as a developed nation although the government had promised to achieve that status by the year 2000.

¹Cited by Prime Minister Goh Chok Tong in his speech in London in April 1994.

²1994 *Economic Survey of Singapore* published by the Ministry of Trade and Industry in February 1995.

Professor Boon-Siong Neo of Nanyang Technological University, Professor John L. King of the University of California at Irvine, and Professor Lynda M. Applegate prepared this case as the basis for class discussion rather than to illustrate either effective or ineffective handling of an administrative situation.

Copyright © 1995 by the President and Fellows of Harvard College. To order copies or request permission to reproduce materials, call 1-800-545-7685, write Harvard Business School Publishing, Boston, MA 02163, or go to <http://www.hbsp.harvard.edu>. No part of this publication may be reproduced, stored in a retrieval system, used in a spreadsheet, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without the permission of Harvard Business School.

Nevertheless, Singapore's small physical land area and population, plus the lack of natural resources, were recognized constraints to continued economic growth. There was a physical limit to the number of people and amount of economic activity that might be contained in this small island. Moreover, wages and other costs had increased with success. Costs in other Asian developing countries were much lower than those in Singapore, and these countries were eager to grow and develop economically; recognizing their lack of capital and technology, they had also become very aggressive in seeking foreign investments. As Asia in general is expected to lead the world in economic growth in the next two decades, Singapore must be plugged into the region to benefit from that expected growth. Thus, aware of the need for a new economic strategy to ensure its continued prosperity and enhance the standard of living of its citizens, Singapore set out to develop a *second wing* to its economy, i.e., to build an external economy so that more of its income could be earned overseas, thereby overcoming its limited amount of land and human resources.

Launching A "Second Wing": Regionalization

During 1993 and 1994, Singapore's political leaders, including Prime Minister Goh Chok Tong and Senior Minister Lee Kuan Yew, visited many countries in Asia (China, India, Vietnam, and Myanmar—formerly Burma), and Europe (Germany, France, Switzerland, and the United Kingdom) as well as Australia, and New Zealand. These visits not only were made for developing political relationships but also reflected a larger economic vision to develop a regionalization—a second wing—strategy for the country. The political leadership's focus on economic development was not new; it had been a key reason for the material progress Singapore had achieved over the past 30 years. Previous visits by cabinet ministers to the United States, Europe, and Japan had been primarily to attracting targeted MNCs to invest in Singapore. On more recent visits, they continued to emphasize that Singapore saw investing in the rapid growth of Asian economies like China and India as strategic to its continuing growth and wanted to attract industry partners in the developed countries to invest in Asia. In a sense, Singapore Inc. wished to become Singapore Unlimited. At a forum of European business leaders in London in April 1994, Prime Minister Goh articulated the strategy:

Investing in the [Asian] region, or "Going Regional" as we call it, is part of our long-term strategy to climb up the economic ladder. Regionalization means that we will be able to participate in the growth of the region, to interlock the regional economies with our domestic economy. We thus expand our economic space, and through this expansion, strengthen our domestic economy, especially the manufacturing sector. Building an external economy is a national imperative. Until recently, the Singapore Government's foreign reserves were invested mainly in bonds, shares and real estate in the developed economies. Our new strategy is to gradually invest up to 30% of our reserves in our regional economies.

We have always played the role of a "business architect"...helping companies, Singaporean and foreign alike, plan their business strategies and configure their activities for maximum returns. We carry out some form of "global knowledge arbitrage." Firstly, in information. Singapore's familiarity with both the East and West means that we are able to identify informational gaps, and the business opportunities which can arise if these gaps are filled. Our industrial park projects in the region are an example. The host country has the natural resources, but is unable to package them in a way which meets international investors' needs. The investor is interested in doing business in a country or region, but is often unsure of the rules, business customs, and the market. Sometimes, the investor may be familiar with what the location can offer, but is unable to convey his needs to the host country. This is where Singapore's industrial parks in China, India and elsewhere will prove useful. They provide the conducive business environment international investors are familiar with, and which at the same time satisfy the host country's needs, aspirations and concerns.

Secondly, different countries have advantages which are suited to different activities. In some cases, companies may find that different locations have their individual attractions, and there is no one location which meets all their needs. This is where knowledge arbitrage of locations comes in. A specific example is the growth triangle we have formed between Singapore, the Malaysian State of Johore, and the Riau Islands of Indonesia. Each of these three locations is less than an hour's ride away from the other, and yet each has its own advantages. Singapore has a well developed infrastructure and is a base for multinational companies. Johore has international technology and semi-skilled labor while the Riaus are origin territories. An investor can make full use of all these advantages by, for example, locating its business headquarters and high value-added manufacturing in Singapore, and its resource-intensive manufacturing operations in the Riau Islands or Johore.

We can help to adapt and customize investors' capabilities to Asian needs, taking into account the different technology absorption capabilities of various Asian markets. Nestle of Switzerland for example, has located its R&D center in Singapore to research into the specific food and beverages needs of the Asia Pacific market. This is a highly successful project, which has developed many new products specifically for the Asian palate.

The new regionalization strategy was bold and risky; the business press was already reporting on MNC investments in developing Asia that turned sour. Further, it was not sure that Singapore's major business and government-linked corporations were willing to commit the resources to invest in the region for the long term. Businessmen expressed concerns that Singaporean managers accustomed to a "squeaky clean" business environment were a misfit in a region where under-the-table dealings were part and parcel of doing business. Some argued that little in Singapore's past successful economic experience prepared it for the new regionalization drive. The ability to convince MNCs that Singapore was a great place for investment provided no guarantee that Singapore-trained executives could pick the right investments in the region and groom them into profitable enterprises. Past success was no assurance of future survival.

Thus, a series of questions remained as Singapore embarked on its second-wing strategy. What could Singapore learn from its past and current success to prepare it to compete in the new business environment? What factors contributed to Singapore's current enviable economic position? Would its new technology vision drive it to the future world it envisaged? Would the business infrastructure that Singapore had so carefully constructed over the last 30 years serve it in the next 30? What new roles, expertise, skills, and infrastructure would it need? How crucial a role would IT play in this new economic strategy? Could lessons learned from building business infrastructure in the past be used for building a new information infrastructure for the future?

Building Business Infrastructure For Economic Growth

The factors attracting MNCs to Singapore in the past 30 years included its political stability, its English-educated workforce, its free port status and open trade policies, and its excellent physical, transportation, and communications infrastructure. Many MNCs experiencing frustration in other developing economies found Singapore's clean, honest governmental dealings and its reliability in providing essential services to be particularly important features, and Singapore hoped to exploit the same infrastructure in its strategy to develop an external economy.

The Economic Development Board (EDB) was set up in the early 1960s to be a one-stop shop to facilitate MNC investments by coordinating business requirements with other government departments and agencies. EDB was now expanding its mission to be a channel and facilitator for Singapore investments in strategic projects in Asia. Government-to-government agreements provided the environment for direct investments by Singapore business firms. Government agencies and government-linked companies also developed sites in the region and provided locations for subsequent business investments—examples included the Batam Industrial Park project in Indonesia, the Information Technology Park in Bangalore, India, and the Suzou Township Project in China. EDB

also played a broker role by helping to locate government-linked companies or foreign MNCs that might join local business firms as partners in investing in the region.

Singapore's policy for infrastructural investments had been aimed at leveraging its limited land area and well-trained human resources, an approach Finance Minister Richard Hu reviewed in his budget statement to Parliament in February 1994 :

Singapore's philosophy of economic management is that the Government's role is not to supplant the private sector but to help its development, so as to provide Singaporeans with a good life. With this guiding principle in mind, Government's intervention has been, and will continue to be, in four areas:

- a) providing a conducive environment for economic growth and social stability;
- b) maximizing the employment potential of Singaporeans through a practical and rigorous education system;
- c) upgrading economic structure through selective direct investments in strategic projects;
- d) ensuring that Singaporeans have relevant skills by providing up-to-date training and skills upgrading programs.

We must continue to plan well into the future to keep our infrastructural development ahead of demand. At the same time we must further streamline administrative procedures and reduce government involvement in areas where it is no longer necessary. The Government must also intervene to provide the necessary social infrastructure. Left to market forces alone, most Singaporeans will not have decent housing and many will not have adequate access to medical services. The Government will therefore continue to provide the necessary social infrastructure for lower-income earners, and adequate subsidies for essential health, education, and housing.

"Business infrastructure" referred to the basic framework of physical structures and socio-economic policies providing the capacity and capabilities for facilitating productive business activities in Singapore. Physical infrastructure included the planning and development of the city, housing estates, schools, the transportation network, parks, and other physical facilities. Socio-economic infrastructure included the formulation and implementation of government policies relating to transportation, housing, education, economic development, labor and wages, and the functioning of government agencies.

In its approach to infrastructural development, the Singapore government planned for and funded upfront capital investments, and then established agencies to operate them to recover recurrent operating costs and surpluses for future operations. For example, the Mass Rapid Transit railway system, built for S\$5 billion, was funded from accumulated budget surpluses. Commuters using MRT currently paid no more than bus fare rates, with the highest MRT fare pegged at S\$1.50 between the two furthest stations.³

Teo Chee Hean, Senior Minister of State for Defense and chairman of the blue ribbon National Information Technology Committee, illustrated how Singapore built infrastructure in anticipation of demand:

When we opened our first two container berths in 1971/1972, containerization was not a major trade yet. Now we are one of the world's largest container ports. We are now planning a new container terminal in Pasir Panjang that

³In May 1995, 1.4 Singapore dollars equaled one U.S. dollar.

can handle three to four times the capacity we are handling today. That will provide us the capacity we anticipate we will handle for the next 30 to 40 years. That is an investment of hundreds of millions of dollars and the decision was taken at the cabinet level. Similarly, we decided to move from Paya Lebar airport to Changi in the mid-1970s because Changi provided the space for future growth. We are now planning for our third and fourth terminals in Changi although the second airport terminal was only opened recently and is adequate for our needs in the next few years. Our expenditure policy has been quite stable over the years. We have consistently allocated 60% of the government budget to development expenditures, mainly infrastructural investments for the future.

Philip Yeo, chairman of the Economic Development Board, explained why Singapore's infrastructure was attractive to MNCs:

They want to get better returns for their investments. Our excellent infrastructure made it convenient for them to come and do business here. Their total operating costs are lowered because we have made the upfront investments ourselves. The MNCs can come in quickly, plug in, and pay for what they need to operate. Even for factory space, we have that readily available to lease to MNCs. We are using the same strategy in building industrial parks in the Indonesian islands of Batam and Bintan, in India, and in China to encourage foreign investments by Singapore and other firms in those countries.

Many MNCs had been impressed by EDB's effectiveness in enabling them to relocate to Singapore and begin operations speedily. Hewlett-Packard, for example, began manufacturing in Singapore in 1970; that operation was now responsible for R&D and marketing HP's ink jet printers and keyboards worldwide. Alex Chan, HP's former managing director in Singapore, elaborated:

When HP was looking for a second Asian site in the 1960s, Singapore was going through a lot of soul-searching and there were slums everywhere. What tilted our decision to Singapore over Hong Kong and Taiwan was the government and its agencies. . . . They just projected a much more willing and welcoming attitude. . . . Tax incentives were offered...but they were never really that important because you never know whether there was going to be profits . . . so it was a minor carrot. The central location in Asia was important. There was also a workforce that was deemed as educated enough, and willing, and low-cost enough. Today, the factors are different. We have to compete with the best of HP's divisions. We have to show that we could build high quality products at lower cost and deliver them logistically to wherever the market was. We have moved up the capability ladder and it is important that we have people who have the necessary skills and expertise, and who are trainable. This is also where Singapore telecommunications and transport infrastructure come in. They allow us to distribute products worldwide and provide 24-hour support to major markets.

Another impressed MNC was Reuters, which celebrated its 125th anniversary in Singapore in 1993. Although it had been providing news and financial information services to Singapore organizations during all those years, only in the last 10 had substantial regional management functions like finance, information systems, and logistics been transferred to the island. Reuters recently invested in a new S\$40 million facility with its own telephone exchange and specially laid fiber optics cables. Phillip Melchior, Reuters's South East Asian regional managing director, listed four factors for this increased commitment:

One is simply geographical—Singapore happens to be a good, convenient center to be based. That's really the least important. Second would be the availability of various tax incentives, which is important but not of over-riding importance. Third would be our ability to hire the right people—people who can operate at a high level of spoken and written English, and with the right educational qualifications. The last reason is the physical infrastructure in place. We can operate more cheaply in Singapore than we can elsewhere. Singapore's technical infrastructure is good but not qualitatively better than Hong Kong, Sydney, or

Tokyo. But for our purposes, its people are better here. We are now sending Singaporean managers to Hong Kong and China because they can operate in both English and Chinese.

Building Information Infrastructure

To accompany its second-wing strategy, Singapore was building a new information infrastructure that could leverage its available geography and people. (Information infrastructure referred to the computing hardware, operating software, communication networks, common systems, and expertise that provided the need capacity and capabilities for capturing, processing, storing, communicating and presenting information.) The foundation of its current information infrastructure has its genesis in the late 1970's; its new IT2000 National Information Infrastructure Plan, released in 1991, sought to reposition Singapore for the 21st century.

The drive to attract foreign investments began in the 1960s as a means to provide employment, yet the success of that policy led to unexpected consequences: labor shortages, beginning in the mid-1970s, and a need to bring in foreign workers. To overcome this problem, the government embarked on a new policy to encourage industries to automate and economize in the use of labor. A high-wage policy, whereby wages increased by more than 20% per year from 1979 to 1981, was implemented to accelerate the inevitable industrial restructuring. In 1980, a government study identified information technology as crucial for Singapore's ambition to be a center for "high-tech, brain intensive services." A new government agency, the National Computer Board (NCB), was formed in 1981 to spearhead Singapore's drive into the information age in three key areas: computerizing the civil service, training an adequate pool of computer personnel, and nurturing a computer services industry.

Although the development of its telecommunications infrastructure to provide basic telephone services began when Singapore was ruled by the British in the 19th century, major investments were made only from the late 1960s, with the commissioning of its first submarine cable. Extensive telephone installations in the 1970s and conversion to push button telephones in the 1980s enabled easier access to a wider range of services through the phone. Fiber optics replaced copper and digital switching equipment replaced analog, making the telephone network fully digitized in 1994. In 1994, 60% of buildings in the country had a fiber pass and a fiber-to-the-home project had been initiated. Nationwide ISDN (integrated services digital network) services allowing different streams of data and voice to be carried on the same telephone line became available in 1989, and broadband ISDN trials started in 1992. Singapore Telecoms spent between S\$200 million to S\$600 million per year on capital investments since 1982, and expected to invest another S\$3.5 billion in the next five years. Many new telecommunication services were now available, and Singapore's long distance rates were among the lowest in Asia. As mentioned earlier, since 1991, the *World Competitiveness Report* had ranked Singapore as having the best telecommunications infrastructure in the world.

Government Computerization

Until 1980, computing requirements for government departments, except Defense, were centralized in the Ministry of Finance. Computerization had proceeded at a measured pace because of the difficulty in recruiting and retaining professional staff. With the subsequent formation of NCB, under its first chairman, Philip Yeo, several organizational innovations were adopted to expand the computerization of the civil service :

- Computer hardware and equipment were decentralized to individual government ministries.
- Computer Information Systems Departments (CISD) were set up in individual ministries, staffed by NCB's IT professionals.

- Each ministry appointed one of its senior officials to be the director of and to oversee its CISD; operational running of the CISD was left to a NCB- manager.
- An NCB subsidiary, National Computer Services Private Limited, was set up to hire IT professionals, who were then seconded to NCB; this arrangement effectively removed NCB's IT professionals from the then uncompetitive salary structures in the civil service and enable them to be paid market-based salaries.
- NCB billed each ministry at market rates for computing services rendered.
- NCB set technical standards for hardware, operating software, systems development, data architecture, and communications protocols for the government ministries; it was the sole procurement agency for government departments for hardware and software.

Computerization projects were started in 10 government ministries in 1982, because "all their needs were very pressing"; 10 years later, more than 30 government ministry departments and organizations had been computerized. The IT professional staff quickly grew to 121 in 1982, 252 in 1985, 601 in 1988, 800 in 1991, and more than 1,000 in 1994. The number of mainframes and minicomputers grew from 10 in 1982 to more than 100 a decade later; the number of workstations/PCs increased to 7,000 in the same period. By 1993, 662 new application systems had been developed for the civil service, with 74 under development and 71 identified for development.

A Ministry of Finance study in 1988 concluded that investments made in government computerization had generated a 171% return; the annualized investment of S\$73.3 million gave annualized savings of about \$198.3 million, the bulk of which came from eliminating 1,500 civil service jobs and avoiding another 3,500 jobs. In 1992, NCB began consolidating the government ministries' mainframe computers to obtain economies of scale from operations.

Human Resource Development

An adequate pool of trained computer personnel was crucial to Singapore's intention to be a player in the "brain services" arena; however, in 1980, there were only 850 or so computer professionals in the country, and educational institutions were graduating fewer than 100 qualified professionals a year. A key function of the newly formed NCB, therefore, was to devise a strategy for training sufficient numbers of technical professionals so that organizations could exploit IT. In 1981 and 1982, three new training institutes were established, in collaboration with vendors and major sources of technological expertise, to speed up the "production" of new technical professionals: the Institute of Systems Science (in collaboration with IBM), Center for Computer Studies (with ICL of UK), and the Japan-Singapore Institute of Software Technology (with the Japanese government). Altogether, these institutes had graduated about 400 technical professionals by 1986. A Department of Information and Computer Science was also established at the National University of Singapore. During the latter half of the 1980s, three additional collaborative institutions were formed to provide training in specialized technical skills: computer-integrated-manufacturing (with Grumman International), telecommunication software specialists (with AT&T), and artificial intelligence (with the Japanese government). These efforts, together with additional "intakes" at the universities and aggressive recruitment for foreign talent, increased the available pool of trained IT professionals from 850 in 1980 to 4,000 in 1984, 7,000 in 1987, 14,000 in 1991 and 18,000 by the end of 1993. Non-Singaporeans admitted under liberal immigration policies for highly qualified people represented about one in five IT professionals working in the country.

Developing A Computer Services Industry

A principal aim in Singapore's computerization drive in the early 1980s was developing an indigenous computer services industry for export. Given the low level of computerization in the government and business sector, however, along with the severe shortage of trained technical

personnel, achieving this objective would have to be deferred. The twofold strategy, therefore, was to attract major IT vendors to carry out high value-added activities, to serve the needs of national computerization, and to transfer software technology and expertise to local partners. By 1989, 14 Software Development Centers were established by leading IT vendors including HP, NEC, Xerox, Nixdorf, and others. These Centers employed 500 software professionals and invested a total of S\$100 million annually.

Several government assistance schemes were introduced in the 1980s to encourage local IT vendors to invest in innovative software product development with potential for export. The Product Development Assistance Scheme, for example, provided financial support for up to 50% of the direct costs (salaries, fees, prototype development and testing, etc.) of an approved software product. By 1994, about 20 IT vendors had benefited from this scheme. Interestingly, although the scheme made it easier for firms to complete development projects, there had yet to be a blockbuster software product created as a direct result of the scheme. Further, Creative Technology and Aztech, market leaders of Singapore's world class multimedia soundcard products, had developed their offerings independently of direct government assistance. While many CEOs of local software firms appreciated government help, the tedium of form-filling and the strict accountability the government required when assistance schemes were utilized discouraged participation.

Nonetheless, from 1982 to 1992, computer services industry output grew from S\$259 million to S\$3.7 billion, representing about a 30% annual increase; the export portion grew from \$50 million, representing 20% of the industry, to \$1.6 billion, representing 44% of industry revenues. Export revenues were expected to continue growing faster than the overall industry as local firms expanded into the region. Although it was recognized that research and development of new software products for world markets represented the real potential for the industry, at the same time there was little slack for experimentation given the relatively small size of local software vendors. (NCB was trying to overcome this problem through its R&D unit, the Information Technology Institute, and other government-funded research centers, which were committed to joint R&D with industry partners in return for equity participation in potential new ventures.) And sophisticated IT firms aiming to do innovative software product development found a shortage of creative software engineers. Singapore wanted more companies like Creative Technology and was hoping that its policy framework would provide a conducive environment to nurture such world class companies. Potentially, however, its greatest obstacle could be more socio-cultural than a lack of government commitment. In a society where failures carried a social stigma and second chances were infrequent, few people were willing to risk venturing into the uncertain business of new product development. Many companies instead seemed all too happy distributing established products and servicing local customer needs.

Business Computerization

After taking the lead in computerizing the civil service in the early 1980s, NCB began promoting IT applications in all business sectors in 1986—when the Singapore economy contracted for the first time in 25 years and the need to be competitive in all business sectors heightened. A National IT Plan was developed to position Singapore to better take advantage of the convergence of computing and communication technologies. An important result was a focus on how industrywide computer networks could lower costs and provide better turnaround for businesses operating in Singapore. In the latter half of the 1980s, three strategic industry systems were created: TradeNet, MediNet, and LawNet.

With TradeNet, traders could submit import and export permit applications to government agencies electronically, saving time and manual labor in the trade documentation process; trade permits were now approved in 15 minutes instead of the previous two days. To implement TradeNet, Singapore Network Services (SNS), a government-owned private company, invested in a network Electronic Data Interchange manager from IBM. The network manager in turn became an important software for speedily implementing other industry networks. Thus, MediNet allowed hospitals to submit patient claims to insurance programs and medical fund schemes managed by the Central Provident Fund, the government agency which was the custodian for workers' retirement funds; more than 90% of hospitalization claims were now processed within one day instead of 10. LawNet enabled legal firms to access legal statutes and court notices electronically. A module

providing for electronic conveyancing in property transactions was currently under development. Other electronic networks and EDI applications had been implemented for the retail, manufacturing, construction, and freight forwarding industries. A new internally developed EDI network software, implemented in 1993, catered to the fast growth SNS had experienced since implementing TradeNet in 1989, equipping it to provide a full package of network services to clients in the Asian region.

In addition, a scheme to assist smaller local companies in their computerization needs was introduced in 1986, and by 1994, more than 260 firms had been assisted while many others had benefited from generous tax incentives for investing in computerization. Overall, the level of business computerization among firms with 10 or more employees had risen from 13% in 1982 to 59% in 1987 to 90% in 1994.

IT2000 National Information Infrastructure

As NCB reviewed Singapore's IT progress in its first 10 years, it also began pondering what it would do for the ensuing 10. According to NCB's chief executive, Ko Kheng Hwa, commitment to the IT2000 concept evolved over several months in early 1990:

Our national IT plans were conceived to respond to new national challenges and technological opportunities. The IT2000 project was no different. There was no single flash point. We began thinking about the idea of a new IT masterplan to support Singapore's thrusts to become a developed country during our corporate planning sessions in early 1990. As we looked back to the 1980s, we started looking forward to the 1990s. Initially, we code-named the project IT2001. However, as there were several other "2000" planning projects going on, we felt that the name "IT2000" would be accepted more readily. The scale of commitment to the project evolved slowly. However, over the few months, we were able to persuade senior NCB managers about the project, and they became committed. It was a NCB team effort from then on.

When we looked back, our attention in the early 1980s was focused on basic computerization, the first "C." The 1986 plan added another "C"—communications. TradeNet was a prime example of what came out of the '86 plan. Now we have yet added another "C" to our menu—content. IT2000 is all about making multimedia information contents available and accessible. This includes business databases and new areas like multimedia learning, entertainment on demand, personalized newspapers, and others. There are few precedents elsewhere to learn from. The challenges facing NCB in its implementation of IT2000 is more daunting than coming out with the plan. There are few precedents elsewhere to learn from. We are looking at technologies that have not been tried on such a scale. Many standards are not even defined. We need all kinds of expertise and skills. We need to coordinate and collaborate on both national and international scales. Our role has also expanded. Economic exploitation of technology is still a key thrust. Increasingly, we have to look at the use of IT by schools, families, and individuals. It will be a real challenge for us. We have to start somewhere. The IT2000 vision and plan provide that start. It is up to us to build on it.

Eleven industry sectors were selected for planning: construction and real estate, education, financial services, government, healthcare, IT industry, leisure and tourist services, manufacturing, publishing and media, retail/wholesale/distribution, and transportation. All sectors chosen were important to the Singapore economy, but a few important sectors (e.g., defense) were excluded because they were not accessible; others (e.g., oil refining) were excluded because they were dominated by a few large firms. According to an NCB director, "The tasks and competitive needs for coordination are much less in concentrated sectors. The sectors selected for the IT2000 planning process were those with many firms, where there is greater potential for enhancing sectoral coordination and competitiveness through inter-organizational systems." About 200 senior executives, academics, and industry experts met, by industry, over a six-month period in 1990 to

define and deliberate the strategic systems crucial for each sector. NCB coordinated the study and prepared the final report, whose most important recommendation called for creating a National Information Infrastructure (NII). The NII, described at a relatively high level (see **Exhibit 1**), consisted of the three components: conduit, content, and compute.

Conduit refers to the physical 'pipelines' that carry information. Examples of such pipelines include voice and data lines, broadcast and cellular transmission. Content refers to information that flows through the conduit. Examples of such information include multimedia courseware, entertainment programs, government database records, and payment instructions. Compute refers to the processing of content in the NII. Examples of such processing include user authentication, billing, and processing of permit documents. The three components of the NII are under the purview of several government agencies and involve the private and public sectors.⁴

NII was intended to turn Singapore into a more efficient switching center for goods, services, capital, information, and people, and to contribute to the competitiveness of every sector of the economy, particularly those where information was a key factor of production. NII was also expected to affect the private lives of individuals by providing opportunities for lifelong learning, extending the "personal reach" of Singaporeans, creating electronic communities of people with similar interests, and expanding individuals' leisure time and opportunities through increased efficiency in performing essential tasks.

The NCB report also specified the key organizations to be involved in NII development: a policy steering committee, Singapore Telecoms, Singapore Broadcasting Corporation, Project Specification Teams (NCB Application Groups in partnership with the relevant private and public organizations), and a newly formed NII Group within NCB.

Implementing IT2000: From Technocracy to "Learning Nation"

Since announcing the IT2000 plan in 1991, NCB refocused to implement the new vision :

- it formed a new division, the National Information Infrastructure Division, to spearhead the implementation of IT2000;
- it deplored 50 technical specialists to design the NII infrastructure and services;
- it embarked on a number of collaborative projects with overseas organizations for joint research on issues pertinent to IT2000;
- senior managers visited a number of sites in developed countries to seek ideas, view the implementation of innovative prototypes, and establish contact with potential vendors;
- it developed a network prototype for new applications and services in the education, medical, construction and real estate, and manufacturing industries;
- it created and implemented several "information kiosks" for public access to information sources and transactions.

As NCB was looking at a 15-year time frame for implementation, initial excitement generated by the IT2000 plan had grown into serious discussions and experimentation with prototype technical solutions.

⁴A Vision of an Intelligent Island: IT200 Report, published by the National Compute Board, 1992.

Organization of Information Services Providers

Singapore Telecoms was privatized and listed on the Singapore Stock Exchange in November 1993; the government sold to the public 1.3 billion Telecoms shares representing 11% of its shareholding in the first phase of its privatization, with more shares to be sold in subsequent years, an effort begun in 1989 to prepare Telecoms to compete in the marketplace. When Telecoms was corporatized in 1992, it was given a sole license for operating mobile telecommunication services until 1997, and domestic telephone services until 2007. Singapore Telecoms International was set up as a wholly owned subsidiary in 1988, to invest in overseas telecommunications projects and bid for service contracts; by March 1994, it had invested S\$470 million in 23 projects in 12 countries. Its joint ventures had recently won licenses to operate mobile phone services in Indonesia, private mobile telecommunications network in Norway, radio broadcasting in Sri Lanka, telephone and cable television services to the Yorkshire and Cambridgeshire regions of the United Kingdom, and international telephone services in the Philippines.

The Singapore Broadcasting Corporation (SBC), a government agency for delivering radio and TV services, was corporatized in 1994. Four private companies were formed to take over SBC's programming functions to prepare it to compete with other entertainment and information providers. Minister for Information and the Arts George Yeo asserted that "to protect and nurture our sense of self and our values, we must make sure that SBC channels remain the anchor channels in Singapore." In January 1994, SBC started to beam one hour of its programs per day to other Asian countries using Indonesia's Palapa satellite. The aim for the service was to "keep in touch with Singaporeans abroad and to project Singapore's way of life to those in the region." Using a sailing analogy, Yeo articulated the government's attempt to deal with the influx of foreign TV channels:

We cannot avoid the hurricane coming our way. If we shut our eyes and do nothing, our boat will capsize. The only way for us to survive this storm and emerge from it stronger is to stay very alert and flexible. Like good sailors, we have to work with, and not against the waves.⁵

Another issue being addressed was the convergence of broadcasting and telecommunications. Broadcasting and cable TV were currently transmitted via microwave, while telecommunication services were transmitted via cables; the trend was towards the use of fiber optic cables for transmitting TV channels and for microwave and satellite for transmitting mobile telephone and telecommunications services. However, Singapore's transmission channels had been developed by different organizations, Singapore Telecoms, and SBC. A task force was now looking into how organizational arrangements like access to each other's networks, pricing, and future developments, might need to be changed to be aligned with the technological convergence of telecommunications and broadcasting. A more fundamental issue was whether, given convergence, separating organizational responsibility by different transmission channels was a rational arrangement at all.

Social Order and National Direction

One of the challenges to fulfilling the "intelligent island" vision was how greater access to electronic information could be reconciled with Singapore's desire to limit external influence in its social and political developments. Censorship of film, video, and TV was stringently enforced to keep out "undesirable material" with excessive violence or sexual content. Control over print media and licensing for overseas publications with substantial circulation in Singapore had been designed to allow the government to rebut articles about Singapore which it deemed inaccurate or biased. Such publications as *Time*, *The Asian Wall Street Journal*, *The Economist*, and *Far Eastern Economic Review* had seen their circulation restricted for limited periods because the Singapore government felt it was not given the full right of rebuttal to certain articles (circulation for all but the *Far Eastern Economic Review* had been restored to pre-restriction levels). Use of satellite dishes was also banned in Singapore except for commercial purposes.

⁵As reported in *The Straits Times*, December 24, 1993.

While enforcing censorship in the flow of electronic information was obviously difficult, the broader issue was how Asian conservative, Confucian values could be preserved, and how Singapore could exert a control over its own political destiny in an age of unlimited access to all kinds of electronic information. The government recognized that as satellite dishes became smaller, restricting them could prove impossible; however, it aimed to restrict them for as long as possible and provide a greater range of TV programs at the same time. Thus, it adopted a twofold approach: 1) to provide greater access to information, but still subject it to control; 2) to compete in the information provision business. In December 1993, it announced that more than a dozen cable TV channels would be available by 1995, and up to 30 channels by 1998. Noted the Minister for Information and the Arts, "Needless to say, channels that are pornographic or incendiary will not be allowed." The government hoped that the additional TV channels "would reduce the desire for satellite dishes."

IT as a Learning Facilitator

A new information infrastructure with sufficient bandwidth could open up possibilities for lifelong learning and re-learning, ultimately redefining how people lived and used their time. NCB saw this challenge as using IT to enable Singapore to become a learning nation:⁶

In 1981, the original National Computerization Effort, which led to the establishment of the NCB, called for the development of a national core competence in computer software technology. In 1986, the National IT Plan set out to integrate this budding software competence with communication technology to create world class applications of information technology. In 1991, the IT2000 masterplan sought to integrate the computing and communication technologies with the sectoral knowledge of over 200 senior executives from industry, government, and academia to generate a vision of Singapore as an Intelligent Island with advanced information infrastructure.

Every new stage of master planning was a major organizational learning experience for the NCB. The implementation of each master plan needed major organizational reengineering. Having experienced the stages of reinvention and reengineering, the NCB can help Singapore become a learning nation in the emerging global knowledge economy. We welcome the "learning, relearning, and unlearning" challenge posed by the emerging knowledge economy. We are committed to enabling this through IT.

Tan Chin Nam, then chairman of NCB,⁷ and Ko Kheng Hwa, NCB's chief executive, chaired a special Library 2000 Review Committee to explore the role of libraries in the next phase of Singapore's economic development. The committee's report, which the government accepted for implementation, sought to position libraries as an integral part of a national system supporting Singapore as a learning nation:⁸

We must expand Singapore's capacity to learn faster and apply knowledge better than other nations. This differential lead in our learning capacity will be crucial to our long term national competitiveness. . . . An advanced National Information Infrastructure being developed under the IT2000 plan will provide a new generation of information superhighways to distribute information and knowledge to empower individuals to perform optimally in our learning nation. All our libraries should be plugged into the NII, serving as nodes, switching centers, and access points for information and knowledge. This network of borderless libraries will provide our people with easy access . . . to information resources . . . in Singapore and overseas.

⁶ Chairman's Statement in NCB Yearbook, 1992/1993.

⁷Tan Chin Nam has been with NCB since its inception, first as General Manager, and then its Chairman till 1994. The current Chairman of NCB is Lim Swee Say.

⁸*Library 2000: Investing in a Learning Nation*, published by the Ministry of Information and the Arts, 1994.

Yet Singapore faced a basic dilemma in this regard: how to enhance learning capacity while maintaining strong social control. A promotion of learning inevitably would lead to greater reflection, questioning of the status quo, challenges to authoritarian structures, and alternative or conflicting viewpoints—all processes generally deemed necessary for developing better and more creative options and solutions to problems. How would this reconcile with promoting Confucian values, which encouraged deference to authority and discouraged the use of disagreement as a means of creating better alternatives?

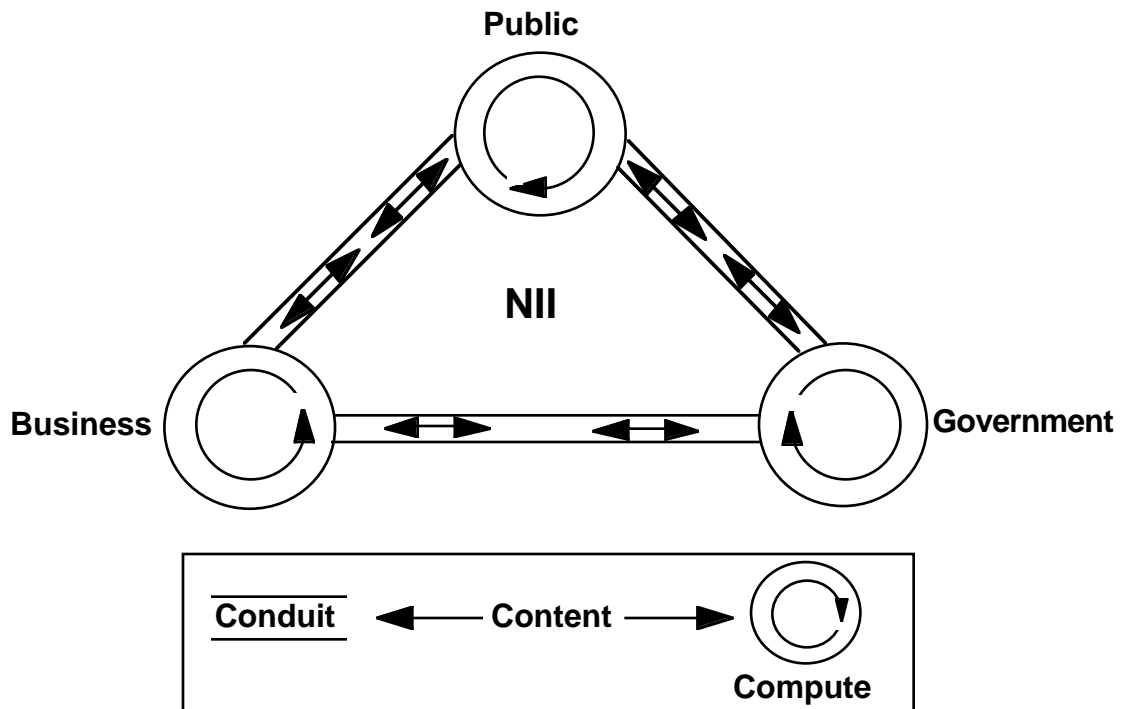
The Challenge

The “intelligent island” vision was more than a technical project, although its technical challenges were by no means trivial, and its implementation would generate economic, social, and political consequences. Assumptions about the availability of easy-to-use information appliances and the cost of accessing information services when they became available would be key in determining the ultimate use of anticipated IT2000 services in homes and by private individuals. NCB was trying to be the coordinator that would tap creative ideas and collaborative efforts between government agencies and business firms, and among industry groups in developing common applications for the IT2000 platform. Some potential contributors among the business firms that were accustomed to relying on the government to take the lead were sitting on the sidelines, however, rather than participating actively. And some IT vendors hoping to profit from IT2000 had been disappointed because of the long development period. In the meantime, the IT2000 vision captured the imagination of many countries, which were using it as a model for their own IT plans.

Another issue that could pose a significant challenge to the realization of the intelligent island vision was how the population’s relatively low educational level would affect the literacy skills required to achieve the IT2000 vision. The government implemented a policy requiring a minimum of 10 years education and targeted 60% of each cohort to complete tertiary education, but the effects of increased education would take time to filter through.

Efforts in building an information infrastructure had already paid dividends, of course, as more MNCs like Citibank, HP, and Reuters established regional data hubs and data center operations in Singapore. But, Singapore’s ability to extend the range and reach of its network in the region would also depend on telecommunications evolution as well as political developments in the regional countries. It remained an open question whether IT2000 would enable Singaporeans to enjoy a higher quality of life; whether it would allow businesses to manage and coordinate regional operations out of Singapore, enable people to maintain relationships while working and traveling in regional countries, and turn Singapore into a global city and hub for the transshipment of people, goods, services, and information.

No one doubted the seriousness with which the IT2000 vision was viewed and the commitment of the government to implement it; Singapore had surprised the world many times in its short history. Such NCB leaders as Philip Yeo and Tan Chin Nam had built their reputations on attempting and successfully implementing enormous, high-risk projects. As a result, NCB’s dare-to-do attitude was winning many admirers. Nevertheless, Singapore faced many social dilemmas in its quest to be an intelligent island and a learning nation. Constraints led to interesting social innovations in the past: Would Singapore be able to find equally creative solutions to its social dilemmas in the future? The intelligent island vision seemed set to be implemented, even if few people knew what the result would look like.

Exhibit 1 Components of the National Information Infrastructure (NII)

The **Telecommunication Networks** consisted of both cable and wireless networks, partly under the purview of Singapore Telecom (ST) and partly under the Singapore Broadcasting Corporation (SBC). The **National IT Application Projects** consisted of applications that could be implemented using telecommunications networks of the early 1990s and those that would require the higher bandwidth and wireless features of future networks.

Common Network Services were value-added services implemented mainly through software. They imposed the standards necessary to enable users to exchange information and perform transactions in a secured, reliable and compatible environment. These included user authentication, user and service directories, network security and central billing.

Technical Standards, based mostly on international standards, were applied to the telecommunication networks, the common network services, and the national IT application projects. They ensured seamless and harmonious interaction across the infrastructure.

The **Policy and Legal Framework** would help address non-technological issues such as data protection and intellectual property rights.

Source : *IT Report*, published by the National Computer Board in April 1992