Leveraging information technology to achieve the IT2000 vision: the case study of an intelligent island

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Abstract. Although many developing and developed countries have major initiatives to promote the use of information technology (IT), Singapore is one of the few countries which not only has a comprehensive IT2000 vision, but which is also taking proactive steps to make the vision a reality. This paper examines how Singapore is currently leveraging IT applications to achieve the IT2000 vision. It also explores some of the uses of IT that will be deployed in the near future. Specifically, this paper discusses the use of IT applications to provide one-stop, non-stop government and business services, promote cashless transactions, provide more options for leisure, and facilitate easy commuting.

1. Introduction

Arising from the recession that affected Singapore in 1985, the government set up an economic committee to (1) review the progress of the economy; (2) re-examine the fundamentals which underpinned the viability of the economy; and (3) identify new directions for future growth (Wong 1992, Goh et al. 1993). Information technology (IT) was recognized as a potential resource for improving Singapore’s productivity and competitiveness in the world market. A National Information Technology Plan (NITP) was mapped out to provide directions for a seven pronged integrated approach to exploit IT in Singapore. Briefly, this approach sets directions for building a strong IT industry, encouraging use of IT applications, improving quality of IT manpower, building an information communication infrastructure, educating individuals and businesses about IT, promoting creativity and entrepreneurship, and coordination and collaboration of the efforts of different organizations in promoting IT (Liang 1993, Wong 1992).

Five years after the formulation of NITP, the government felt that a more action oriented IT plan labelled as IT2000 vision was needed. The IT2000 vision was the result of a widespread and rigorous study involving eleven major sectors, namely construction and real estate, education, financial services, government, healthcare, IT industry, leisure and tourist services, manufacturing, publishing and media, retail, wholesale and distribution and transportation. The study tapped the expertise of more than 200 senior executives in both the private and public sectors in examining how IT can be used to realize the vision of an intelligent island by improving economic and business performance as well as the quality of life in Singapore (NCB 1992).

In the IT2000 vision, Singapore aims to be among the first countries in the world with an advanced nationwide information infrastructure which will interconnect computers in virtually every home, office, school and factory. The use of IT will be pervasive in improving business performance, making working life easier and more productive, and enhancing options for leisure and recreational activities.

Singapore has no natural resources. Its only natural resource is its people. Consequently, the adoption and implementation of new technologies plays a crucial role in leveraging human resources in Singapore. The government firmly believes that IT can be used to improve productivity, increase national competitive advantage and enhance the quality of life in Singapore. This paper is an informed discussion by the authors on some of the IT applications that are currently being implemented to achieve the IT2000 vision. It also explores IT applications that will be used in the near
The implications of various IT applications are also discussed.

2. Towards IT2000 vision

The use of IT to achieve the IT2000 vision in Singapore will be examined in terms of four broad areas, namely:

(a) One-stop, non-stop government and business services;
(b) Cashless transactions;
(c) More options for information and leisure; and
(d) Easy commuting.

Each of these four areas will be discussed in the sections that follow.

2.1. One-stop, non-stop government and business services

An important aspect of the IT2000 vision is the development of a National Information Infrastructure (NII) to interconnect every home, business, and government agency; and the provision of one-stop, non-stop business and government services. Table 1 shows the use and implications of IT to provide one-stop, non-stop business and government services.

In line with the IT2000 vision, IT is viewed as a key enabler in the delivery of integrated public services. The National Computer Board (NCB) plays a key role in facilitating the computerization of major government agencies and statutory boards. Staff from NCB work closely with various government agencies in their tasks of planning and managing IT programs. NCB develops and establishes overall civil service IT master plans, IT standards, policies and practices. Consequently, their role is analogous to an overall government chief information officer to the various government agencies.

As the result of this central role, NCB is better able to facilitate more effective coordination and collaboration among various government agencies, thereby resulting in integrated services to businesses and the public. To date, about 800 systems costing S$655 million have been developed and implemented in the civil service. The civil service computerization programme aims to leverage IT to reengineer work processes, streamline workflow and enhance productivity. As well, the government hopes to make the civil service one of the most efficient in the world with improved services in terms of convenience, friendliness, accessibility and availability to the public and businesses (NCB Year Book 1994/1995).

Perhaps the most well known IT application in Singapore to provide one-stop, non-stop service is TradeNet. TradeNet, implemented in 1989, is the first electronic data interchange (EDI) application in the world that is implemented on a national scale to link all parties involved in international trade (Wong 1992). TradeNet significantly speeds up the clearance of trade

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<tr>
<th>IT applications</th>
<th>Implications</th>
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<tr>
<td>Civil service computerization</td>
<td>Improves productivity.</td>
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<td></td>
<td>Streamlines workflow.</td>
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<td>Electronic data interchange</td>
<td>Improves customer service</td>
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<td>TradeNet</td>
<td>Improves convenience and accessibility.</td>
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<tr>
<td>LawNet</td>
<td>Electronically links up parties involved in trade.</td>
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<td>Faster clearance of trade documents.</td>
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<td></td>
<td>Operational 24 hours a day, 7 days a week.</td>
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<td>Enhances Singapore as the hub for trade and OHQ.</td>
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<td>CoreNet</td>
<td>Creates/maintains jobs in trade related professions.</td>
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<td>Trading firms benefit in terms of savings in labour,</td>
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<td>inventory and document overheads.</td>
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<td>Imaging technology</td>
<td>Electronically links up the construction and real estate</td>
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<td></td>
<td>Streamlines process of designing and constructing buildings.</td>
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<td>Reduces turnaround time in development projects.</td>
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<td>Enables local construction companies to be more</td>
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<td>productive and to compete more effectively.</td>
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<td>Automated machines</td>
<td>Faster search and retrieval of files.</td>
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<td>PAM</td>
<td>Reduces paper flow.</td>
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<td></td>
<td>Increases productivity.</td>
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<td>Improves customer service.</td>
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<td>More than one staff can access same document at the same time.</td>
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<td>Oscars</td>
<td>Increases convenience for reporting of change of address.</td>
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<td>Reduces incidence of undelivered mail due to wrong</td>
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documentation by different agencies by enabling documents to be sent electronically 24 hours a day, 7 days a week. Trading firms reported substantial savings in labour and inventory holding costs as well as 20–30% savings in documentation overheads (Neo 1994).

Although TradeNet was developed with the aim of serving the needs of the business community, it does indirectly impact on the quality of life in Singapore. Traditionally, Singapore has made use of its strategic location and natural deep harbours to facilitate international trade. TradeNet has helped Singapore maintain its traditional trading activities and consequently also helped to spur economic growth since trade plays a major role in Singapore’s economy. By helping to develop Singapore as the preferred seaport or airport in Asia, TradeNet has also helped to create or maintain jobs in the shipping and airline industries. Furthermore, since goods can flow freely into Singapore for trading, it becomes relatively convenient for Singaporeans to obtain goods from other parts of the world.

Teo et al. (1995) found that all participants in TradeNet, regardless of organizational characteristics benefited from enhanced organizational efficiency in terms of preparation cost, exchange cost and document flow. Furthermore, early participants in TradeNet and those who integrated TradeNet with their internal systems benefited from increased organizational effectiveness in terms of international competitiveness and inventory control. The results suggest that greater benefits may be derived from EDI applications by taking a proactive approach towards IT deployment.

By facilitating faster turnaround time as well as by making it easier, and more cost effective for traders to do business in Singapore, the government hopes that Singapore will become the operational headquarters (OHQ) for multinational companies (MNCs) doing business in Asia. In addition to such technological developments, the government also offers tax incentives to MNCs who establish their regional OHQ in Singapore (East Asian Executive Reports 1993b).

TradeNet’s success was internationally recognized when the Society for Information Management awarded it the Partners-in-Leadership award in 1989. The success of TradeNet resulted in other EDI applications being developed e.g., LawNet for the legal community and CoreNet for the construction and real estate community.

LawNet is a nation-wide computer network launched in 1990. It allows the legal community to obtain information on civil suits filed at the courts, Singapore statutes, case laws, bankruptcies and other court matters through their office computers. In addition, the LawNet’s InteReq (Integrated Legal Requisition System) allows law firms to carry out some of the searches involved in property transaction, e.g., finding out if a property will be affected by public works in the future. This on-line system is expected to halve the time taken by the old method, which involves filling out forms manually.

CoreNet is a S$185 million, 8-year project launched in September 1995 to radically speed up and streamline the entire process of designing and constructing buildings. In addition to facilitating the exchange and processing of documents for regulatory approval, the system will also provide one-stop access to a wide range of information from property prices to land development information. The first CoreNet application, scheduled for implementation in 1997, is an expert system called BP-expert that automates the checking of building plans (NCB Yearbook 1995/96). When CoreNet is fully implemented by 2003, it is expected to reduce the total time taken to develop a building by 25%.

By linking the construction community, the system will reduce turnaround time for developers, and promote higher productivity (Williams 1995), thereby facilitating better quality and more affordable buildings for the public. Consequently, CoreNet will also enable local construction companies to improve their competitive advantage regionally. On a broader view, the system may also help to attract foreign investments due to shorter turnaround time from approval of building plans to construction of buildings. It is therefore apparent that even the traditionally low IT intensive construction sector in Singapore is also beginning to harness strategic applications of IT (Betts et al. 1991).

Other IT applications to provide one-stop, non-stop services include the adoption of imaging technology that will enable transactions to take place more rapidly. For example, imaging technology has been successfully implemented in November 1991 by the Registry of Companies and Businesses (RCB). Benefits from the auto registry system using imaging technology include fast search and retrieval of files, reduced paper flow, 100% increase in productivity, 200% reduction in turnaround time for 95% of correspondence, and 400% increase in compliments for good service (Chang 1995).

Similarly, the Inland Revenue Authority of Singapore (IRAS) is embarking on a project to digitally scan and store personal and corporate tax returns and supporting documents. This will enable the IRAS to reduce the amount of paper being moved around and also allow more than one tax officer to access the same file at the same time. Hence, tax enquiries by the public or businesses can be handled more quickly and efficiently.

Automated machines are also developed to enable transactions to take place both during and after office hours. For example, Singapore Post Office has installed
several Postal Automated Machines (PAM) that help to serve customers. A friendly face in video guides the user step-by-step to complete the transaction. Colour graphics and simple instructions make the system very easy to use. Users can buy stamps, envelopes, aerograms and postcards from PAM. In addition, they can also pay fines for parking offences. PAM also allows users to access information regarding the latest postal rates and even the latest books available at the National Library. Users can either pay by cash or electronically. Since PAM operates 24 hours a day, it offers greater convenience to customers since there is no need to queue up or rush to the post office before closing time. Hence, PAM benefits Singapore Post in the form of shorter queues, thereby enabling postal staff to provide better service. In addition, PAM is also more cost effective and helps to reduce space and manpower required at post offices (Kon 1994).

Another innovation to provide one-stop, non-stop service is the development of the multimedia information kiosk network called Singatouch. Singatouch is one-stop because transactions with different government departments can be done at one kiosk, and non-stop because the public can conduct transactions with the various government agencies 24 hours a day, just like banks' automated teller machines (ATMs). Singatouch also allows users to pay parking fines (Singapore Enterprise 1995) and even bid for Certificate of Entitlement (COEs) to purchase motor vehicles. Such kiosks improve the quality of life by offering a convenient means for the public to conduct transactions and therefore allowing better use of free time for more productive pursuits.

The government has also implemented the One-Stop Change of Address System (Oscars) for the public to register their new addresses when they move to another place of residence. All they have to do is to bring their identity card to the National Registration Office or any police station. Once their new address is keyed into the computer, other government agencies and statutory boards will automatically be notified of the new address. Previously, Singaporeans who moved house had to write separately to the various government agencies to inform them of the change in their address. Hence, this system not only makes it convenient for the public to report their new address but it also saves time and effort to do so. Government agencies also benefited since the system reduces the problem of undelivered mail due to outdated mailing addresses.

Under the concept of ‘virtual government’, plans are currently underway to install video-conferencing booths at selected town centres to enable the public to carry out transactions with government agencies and statutory boards. Hence, instead of dealing with a machine, the public can actually interact in real-time with staff from government agencies using the video conferencing booths. This system will save time as well as make it convenient for the public to interact with government agencies since they need to travel only to the nearest town centre where video conferencing booths are available (Straits Times 1995b). The ultimate aim is to deliver integrated electronic government services to the public, thereby making it easier and more convenient for the public to interact with government agencies.

In July 1995, the government launched a programme called ‘Public Service for the 21st Century’ (PS21), to further improve government-related services to businesses and the public. The government hopes to re-engineer the civil service to make it more responsive to the needs of both businesses and the public. IT-related applications will be used whenever possible to streamline workflow and make it more pleasant and convenient for people to interact with government agencies.

One major characteristic which distinguishes Singapore from other countries is that the government is not only very proactive in leveraging IT, but has also acted boldly and imaginatively in devising policies and programs to ensure that IT applications are implemented successfully. In the long run, with a more responsive civil service, businesses will find it ideal to establish their OHQ in Singapore as a springboard for venturing into the Asia Pacific region. This will lead to the growth of the economy and consequently also contribute to better quality of life in Singapore. In fact, Singapore was the only non-US government body to be cited by CIO Magazine for its excellence in delivering outstanding customer service through civil service computerization (Straits Times 1993).

2.2. Cashless transactions

Table 2 summarizes the use and implications of IT to promote cashless transactions.

One of the oldest forms of cashless transaction in Singapore is the GIRO service. In the 1970s, the GIRO service was designed to enable the public to settle conveniently and without charge, bills of electricity, water, gas, telephone, property tax, rental and conservancy charges of public housing by automatic electronic transfer of the billed amount from their savings account in the bank. Over the years, more government as well as private organizations have used GIRO to facilitate easy collection of payment. The latest development is the use of GIRO farecard for travel on public transport. With the GIRO farecard, electronic transfer of funds from bank account to the farecard can be made.
The impact of GIRO on the public is substantial. GIRO has rendered it unnecessary for people to queue up to pay bills or worry about forgetting to pay bills, thereby incurring financial penalties. Once a standing order is made, a specific amount can be deducted from the bank account on a particular date. The account holder is able to ensure that no unauthorized deductions are made since an account statement is sent to them every month. Since the amount due is deducted exactly on the due date, the account holder saves interests on his bank deposits.

GIRO has also affected businesses in that manpower and other resources are saved since payments are done electronically both to and from their bank accounts. There is therefore a large reduction in the manual processing of payment and handling of cash, thereby resulting in savings in terms of paperwork, time and manpower. Cash flow accounting is also more predictable and timely since organizations can expect to automatically receive payments by the due date. By making it more convenient for customers to pay their bills, organizations may in turn attract new customers and enhance their earnings.

Although GIRO started more than twenty years ago, it still plays an important role in Singapore’s IT2000 vision of moving towards a ‘cashless society’. The government has continued to encourage the use of GIRO by individuals and organizations by including more categories of payment that can be processed electronically. In fact, the salaries of most employees in government-related services are paid through GIRO. Hence, if less manpower, time and resources are required for collection, handling and processing of payments and cash in our society, such savings can be channelled to making Singapore a more productive society.

Another innovation that has affected Singaporeans significantly is the Network for Electronic Transfer System (NETS). NETS evolved from the idea of Electronic Fund Transfer at Point of Sale (EFTPOS) whereby, at Automatic Teller Machines (ATM), card-holders can authorize fund transfer through the use of a Personal Identification Number (PIN). Hence NETS allows ATM cardholders to buy and pay for goods and services electronically at participating outlets such as supermarkets, petrol stations, restaurants, retailers and government agencies. NETS differs from GIRO in that it requires the use of an ATM card and a PIN.

NETS is gaining popularity among businesses in Singapore because it makes it more convenient for customers to purchase goods and services. Customers do not need to carry large amounts of cash for their shopping. With NETS, shoppers are not restricted by banks’ operating hours or the need to search for ATM machines if they have insufficient cash. There is also practically no fear of unauthorized transactions since all transactions are made using a PIN. Since funds are transferred electronically, there is less danger from losses due to thefts, robbery or fire. In fact, the number of transactions using NETS has almost doubled from about S$56 million in 1986 when it was first launched to about S$100 million in 1995 (Sunday Times 1995).

Currently, there is a proliferation of different types of cards in Singapore ranging from credit cards, cards from different retailers and restaurants, bank cards to prepaid cards like phone cards, MRT (mass-rapid transit) cards, and cinema stored value cards. Singapore is currently pilot-testing a smart CashCard which it hopes will be a multi-purpose card that will replace all existing cards. In other words, the CashCard can be used, interchangeably, as a credit card, or to withdraw money from ATMs as well as for NETS transactions. The CashCard aims to offer a good substitute for cash by providing the public with an easy and convenient way to pay for goods and services. Hence, the CashCard can be used almost anywhere including cinemas, telephones, petrol kiosks, supermarkets, restaurants, car parks and department stores. When the cash value is low, the CashCard can be topped up at specially adapted ATMs located at banks, post offices, public areas and petrol kiosks. The CashCard differs from NETS in that no PIN is required. This means that transactions can be processed more quickly. With NETS, transactions may slow down slightly since the customer has to key in their PIN. Since the CashCard has no PIN, if it is lost, anyone can use it.

The government also plans to develop a smart card for tourists called the Singapore Tourist Card (STC).

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<tr>
<td>GIRO</td>
<td>Increases convenience since settling of bills is done electronically and automatically on due date. Customer saves interests since payment is made on due date. Reduces manual processing of payment and handling of cash. More predictable and timely cash flow accounting.</td>
</tr>
<tr>
<td>NETS</td>
<td>Increases convenience for payment of goods/services.</td>
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<tr>
<td>CashCard</td>
<td>Increases convenience and faster processing of transactions. Increases convenience for tourists.</td>
</tr>
<tr>
<td>Smart card for tourists</td>
<td>Reduces paperwork.</td>
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<tr>
<td>Electronic procurement and payment system</td>
<td>Improves productivity.</td>
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The STC will be used for purchases, bookings of tickets for arts and cultural events, and access to popular places of interests. Refund of Goods and Services Tax (GST) for tourists can also be made through the smart card.

The technology used in cashless transactions like GIRO and NETS is not unique to Singapore. However, one of the main reasons why cashless transactions are successful in Singapore is because the government takes deliberate steps to publicize and educate the public on the benefits of cashless transactions. By promoting cashless transactions, the government hopes to reduce the costs associated with printing, counting, distributing, collecting and protecting cash. Furthermore, the move to develop a national CashCard indicates the government’s strong commitment to realizing its vision of a ‘cashless society’.

The move towards a ‘cashless society’ may also help to encourage the ‘paperless’ office. For example, an electronic procurement and payment system is currently pilot-tested at two sites, namely the Ministry of Health’s Pharmaceutical Department and the Ministry of Finance’s Budget Division. The aim of this system is to reduce paperwork by streamlining and automating the procurement and payment processes in the civil service (NCB Year Book 1994/1995).

2.3. More options for information and leisure

The IT2000 vision also outlines various options for leisure such as providing multilingual and multimedia leisure and cultural information for both Singaporeans and tourists. The aim is to make it easier and convenient to tap the vast repositories of information and services in order to facilitate more productive work, and enhance personal, social, recreational and leisure options in Singapore. Table 3 summarizes the use and implications of IT to provide more options for information and leisure.

A pilot scheme for Video-on-Demand (VOD) is currently being implemented in a housing estate in Singapore. VOD provides movies on television through phone lines. The subscriber can select a movie from a wide selection of titles and watch it at his convenience. In other words, VOD is actually an electronic video rental service that is available 24 hours a day, 7 days a week. VOD will be implemented nation-wide if the pilot project is successful.

Another IT application is Teleview which is a public, interactive information service that delivers both text and television-clear colour graphics. While Singatouch is designed for the man-in-the-street, Teleview caters mainly for home and office users. Users must have a personal computer (PC) and modem to access Teleview.

Currently there are about 15,000 subscribers from all walks of life accessing a database of more than 140,000 pages containing information on business and finance, lifestyles, games and education. Subscribers can use Teleview to do on-line banking, research on companies, check both local and foreign news, read articles on lifestyle trends, play games, book holiday packages, chat on-line with friends, do virtual shopping, book tickets for cultural events, check stock market share prices, check lottery results, etc. A similar service that is offered using television is INtv. Unlike Teleview, INtv is not interactive, though the range of information offered is similar to Teleview.

Related to the objective of allowing the public better access to information, the government has embarked on a Library2000 master plan for developing library services. When this plan is fully implemented, the public will have access to information via a network of more than five hundred local and overseas libraries from any public library or even from the comfort of the home. More libraries will be built to involve the local community. Residents and businessmen will be involved in the development and running of the new library system. Library2000 will provide Singapore with information, knowledge and technology which will assist Singapore towards its aim of greater economic success, more sustainable national competitive advantage and better quality of life.

As we move towards Library2000, some of its plans have been implemented. For example, the public information kiosk, Singatouch, discussed earlier, is available at branches of the National Library. Information about the latest book arrivals, dates of library

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<tr>
<td>Video-on-demand</td>
<td>Increases convenience for video rental.</td>
</tr>
<tr>
<td>Teleview</td>
<td>Interactive service that provides a wide range of information.</td>
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<td>Library2000</td>
<td>Facilitates public access to information.</td>
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<tr>
<td>INFOMAP</td>
<td>Electronic links between local and foreign libraries.</td>
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<tr>
<td>Student-teacher</td>
<td>Easier access to business information and market intelligence.</td>
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<tr>
<td>workbench</td>
<td>Provides wide range of information about Singapore on the Internet.</td>
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<tr>
<td>Leisure and</td>
<td>Facilitates more effective teaching and learning.</td>
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<tr>
<td>information system</td>
<td>Facilitates easy access to information.</td>
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<td>Improves IT literacy.</td>
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|                        | Facilitates access to information about current leisure and cultural events.  
|                        | Promotes Singapore as a tourist destination.      |
programs and activities can be easily accessed through a user-friendly touch screen interface.

Under the Library2000 plan, a one-stop centre for business information and market intelligence will also be established. The Trade and Investment Information Centre (TIIC) of the Trade and Development Board (TDB) will play a leading role in establishing Singapore’s Central Business Library by forging electronic linkages with various business information centres and libraries in Singapore, e.g. the libraries of the Economic Development Board (EDB), National Computer Board (NCB), National University of Singapore (NUS), Nanyang Technological University (NTU), Institute of Southeast Asian Studies (ISEAS) and Jurong Town Corporation (JTC).

In addition, linkages to various local and international on-line databases will enable easy access to a wide variety of business information (Singapore Enterprise 1993). The public will be able to subscribe to personalized information services whereby one will be ‘alerted’ when specific information becomes available. Plans are also underway to locate public libraries within shopping centres in order to make it more convenient for the public to access library facilities. By facilitating easy and convenient access to pertinent information, Library2000 will enhance the quality of life and enable Singapore to compete more effectively in this information age.

Singapore is currently linked to the world-wide global network called the Internet, where PC users can access a wide range of information from individuals, businesses, government agencies and libraries around the world. To provide more information to tourists as well as businesses, the Singapore INFOMAP was launched on the Internet. The INFOMAP provides information on Singapore’s media, arts, and culture, sports and leisure, government and politics, education and research, community, society and health, and business and economics.

In order to encourage the use of IT to enrich teaching and learning, a S$10 million pilot multi-media project known as the Student Teacher Workbench (STW) is currently underway in six secondary schools. A wide range of reference documents, teaching materials and self-study materials can be accessed on-line by both teachers and students. On-line video clips, quizzes and interactive experiments make the process of teaching and learning science interesting and fun. Hence, teachers will be able to use multimedia presentation to better explain abstract concepts to students as well as customize teaching materials and assignments to suit students’ learning abilities. Students can access multi-media materials to prepare for assignments and seek knowledge. Ultimately, the system will enhance the effectiveness of teaching and learning in schools as well as instil IT fluency among students at a relatively young age.

An important IT application that is currently under development is the Leisure Information and Reservation System (LIRS) which is a network that links the various players in the travel and tourism industry including travel agents, hotels, transport operators, Singapore Tourist Promotion Board (STPB) and tourism trade associations. The system will support both inbound and outbound tourism activities, publicize conventions, facilitate ticketing for events and booking of sports facilities. More importantly, the system is designed to be linked to other travel-related systems, thereby making information about Singapore available globally and promoting Singapore as an attractive tourist destination in Asia.

With this system, Singaporeans or tourists will be able to buy tickets for places of interest or theatre performances through automated machines which will also double as an information provider in terms of current events as well as tourism products and services. The system is designed to be interactive and will allow Singaporeans and tourists to view local attractions and events, and purchase tickets for tours. This system improves the quality of life by facilitating hassle-free booking and purchase of tickets for events.

The move to create more options for leisure has implications for both foreigners and Singaporeans. It may attract more tourists to visit Singapore, thereby stimulating the economy and creating or maintaining jobs in tourism-related industries. Also, the workforce can be more productive when there are opportunities for them to relax after a hard day’s work. In addition, with greater exposure to arts and cultural events, Singaporeans can learn to appreciate and enjoy the finer things in life.

2.4. Easy commuting

Traffic problems in neighbouring cities such as Hong Kong, Jarkata and Bangkok have prompted the government to take bold steps to ensure smooth flow of traffic in Singapore. The government realizes that traffic congestion results in high economic costs in terms of lost manpower hours, disruption of road distribution networks and increased emission of pollutants from vehicles. As a result, it officially set up a new statutory board in 1995 called the Land Transport Authority that is responsible for overseeing all land transport policies and infrastructure.

Table 4 summarizes the use and implications of IT to provide easy commuting.
One of the measures to reduce traffic congestion is the Electronic Road Pricing (ERP) project. Briefly, ERP is an island-wide system with automated vehicle detection and debiting system that is designed to allow more cars on our limited road space without causing traffic jams. ERP fine-tunes the traffic flow by using differentiated pricing based on when and which roads are heavily used by motorists. The ERP system is expected to cost at least S$38 million for the first five years. It is designed as a solution to congestion in areas like the Central Business District (Leong 1995).

The potential benefits of the system are smoother flows of traffic as well as savings in terms of manpower required to control traffic flow. However, the ERP system is likely to increase the cost of owning a car since every time a motorist uses it to travel on popular roads, he/she has to pay. It is currently debatable whether the system actually improves the quality of life. On the one hand, smoother flow of traffic and less congestion will make driving more pleasant and enjoyable. On the other hand, the increased costs of car usage may deter motorists from using their vehicles and opt for public transport instead.

From a broader viewpoint, having an efficient road system is crucial for businesses. It has been estimated that traffic jams in cities like Bangkok and Manila are costing the economy millions of dollars in wasted time and productivity. However, with ERP, businesses can be assured of smooth traffic flow, though they may have to pay more in terms of higher vehicle operating expenses, since use of major roads will be taxed.

Other IT-related commuting applications include the development of electronic information boards at bus stops. With the use of roadside microwave beacons to detect signals from a transponder located in passing bus, the arrival times of buses are estimated by a central computer and fed back to the various electronic information boards located at various bus stops. This enables waiting commuters to know fairly accurately the estimated arrival time of buses, and thereby allows them to decide whether to opt for alternative transportation if the bus is late. Furthermore, commuters can have more confidence in the reliability of bus services. Currently, pilot testing of the information system is being carried out at selected areas.

In addition to electronic information boards, plans are also underway to provide selected bus stops with water-coolers, telephone booths, farecard machines and pre-payment machines to allow commuters to pre-pay before boarding (Seow 1995). The aim of providing these services is to make travelling on public transport a pleasant experience so that commuters will opt for this mode of transportation, thereby reducing the number of private cars on the road.

Also under consideration is a satellite system that enables monitoring and tracking of buses as well as transmitting the arrival time to electronic information boards at bus stops. The system provides real-time information on passenger loading so that more buses can be despatched if necessary. In addition, the system can also alert the bus company when a bus breaks down. The bus company benefits through better deployment of buses, and the public benefits through knowledge of arrival times as well as more reliable service.

Similarly, a satellite tracking and booking system for taxis is currently being implemented. This system is believed to be the first in the world for taxis. Terminals which are linked to the control room will be placed at popular shopping centres, hotels and other busy spots. Passengers can then request for a taxi using the terminal. The computer identifies the location of the request, tracks down the nearest taxi, and dispatches it to the caller. The commuter benefits through reduced waiting time for taxis. The company also benefits since taxis can be more efficiently deployed.

Regular taxi users can get taxis faster if they register with the taxi company. Upon registration, they will receive individual personal identification numbers (PINs) which will allow them to bypass the radiophone operator. The commuter merely needs to follow a set of pre-recorded instructions over the telephone to know which taxi is assigned to pick him up.

The feasibility of an electronic monitoring system that provides motorists with information on traffic flow is also currently being studied. Detectors placed on major roads and expressways warn control centres of unusually slow traffic speeds. Surveillance cameras placed at

<table>
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<th>IT applications</th>
<th>Implications</th>
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<tr>
<td>Electronic road pricing</td>
<td>Streamlines traffic flow through differentiated road pricing. Enables more effective use of roads.</td>
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<tr>
<td>Electronic information boards</td>
<td>Provides better information to commuters.</td>
</tr>
<tr>
<td>Transport satellite system</td>
<td>Better management through monitoring and tracking of vehicles. Improves customer service.</td>
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<tr>
<td>Electronic monitoring system</td>
<td>Provides motorists with information about traffic conditions.</td>
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<tr>
<td>Telecommuting</td>
<td>Reduces travel demand, thereby reducing traffic congestion. Encourages married women to continue working.</td>
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<tr>
<td>Integrated transport network</td>
<td>Enables more satisfying life-style. Increases convenience for use of public transport.</td>
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<td></td>
<td>Reduces need to use private transport. Reduces waiting and travel time.</td>
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strategic locations can then be activated to confirm whether there is traffic jam. A message is then sent out to electronic display panels near affected roads to alert motorists so that they can consider alternative routes (Leong 1994).

Related to the objective of easy commuting, the government is also currently investigating the feasibility of introducing telecommuting on a wider scale in Singapore. Developments in telecommunications and personal computers have made it feasible for employees to work from home or from any location, rather than only at the office. Hence, the need to travel to work can be reduced, thereby helping to reduce traffic congestion. In addition, telecommuting can also provide Singaporeans with a more satisfying life-style as well as encourage married women with children to continue working. With the availability of telecommuting, people with physical handicaps would find it more convenient to work from home. This is important due to the tight labour market in Singapore. Preliminary studies have shown that the adoption of telecommuting in Singapore can lead to a sizeable reduction in travel demand, and consequently will help reduce traffic congestion (Olszewski and Lam 1993).

The government also plans to develop an integrated road transport system, linking light rail transport (LRT) with mass rapid transit (MRT) and bus services. The aim is to make it convenient for people to use public transport, thereby helping to ease traffic congestion in Singapore. Time and costs associated with travel can also be reduced, thereby enhancing the quality of life in Singapore. In fact, the government’s spending on transport and communication has increased nearly four-fold from S$2.2 billion in 1980 to about S$8 billion in 1995 (Straits Times 1996).

3. Concluding remarks

Since the development of NITP in 1986 and the IT2000 vision in 1991, IT has been widely used by the public, businesses and government agencies. All government agencies and most businesses have participated actively by leveraging IT in their daily operations. IT would not have been used so extensively had the government not sought inputs from and involved all major industries in the private sector in its IT2000 vision. In fact, the percentage of companies (with 10 or more employees) using IT applications has increased about seven-fold from 13% in 1982 to 90% in 1994 (NCB 1994).

The government realizes that a proactive multi-pronged approach is necessary to leverage IT strategically in Singapore. Such an approach includes provid-

<table>
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<th>Table 5. Socio-economic indicators.</th>
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<td>------------------------------------</td>
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<tr>
<td>Nominal GDP (S$ billion)</td>
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<tr>
<td>Per-capita GDP (S$)</td>
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<tr>
<td>Unemployment rate (%)</td>
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<tr>
<td>Inflation</td>
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<td>Infant mortality rate</td>
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<td>(per 1000 live births)</td>
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<td>Life expectancy at birth (years)</td>
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<tr>
<td>Home ownership</td>
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<td>Literacy rate (%)*</td>
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*Figures refer to residents aged 10 years and over
progress in the standard of living as well as quality of life over the past 10 years.

Although this paper generally focuses on the use of IT to achieve the IT2000 vision, it is important to note that it is not IT itself, but the judicious and well-planned use of IT that will have the greatest impact. Unlike the United States and Japan which leave the development of their national information infrastructures to the hands of the private sector, in Singapore, the government plays a proactive central role in its vision to wire up Singapore into an intelligent island by the turn of the century. Singapore has made several significant achievements in IT infrastructure developments. For example, in 1989, Singapore became the first country in the world to offer nationwide ISDN facilities. In 1994, Singapore had developed a completely digitized network, and had among the highest fixed lines, mobile telephone and paging service penetrations in the world (Singh 1995).

The success of Singapore in encouraging IT strategically has been recognized internationally. For example, the Canadian Federal Government Auditor General’s 1994 report cited Singapore as an excellent example of how a small country managed to leverage EDI applications (e.g. TradeNet) for national competitive advantage. The report also praised Singapore for its foresight in setting up a proactive national advisory body to guide its vision for the strategic deployment of IT (Shaw 1994).

Many of the IT applications discussed in this paper are available in other countries or have already been used by more developed countries. However, a noteworthy feature of Singapore’s experience which distinguishes it from those of other developing or developed countries, is that the government has acted boldly and imaginatively in devising pragmatic policies and programs to realize its IT2000 vision. An analysis of IT policy in Singapore showed a high level of government involvement in the computerization and informatization of Singapore. This participatory role coupled with a smaller but significant regulatory and coordinating role have greatly facilitated the development and diffusion of IT in Singapore (Gurbaxani et al. 1990).

The careful and deliberate articulation of its IT2000 vision would be worthless if steps necessary to achieve the vision are hindered by resistance to change. Hence, the government is determined to effectively tackle any obstacles and difficulties in encouraging IT applications by educating the public, as well as by channeling appropriate resources to make the vision a reality. For example, the promotion of cashless transaction via GIRO was carried out through educating the public on its benefits and reassuring them of the safeguards available. To lead by example, almost all employees in government-related services are paid through GIRO.

The government also realizes that in order to make IT2000 vision a reality, collaboration among the National Computer Board (NCB) and other government agencies as well as the IT industry is crucial. In line with this, in 1995, eight industry clusters which mirror the key industry sectors, namely, construction, digital library, education, healthcare, manufacturing and distribution, new media and the Internet, public services, and tourism and leisure were established with the aim of facilitating more effective collaboration with the IT industry and user communities in identifying and deploying strategic IT applications in these sectors. In addition, a $200 million IT Cluster Development Fund was specially set up to fund and speed up IT2000 projects (IT Focus 1995).

Singapore is one of the few countries in the world which successfully exploits IT on a nationwide scale for national competitive advantage as well as enhancing the quality of life. In fact, the 1995 World Competitiveness Report ranked Singapore as the second most competitive country after the United States. Singapore is also placed among the top nations in the world in terms of strategic use of IT, computer literacy of workers and excellence in telecommunications infrastructure (Straits Times 1995a).

Singapore’s success can also be attributed to the adoption of a unified approach to IT infrastructure development complemented by intensive government involvement in championing the strategic use of IT (Lally 1994). The success of various government policies and programmes to develop IT strategically in order to promote economic growth is reflected by the fact that Singapore was classified as an advanced developing nation in 1996.

In June 1996, the Singapore ONE (One-Network-for-Everyone) project was launched by the NCB, Telecommunication Authority of Singapore (TAS) and National Science and Technology Board (NSTB). The aim of the Singapore ONE project is to build a high speed broadband network that provides the necessary telecommunication infrastructure for delivery of interactive multimedia applications and services to every home, business and school in Singapore (NCB Yearbook 1995/96). Through continued investment in telecommunications infrastructure, Singapore is poised to become the world’s most fully networked society (Hepworth 1993, Sikes 1994).

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