

Singapore's ICT Policy for the New Millenium: Implications for SMEs

Jamus Jerome Lim

Institute of Southeast Asian Studies

Abstract: This paper outlines the ICT policies in Singapore and draws implications of these plans for local small and medium enterprises in Singapore. Whilst a large literature exists on ICT policy in Singapore, currently, only anecdotal evidence is available on how these policies impact SMEs. The paper utilises an economic framework for the discussion and analysis of these policies, and concludes that future ICT policy will need to be more broad-based and flexible, in order to prevent severe market distortions from arising.

Keywords: ICT Policy in Singapore, Small & Medium Enterprises, Infocomm 21 Plan

I. Introduction

Singapore is, today, one of the world's premier business cities, being consistently ranked as one of the world's most competitive nations (World Economic Forum 2000). The government has played an active role in fostering economic development, resulting in an increase of per capita GDP of about \$1300 in the 1960s to about \$38,000 currently. This phenomenal rate of growth has largely been due to a continuously evolving industrial policy, tempered by a strong bias towards technology. This is evident from the fact that Singapore places second in Asia, behind Japan, in the degree of ICT diffusion and adoption (ISI Research 2000). This paper aims to examine the evolution of Singapore's Information and Communication Technology (ICT) policies, and in particular, those that exert an impact of small and medium enterprises (SMEs).

This paper is structured as follows. After this introduction, section II will provide some background discussion the economic motivation of ICT policy in Singapore. This is followed by section III, which will examine the development of ICT policy pertaining to SMEs, within the framework of the broader ICT plans pursued by the government. This constitutes the bulk of the paper, and also includes reflections on and interpretations of these policies. The final section concludes by suggesting strategies for future possibilities in this area.

II. Background

The economic bedrock by which government intervention in ICT policy rests is best illustrated by the theoretical literature on endogenous growth theory¹. Here, goods are grouped according to two continuums: rivalry and excludability. Knowledge and information technology is generally viewed as non-rivalrous, but, subject to the legal framework, may be either excludable or non-excludable. These concepts are summarised in figure 1.

The traditional argument for government policy is that ICT is a public good, and hence is both non-excludable and non-rival. As such, a market-based pricing and allocation mechanism is untenable, as the market will tend to under-provide ICT, since ICT yields positive externalities that accrue to society as a whole. The public sector thus the natural provider of ICT services (Low 2000).

¹ For a comprehensive review, see Aghion & Howitt (1997) or Zagler (1999). Zagler's treatment is more focussed on government role in ameliorating market failures, whereas Aghion & Howitt favour a theoretical approach.

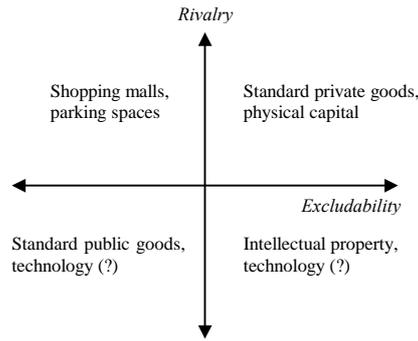


Figure 1. Rivalry and excludability.

Endogenous growth theory takes the argument a step further by introducing the possibility of intellectual property rights (through patents and copyrights) which would then move ICT to being a non-rival *but* excludable good. The surprising conclusion is that, in spite of an adequate legal framework to encourage private provision of ICT, the growth rate of the economy will still be socially inefficient, and the rate of innovation will be too low in a decentralised economy² (Romer 1990). The door is thus open to government provision of ICT.

A caveat to be made at this stage concerns Solow's (1987) (in)famous productivity paradox³. Whereas more recent evidence in the US points towards higher returns on ICT investment which began in the late 1990s (Brynjolfsson & Hitt 1996; Oliner & Sichel 2000), there is evidence that, for the case of Singapore, ICT has yielded positive returns and has contributed to its rapid economic development (Wong 2000, 2001). In a sense, therefore, the faith in which the Singapore government has placed in ICT policy has not been entirely misplaced, and indeed has yielded positive payoffs.

III. Singapore's ICT Policy

In the thirty or so years since its independence, Singapore's economic structure has been transformed from one of a labour-surplus, manufacturing-intensive economy to a highly-skilled, technology-intensive one. This section will explore the constantly evolving ICT

² The model is discussed in detail in the technical appendix.

³ The paradox basically states that, despite heavy investment in IT in the US, there has been no corresponding increase in productivity.

strategy of Singapore, in accordance to the schema produced in figure 2, with the focus on the ramifications of these policies on SMEs.

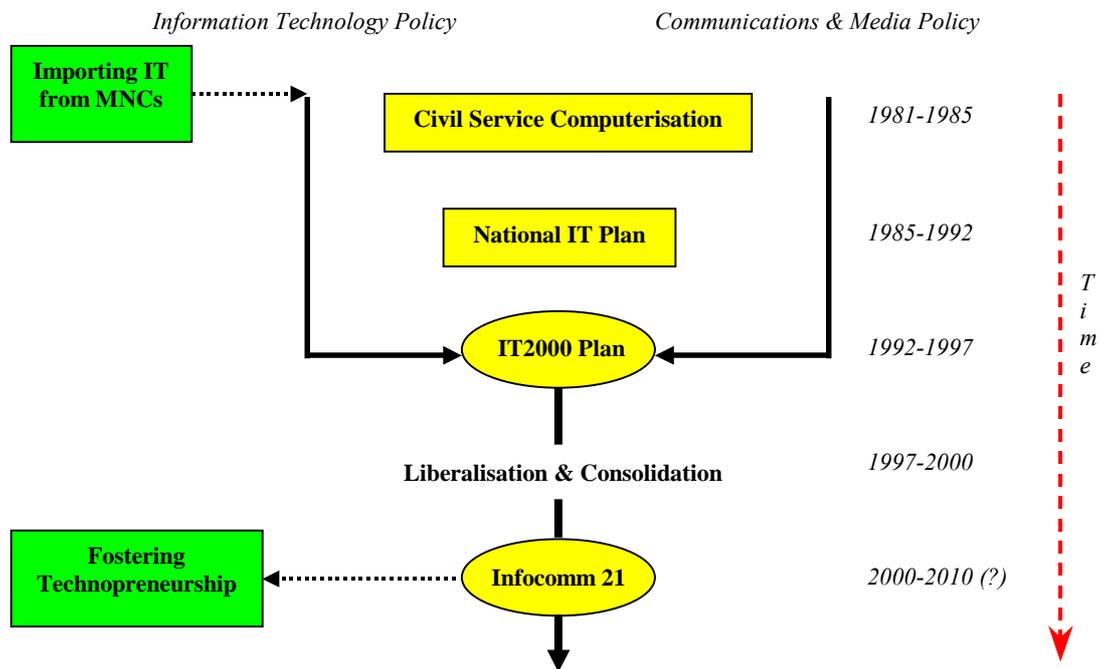


Figure 2. Singapore's evolving ICT strategy

What is most striking about the schema is the initial, discrete time paths of Singapore's Information Technology (IT) and Communications & Media policies, which, from 1997 onwards, converge into a single, consolidated policy path. This period, beginning with liberalisation within the telecommunications sector from April 1997, culminated with the merger of the Telecommunications Authority of Singapore (TAS) and the National Computer Board (NCB) in December 1999. The rest of the section will address each of these phases in turn. For the purposes of expository simplicity, these policies will be referred to collectively as ICT policy, although elaboration will be provided where the meaning is not clear in the specific context.

Phase I: Tentative baby steps

Earlier efforts of the government to embrace ICT began with the Civil Service Computerisation Programme (CSCP) in 1982, with the primary aim being to spearhead the national computerisation effort and to establish the pace for the application of IT in Singapore. This consisted of two separate waves of CSCP applications, the first in order to improve productivity within various ministries and organs of the state and the second to link and co-ordinate workings between the agencies of the civil service (Chan 1989).

Furthermore, there was a drive importing technology by towards leveraging off technological expertise from MNCs. As such, Singapore, a small, open economy with no natural resources and mainly unskilled workforce, could draw upon second-mover advantage through learning from the industrialised nations without needing explicit research and development (R&D) facilities or advanced human capital (Wong 1995).

Although the period was characterised by foreign direct investment (FDI), these two preliminary approaches to a national ICT policy set the stage for the development of SMEs in Singapore through their indirect effects. Through the open door policy, local SMEs were exposed to the forces of global competition and were therefore encouraged to strive for efficiency in operations. At the same time, the spill-over effects of technological expertise and training brought by MNCs benefited the local firms by building both the physical as well as human capital in the fledgling economy.

The CSCP set important precedents for SMEs, encouraging technology adoption by displaying the benefits of ICT as well as giving these companies the opportunity to study the new (and often costly) technology without having to commit any investments of their own. In addition, the programme also established a firm expertise base of ICT professionals from which the private sector, especially SMEs, could draw on. The test-bed approach, however, proved to be limited, as technological uptake remained low relative to larger companies⁴. The main impediments to the widespread adoption of ICT by SMEs were cited as a lack of awareness of the possible application of ICT to their particular business; confidence and know-how to implement ICT systems; and a lack of funds (Ko 1989). Nonetheless, that there has been ICT adoption by these firms showed encouraging signs for future trends. It was with this feedback in mind that SME-specific policies were mooted and which the next phase of policy sought to address.

Phase II: Learning to walk

In 1985, the government, through the NCB, introduced the National IT Plan (NITP). In it, the government outlined a seven-pronged approach to ICT strategy in Singapore. These include the development of IT professionals and experts; improvements to the information

⁴ For example, up till 1987, SMEs substantially lagged larger firms in terms of exploiting ICT. In 1987, 42% of establishments with 10 to 24 employees used computers, as compared to 88% for establishments with more than 100 employees (NCB 1987).

communication infrastructure, promotion of the ICT industry; co-ordination and collaboration between various ICT-promoting organisations; establishing a culture that welcomes ICT; encouraging creativity and entrepreneurship and increasing ICT application in workplaces (Tan *et al* 1985). It is these final three initiatives that are of particular relevance to SMEs.

One of the recommendations for establishing an IT culture involved a push for more acceptance of tele-working in society. This would allow a larger pool of labour to be tapped, lowering the marginal cost of labour and consequently the costs to SMEs, which tend to be particularly sensitive to costs, especially labour costs. Although the benefits of telecommuting are, on paper, large, the feasibility of telecommuting would probably be limited to female professionals, who would greater appreciate the flexibility offered, especially when balanced against the needs of family commitments. These conclusions have been corroborated by empirical research (Tng & Yap 1989).

The nascent attempt at encouraging entrepreneurship and creativity in the NITP focussed on developing the various R&D capabilities of Singapore and Singaporeans. The educational system in Singapore was reworked to offer greater concentration on ICT-related aspects. At tertiary level, the two polytechnics and the national university were orientated towards ICT-related training; at secondary and primary school levels, the system was restructured away from the British system to incorporate features of a German system, such as training in mathematical and technical competencies (Low, Soon & Toh 1991). Concurrently, computer awareness programmes were introduced in schools, and these were, in the main, successful (Wong 1999).

Beyond the classroom, however, R&D institutions were scarce. In 1985, outside of the university, the only other major research institute was the Singapore Institute for Standards and Industrial Research (SISIR). Gross R&D expenditure was abysmal: the 1978 expenditure of \$37.8 million (0.2 % GNP) had only increased to \$214.3 million (0.6% GDP) by 1985 and \$374.7 million (0.9 % GDP) by 1988 (SCS 1989a, b). This provided the impetus for the implementation of a National Technology Plan in 1991, aimed primarily at promoting R&D (NSTB 1991).

The benefits of this drive, being qualitative in nature, are difficult to assess. However, it is important to have an idea of the performance of this aspect of policy, since entrepreneurs are a direct link to the formation of SMEs. As a proxy, therefore, the figures for the number of new small companies incorporated between 1985 and 1991 are presented in table 1. These figures form a rough basis for an indicator of entrepreneurial fervour. It can be concluded that

these policies have had some effect, as evidenced by the upsurge in local business formation from 1985 onwards, and therefore SMEs have possibly benefited from this aspect of the NITP.

	<i>Formation</i>	<i>Companies</i>	<i>Businesses</i>
1978	5,529	1,989	3,540
1979	6,731	2,392	4,339
1980	7,194	3,146	4,048
1981	8,795	4,010	4,785
1982	8,692	3,854	4,838
1983	10,598	4,438	6,160
1984	10,358	3,399	6,959
1985	8,998	2,096	6,902
1986	11,870	2,352	9,518
1987	15,633	3,261	12,372
1988	15,803	3,373	12,430
1989			
1990			
1991			

Source: Registrar of Companies & Businesses, Singapore

Table 1. New incorporations of small firms, 1978-1991

Perhaps the most important ICT-related initiative during this period with regard to SMEs is the Small Enterprise Computerisation Programme (SECP), and its sister programme the Small Enterprise Computerised Accounting Programme (SECAP), aimed at attempting to energise SMEs with ICT in order to upgrade their business operations and meet this new challenge.

The SECP involved the provision of technical assistance to SMEs. This could either take the form of direct assistance, through technical advisors and consultants who would handhold a SME through the various stages of computerisation; or indirect assistance, when the NCB assists SMEs through their respective trade/professional associations.

In addition to technical assistance, various financial assistance schemes exist. On top of the computerisation grants offered under the SECP⁵, the small industry technical assistance

⁵ These were often very generous. Atypically, financial assistance would involve grant of up to 70% for engaging technical advisors and/or consultants, loans to purchase hardware and software at below-market interest rates, and

scheme (SITAS)/local enterprise technical assistance scheme (LETAS), the product development assistance scheme (PDAS) and the market development assistance scheme (MDAS) made it possible for the company to obtain subsidies for ICT adoption. Studies performed by the NCB indicate that the SECP has been effective in assisting SMEs in their computerisation effort (Ko 1989)⁶.

Other forms of technical assistance programmes were also introduced through the medium of government-funded centres, including, *inter alia*, the Technology Diagnostic Centre and the Design and Development⁷. Many of these schemes fell under the umbrella of the SME Master Plan (SME Committee 1989), which purposed to bring about transformation and growth through: technology adoption, application and innovation; business planning and finance; human resource management; productivity improvement & training and marketing & business partnership.

Phase III: Walking with confidence

The IT2000 Report released by the NCB in 1992 painted a vision of an ‘Intelligent Island’ based on an advanced National Information Infrastructure (NII). The report envisioned that

“... some 15 years from now, Singapore, the Intelligent Island, will be among the first countries in the world with an advanced nation-wide information infrastructure. It will interconnect computers in virtually every home, office, school and factory. The computer will evolve into an information appliance... media can be transferred and shared through this broadband information infrastructure, made up of fibre optic cables... and a pervasive wireless network working in tandem. The information infrastructure will permeate our physical infrastructure.”

(NCB 1992, p. 10)

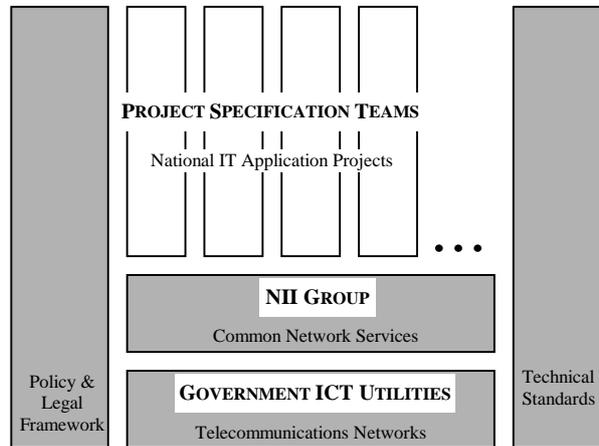
The IT2000 vision set out an ambitious plan that had a few major thrusts: an intensified development of ICT-related manpower, an improved quality of life through ICT, improved personal and community communications through ICT, and using the NII to establish a competitive advantage both within and without the island. This final aim was to be attained

tax incentives in the form of full depreciation for computer hardware in the first year and an additional investment allowance of 30%.

⁶ Subsidies, however, should always be interpreted (and implemented) with caution, as they sometimes tend to impose unnecessary distortions onto the market, not least the fact that private incentives may be displaced by excessive subsidies. A recent example with respect to R&D for the case of Israel is explored in Lach (2000).

⁷ For further discussion of government development assistance schemes, see EPC (1991).

through the provision a superior business infrastructure through R&D development and utilisation of the latest ICT technology (intra-country networking) and the positioning of Singapore as a regional hub by plugging into international business networks (extra-country networking). The fulcrum for all these strategic goals was to be the NII (NCB 1992). Figure 3 shows the overall organisational framework for the NII.



Source: National Computer Board, IT2000 Report

Figure 3. Overall organisational framework for NII

Although the report outlined an ambitious vision for the future, it did not formulate any specific projects or policies⁸. The government, therefore, agreed to fund the implementation of NII projects on an *ad hoc* basis. Moreover, the absence of concrete recommendations has necessitated a high-level steering committee to establish policy co-ordination across ministries and government bodies; this was formalised in the National IT Committee (NITC) (Wong 1996). The major IT and telecommunications projects then became the responsibility of the NCB and the TAS, respectively, with the Singapore International Media (SIM), Singapore Telecoms (Singtel), Singapore Cable Vision (SCV) and Singapore Network Services (SNS) playing major supporting roles⁹.

Although not immediately apparent, the NII has had a profound impact on SMEs in Singapore. These can be categorised into narrowband and broadband application projects: the

⁸ Although several major project ideas were mooted they lacked the specifics to make them fundable.

⁹ It should be noted that not all of these bodies either existed or were named as such during the initial stages of the IT2000 plan. For example, SCV was only formed in 1994, whilst SIM is a holding company for four subsidiaries that now perform the functions of the former SBC.

narrowband projects, which can mainly be delivered using the existing infrastructure, would benefit from enhanced efficiency; broadband projects involve advanced communication networking that would redefine existing business models.

The crowning glory of the existing narrowband NII is undoubtedly the national system for electronic data interchange (EDI) which began with TradeNet in 1989, and has rapidly grown to include CoreNet, PortNet and other EDIs¹⁰. These inevitably yield direct benefits for SMEs as they allow local firms to enhance efficiency and productivity through cost savings in labour, inventory, document overheads and search (Teo & Lim 1998).

Another aspect of the NII involves cashless transactions. First introduced in the 1970s but subsequently expanded and subsumed into the rubric of the NII, the GIRO service allows account holders of banks to place standing orders for automatic approval for transfer of funds to chosen merchants or government bodies. This greatly simplifies routine payments and saves on manpower, time and paperwork; cash flow accounting is also made more predictable and timely. The complementary Network for Electronic Transfer System (NETS) allows holders of bankcards to authorise electronic fund transfers at point of sale through keying in the account holder's PIN into a handheld unit. That this system is a success is evidenced by the fact that the terminal has become a mainstay in almost all medium-sized retail and service firms that engage in transactions with the public. Indeed, payment by NETS in Singapore has become as commonplace as payment by credit and debit cards. For SMEs, this can only be a good sign as the increased ease of payment equates to increased customer spending.

The core broadband network infrastructure was to be based on Asynchronous Transfer Mode (ATM) switching technology; this would form the backbone of the system. Local access networks would have a dual access policy: Asymmetric Digital Subscriber Line (ADSL) which would utilise the existing copper twisted paired telephone wires, and Hybrid Fibre Coaxial (HFC) cables. SingTel and SCV, respectively, would be the service providers.

Broadband network projects would impact SMEs in two main ways. First, firms can plug into the proposed Singapore ONE network. This was to form the basis for electronic commerce (EC) in the nation, linking businesses to consumers (B2C). EC would level the playing field

¹⁰ TradeNet electronically links up parties involved in trade, whilst CoreNet and PortNet serves the construction & real estate and port community, respectively. Other EDIs, such as LawNet and TechNet, exist, but are peripheral to the discussion above.

between large corporations and SMEs, as access to consumers would be equalised. Indeed, Singapore ONE

“...offers businesses a high-speed, high-capacity platform to market to a potential audience of more than three million people, a population that is recognised as having one of the highest IT literacy rates in the world. But the opportunity does not stop here - because once companies have successfully developed their business on Singapore ONE, they can use it as a springboard to penetrate other markets.”

(Singapore ONE 2000)

The EC potential offered by Singapore ONE would also work in tandem with EC opportunities on the Internet, where a wider spectrum of transactions exist in the more mature economic environment (such as B2B and C2C). An Electronic Commerce Hotbed (ECH) programme was introduced in August 1996 in response to the growing importance of this form of exchange. This early effort clearly took bold steps toward embracing EC, with SMEs being an integral part of the entire project. Incentive schemes introduced to entice companies to participate in EC include steep discounts for broadband access charges, tax incentives, grants for EC application development and subsidies for EC manpower training (Wong 1997).

B2B EC is generally conducted over the Internet. However, EC remains in its infancy. Most local SMEs cite initial and ongoing costs as well as a lack of interest as the primary barriers to adoption of Internet-based B2B (Wirtz & Wong 1999), and EC transactions account for only 0.1% of turnover of the overall economy, although its rate of increase is encouraging¹¹ (Wong & Lam 1999).

Second, but more peripheral, is the opportunity for entrants into the market of content provision. The phenomenon of Internet/EC start-ups (usually small operations) has found its way into the popular press, the business fraternity and even into everyday conversation. It should not be discounted, however, that content provision is a fiercely competitive market, as most information content on these networks are provided for free. Also, the market is not necessarily the sole domain of SMEs, as many large corporations and government bodies also provide content services.

The telecommunication policy change in the 1990s was mainly targeted and preparing for the eventual liberalisation of competition in the sector. Initial steps taken were to privatise

¹¹ E-commerce transactions in Singapore are dominated by B2B (98%). Between 1997 and 1999, e-commerce transactions increased from \$958 million to \$1.6 billion to \$1.9 billion (Wong & Lam 1999).

SingTel (achieved in 1993) and to facilitate its internationalisation in order to exploit regional and international business opportunities. An increasing number of telecommunication services were being made open for competitions, and steps were taken to bring about closer integration between the media of information technology, telecommunications and broadcasting. Wireless technologies were also being aggressively promoted in order to facilitate competition (Wong 1996).

These moves ensured that communication costs continued to fall steadily. SMEs found themselves in the favourable position of choosing between ICT providers – by 1997, there were 4 paging firms to choose from, 2 mobile phone operators and 3 Internet service providers (ISPs). This once again meant lower costs and greater flexibility for SMEs in selecting essential overhead services.

In line with continuing to upgrade the ICT capabilities of SMEs in order to enhance competitiveness, the government introduced the Local Enterprise Computerisation Programme (LECP), which was a successor programme to the SECP. It allowed SMEs to gain access to a registered group of ICT consultants and vendors; obtain assistance from the ICT consultant for their computerisation project and obtain grants of up to 70% of defraying consultancy fees for both the feasibility study and system implementation stages (IDA 2000a).

A companion programme to encourage SMEs to adopt EC is the Local Enterprise Electronic Commerce Programme (LECP (EC)). The IDA has also established a database of ICT firms in Singapore that SMEs can draw from to obtain competitively priced services. Computerisation levels measured by survey, shown in table 2, indicate that these programmes have been moderately successful in meeting the objective of ICT diffusion to SMEs.

	<i><25 employees</i>	<i>25-99 employees</i>	<i>100-199 employees</i>
Average ICT Spending	\$18,942	\$219,667	\$343,344
LAN Utilisation	28.5%	70.9%	89.5%
Access to Internet	80.0%	86.5%	99.7%
Organisational homepage	28.8%	46.3%	63.7%
E-commerce usage	7.8%		7.9%
E-commerce interest	25.2%		28.4%
Access WWW by broadband		21.0% (all sites)	
Computerisation		75.0% (all sites)	

Source: ICT Usage Survey 1999, IDA; NCB Business-to-Business E-Commerce Survey 1999

Table 2. ICT adoption & utilisation by SMEs in Singapore

Phase IV: Breaking into a run

The three years between April 1997 to January 2000 saw rapid change in both the ICT industry and ICT policy in Singapore. As the millennium approached, the Singapore government adopted a radical liberalisation and consolidation policy that led to a revised, accelerated schedule for telecommunications liberalisation and a convergence of information technology, broadcasting and communications media. During this time, service operators' fees collapsed as former licensing restrictions were lifted and potential entrants entered the market. Although the scene remained dominated by large, often government-linked firms such as SingTel and major business consortia like StarHub, room opened up at the bottom for SMEs to sub-licence bandwidth and offer low-priced, niche-market services.

For example, international calling services could now be made for a fraction of the cost as recently as 3 years ago, as small operators entered the market and began to offer plain-vanilla international calls. This was not restricted to international calling services – mobile phone charges, internet access charges and even newspapers all encountered similar price falls. Other than the potential market opportunity for SMEs to enter as service providers, existing SMEs in different sectors will all enjoy the reduced costs and expanded choices.

An interesting and exciting development during this time was the shift from leveraging technology from MNCs toward fostering technopreneurship. Spurred on by the Asian financial crisis, the government began to re-examine the traditional role of importing technological and R&D knowledge from foreign sources and began to look inward at local talent in the area. The NSTB restructured itself to work on six key thrusts, all aligned toward technopreneurship and capability development. The objectives were to greater promote science and technology to students, professional and the public via growing technopreneurial businesses; developing a conducive environment; promoting finance & investment; developing manpower for R&D and technopreneurship; establishing international operations and strengthening the technology infrastructure.

A website¹² geared toward preparing a potential enterprise for the challenges of technopreneurship was set up by the NSTB for this very purpose. The site contains the 'Alpha Kit', a collection of useful links to expert opinions pertaining to starting and running an ICT-

¹² <http://www.techsingapore.com.sg>

based SME, together with information on funding, loss insurance and various other administrative issues.

The drive led to a rapid increase in venture capital (VC) funding. In 1998, 40 start-ups received \$160 million of VC funding, whereas in 1999, an additional 31 start-ups had received VC funding totalling \$252 million – with the large majority of funds going towards ICT-related ventures. Singapore had become the premier choice for investment location, exceeding North Asia, other parts of Southeast Asia and even the US¹³ (EDB & NSTB 2000).

In line with attaining the goal of technopreneurship, the legal framework was supplemented in order to make it more ICT-friendly. In order to bring Singapore's legal, regulatory and enforcement framework in line with international standards and models, a study group was convened in February 1997 to study and make recommendations on providing a more conducive environment to support EC. The final report pushed for, among other recommendations, a commercial code to support EC transactions, provision of a public key infrastructure, updating of the Computer Misuse Act and a review of local intellectual property laws (ECH Policy Committee 1997). The culmination of the changes in regulation was the Electronic Transactions Act and the amendments to the Computer Misuse Act, as well as other minor amendments to other acts (such as the Copyright Act) and rules of court; all were designed to promote and enhance trust and confidence in EC¹⁴. These changes are significant for SMEs as a large majority (77%) of these firms cite security concerns as a barrier to adoption of B2B EC (Wirtz & Wong 1999).

Phase V: Chasing the future

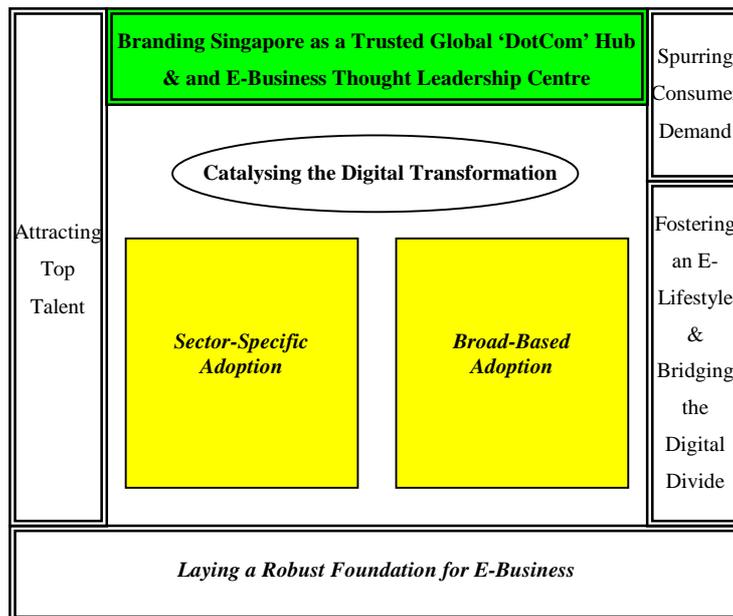
IT2000 and the subsequent consolidation and liberalisation paved the way for the Infocomm 21 that will guide the development of ICT over the next 10 years. The objective of Infocomm 21 is to transform Singapore into a dynamic and vibrant global ICT capital with a thriving and prosperous Net Economy by the year 2010. Because the world is undergoing an ICT revolution, the plan seeks only to outline broad directions, emphasising the need to maintain

¹³ It should be noted that the results were based on a survey of fund management groups based in Singapore (whether local or international), and so might carry an inherent bias. Nevertheless, the survey would at the very least reflect preferences within the region.

¹⁴ The IDA also released a consultation paper in September 2000 seeking submissions on advancing a framework on this very issue (IDA 2000b).

speed and flexibility, and is not meant to be prescriptive. The underlying principles are that Infocomm 21 is to be market-driven, private-sector oriented and global in outlook (Yong 2000).

The key components of Infocomm 21 were to liberalise the telecommunications market in order to develop Singapore as a telecommunications hub; to develop capabilities; and to ‘dotcom’, or bring into the ICT revolution, the private, public and people sectors. Of these initiatives, the crucial one that would fundamentally impact the local SMEs is that of dotcomming the private sector. Figure 4 establishes the framework for this endeavour.



Source: IDA Factsheet on Dotcomming the Private Sector

Figure 4. Framework for Dotcomming the Private Sector

By laying a robust foundation for e-business, Infocomm 21 will change the way in which all businesses operate, SMEs inclusive. The liberalised telecommunications industry guarantees that the pricing for these services that will grow increasingly important in a networked economy will be competitive and offer enough choice to tailor individual packages according to business requirements. An well-defined, common and consistent legal and policy framework will ensure that SME-adoption of EC is not impeded because of security or privacy issues arising from an inadequate legal environment. Additional services that facilitate EC will be implemented on top of existing ICT infrastructure, further improving the benefits already accrued to SMEs from these. For example, the current electronic payments

system (discussed earlier) will be widened to include features such as multiple currency support for e-payments, prepaid cards and electronic cheques (IDA 2000c).

Catalysing the digital transformation involves various strategies that have an impact on SMEs. The most important amongst these is the new SME21 plan, a collaborative effort between the IDA and the Productivity and Standards Board (PSB), which has taken ownership of the plan. This broad-based plan seeks to quadruple the number of local SMEs with EC transactions from 8,000 to 32,000 by the year 2003 (PSB 2000).

There will be continued emphasis on the LECP and LECP (EC). A new scheme, known as the e-Business Industry Development Scheme (eBIDS), will work to further strengthen the adoption of e-business and increase EC transactions among SMEs. It is meant to address the LECP (EC) when it lapses in November 2000; however, it is more comprehensive, with two separate, parallel plans: Plan 1, modelled after the LECP (EC), targets enterprises that have not yet adopted EC; while Plan 2 targets companies that already possess EC capabilities but who wish to expand their online presence.

Sector-specific adoption will also be undertaken for selected sectors – these communities typically contribute to the 70% total sales turnover locally. SMEs that fall within these categories of trading & exchanges, manufacturing & logistics, finance & banking and education will be the beneficiaries of policy efforts by government bodies which aim at improving ICT standards in their respective areas. A case in point is the introduction of E-Capital Market, an initiative attempting to develop a vibrant and conducive e-equities market for fund raising and listing of local and regional dotcom companies and an e-bond market for government securities and corporate bonds. E-capital market is a joint effort by the Singapore Exchange (SGX), the Economic Development Board (EDB) and the NSTB.

Infocomm 21 will spur consumer demand in EC by promoting B2C business locally, as well as with the tourism industry, through promoting a stable B2C e-marketplace and enhancing consumer confidence in e-commerce. These will be achieved by consumer education as well as through the provision of implicit guarantees through trust marks. SMEs, in particular, will be able to reap the benefits of increased online demand for their products and services and it is believed that these trust marks will be a focal point of local online B2C e-businesses.

Finally, there is a strong drive towards encouraging local e-business companies to internationalise. The government will groom promising local enterprises for the regional and global marketplace. Also, the IDA will pave the way for overseas linkages through

partnership with industry players to set up business centres in strategic countries. The Local Industry Upgrading Programme¹⁵ (LIUP) will encompass a sector-specific Infocomm LIUP directed at local ICT firms.

IV. Conclusion

In general, any motivation behind providing support for SMEs rests on implicit assumptions about the workings of markets and the constraints faced by small firms in these markets. In an era of increased globalisation, many government have begun to adopt the view that the protection and nurture of local small and medium sized firms are necessary for the maintenance of national identity. This has been manifested particularly for the area of ICT, regarded as a key driver of economic growth in the 'New Economy'.

Notwithstanding the different reasons for ICT support for SMEs, this paper has shown that there have been a plethora of policies for SMEs in Singapore, and that they have been a key aspect of government industrial policy. The future of such policies in Singapore, however, remains uncertain. It is becoming increasingly difficult to 'pick winners' in the same way that some Asian nations and the NIEs did in the 1970s to early 1990s. The spectacular failure of both the private and public sectors during the Asian financial crisis has underscored the difficulties involved when the public sector gets too involved in private decision-making through incentive-distorting measures, of which industrial policy is a part. Whilst there is a role for ICT policy in the new millennium, it should be measured and, most of all, be as broad-based and blunt as possible.

¹⁵ The LIUP is an EDB programme that has been in place since early 1986. Its aim is to enhance joint development between MNCs and their local suppliers in a symbiotic relationship.

References

- Aghion, P. & Howitt, P.W. *Endogenous Growth Theory*. Cambridge, MA: MIT Press, 1997.
- Chan, P. 'Civil Service Computerisation Programme: Trends and Implications'. In *Information Technology and Singapore Society: Trends, Policies and Applications*, proceedings of a multi-disciplinary symposium, Feb 17-18, 1989.
- Computer Misuse (Amendment) Act (Cap. 50A), 1998.
- Copyright Act (Cap 63), with revisions to s. 7 (A) & s. 17.
- Brynjolfsson, E. & Hitt, L. 'Paradox Lost? Firm-Level Evidence on the Returns to Information Systems Spending'. *Management Science* 42, no. 4 (April 1996): 541-58.
- Economic Development Board & National Science & Technology Board. 'Singapore VC Raised \$1.4 Billion in 1999', press release, April 7, 2000.
- Electronic Commerce Hotbed Policy Committee. *Final Report of the Legal, Regulatory & Enforcement Study Group*. Singapore: ECH, 1997.
- Electronic Transactions Act (Cap 88), 1998.
- Enterprise Promotion Centres. *Government Development Assistance Programmes: A Guide for Entrepreneurs*. Singapore: EPC, 1991.
- Infocomm Development Authority of Singapore. *Key Findings of ICT Usage Survey 1999 on the ICT Adoption of Businesses in Singapore*. Singapore: IDA, 2000a.
- Infocomm Development Authority of Singapore. *A Proposed Framework on Building Trust and Confidence in Electronic Commerce*. Singapore: IDA, 2000b.
- Infocomm Development Authority of Singapore. *Factsheet on Dotcomming the Private Sector*. Singapore: IDA, 2000c.
- ISI Research. *2000 World Times/IDC Information Society Index: Measuring the Global Impact of Information Technology and Internet Adoption*. International Data Corporation and World Times, 2000. Available: <http://www.worldpaper.com/ISI/country.html>

Ko, K.H. 'Promotion of IT Applications in Singapore: Policy Issues and Strategic Thrusts'. In *Information Technology and Singapore Society: Trends, Policies and Applications*, proceedings of a multi-disciplinary symposium, Feb 17-18, 1989.

Lach, S. 'Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel', *NBER Working Paper* no. 7943 (2000). Cambridge, MA: NBER.

Low, L. *Economics of Information Technology and the Media*. Singapore: Singapore University Press & World Scientific, 2000.

Low, L., Soon, T.W. & Toh, M.H. *Economics of Education and Manpower Development: Issues and Policies in Singapore*. Singapore: Mc-Graw Hill, 1991.

National Computer Board. *NCB IT Survey 1987*. Singapore: NCB.

National Computer Board. *NCB Business-to Business E-Commerce Survey 1999*. Singapore: NCB.

National Science and Technology Board. *National Technology Plan 1991*. Singapore: NSTB, 1991.

Oliner, S.D. & Sichel, D.E. 'The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?' *BOGFRS Finance and Economics Discussion Series* 2000-20. Washington, DC: Board of Governors of the Federal Reserve System, 2000.

Porter, M., Sachs, J., Warner, A. & Schwab, K. *World Economic Forum Global Competitiveness Report 2000*. New York, NY: Oxford University Press, 2000.

Productivity & Standards Board. *SME21 Masterplan*. Singapore: PSB, 2000.

Romer, P. M. 'Endogenous Technological Change'. *Journal of Political Economy* 98, no. 5 (October 1990): S71-102.

Science Council of Singapore. *National Survey of R&D Expenditure and Manpower 1984/85*. Singapore: SCS, 1989a.

Science Council of Singapore. *National Survey of R&D Expenditure and Manpower 1987/88*. Singapore: SCS, 1989b.

Singapore ONE. *Singapore: The Ideal Place for Broadband Multimedia*. Available: <http://www.s-one.gov.sg/overview/place02.html> (accessed November 8, 2000).

SME Committee. *SME Master Plan*. Singapore: EDB, 1989.

Solow, R. 'We'd Better Watch Out'. *New York Times Book Review*, July 12 (1987): 36.

Tan, C.N., Goh, S.K., Chua, S.T., Montiwalla, J. & Sung, S.M. *National IT Plan: A Strategic Framework*. Singapore: National IT Plan Working Committee, 1985.

Teo, T.S.H. & Lim, V.K.G. 'Leveraging Information Technology to Achieve the IT2000 Vision: The Case Study of an Intelligent Island', *Behaviour & Information Technology* 17, no. 2 (1998): 113-23.

Tng, H. & Yap, C.S. 'Telecommuting: Attitudes of Female Computer Professionals in Singapore'. In *Information Technology and Singapore Society: Trends, Policies and Applications*, proceedings of a multi-disciplinary symposium, Feb 17-18, 1989.

Wirtz, J. & Wong, P.K. 'An Empirical Study on Internet-Based Business-to-Business E-Commerce in Singapore'. Paper presented at the Conference on the Measurement of E-Commerce, Dec 6-8, 1999.

Wong, J. & Lam, E. 'Measuring Electronic Commerce in Singapore: Methodological Issues and Survey Findings'. Paper presented at the Conference on the Measurement of E-Commerce, Dec 6-8, 1999.

Wong, P.K. 'Singapore's Technology Strategy'. In *The Emerging Technological Trajectory of the Pacific Rim*, ed. Simon, D.F. Armonk, NY: M.E. Sharp, 1995.

Wong, P.K. 'Implementing the NII Vision: Singapore's Experience and Future Challenges'. *Information Infrastructure and Policy* 5, no. 2 (1996): 95-117

Wong, P.K. 'Assessment of Electronic Commerce Developments in Singapore'. *Electronic Markets* 7, no. 3 (1997): 43-45. Available: http://www.electronicmarkets.org/netacademy/publications.nsf/all_pk/194 (accessed 10/30/2000).

Wong, P.K. 'Leveraging the Global Information Revolution for Economic Development: Singapore's Evolving Information Industry Strategy'. *Information Systems Research* 9, no. 4 (1998): 323-41.

Wong, P.K. 'The Productivity Impact of Information Technology in Singapore: Macroeconomic Evidence'. Mimeograph. Singapore: Centre for Management of Innovation & Technopreneurship, 2000.

Wong, P.K. 'The Contribution of IT to the Rapid Economic Development of Singapore', in *Information Technology, Productivity and Economic Growth: International Evidence*, ed. Pohjola, M. New York, NY: Oxford University Press, 2001.

Wong, S.K.P. 'Leapfrogging Across the Millennium: Information Technology in Singapore Schools'. In *Information Technology Diffusion in the Asia-Pacific: Perspectives on Policy, Electronic Commerce & Education*, ed. Tan, F.B., Corbett, P.S. & Wong, Y.Y. Hershey, PA: Idea Group Publishing, 1999.

Yong, Y.I. 'Infocomm 21 – Singapore's Strategic Plan for Infocomm in the New Economy', speech presented at the Infocomm 21 Leadership Dialogue, August 1, 2000.

Zagler, M. *Endogenous Growth, Market Failures and Economic Policy*. New York, NY: St. Martin's Press, 1999.

Appendix

The basic Romer (1990) model postulates a potentially infinite set of varieties of capital, K , goods $(1, n)$. Research and development (R&D) allows n to expand over time. Technology is given by A and the net output of final goods is given by

$$Y = AL^\alpha \sum_1^n K_i^{1-\alpha} \quad (1)$$

This technology displays constant returns in $\{L, K_1, \dots, K_n\}$ but increasing returns in $\{L, K_1, \dots, K_n, n\}$. Assume that labour, L , remains constant at unity. The goods market is competitive, and therefore the demand for capital inputs by final goods producers is

$$(1-\alpha) AK_i^{-\alpha} = R_i \quad (2)$$

where R_i is the user cost of capital for the i^{th} variety.

Now consider the capital goods industry. A capital goods producer can develop a new variety of capital by spending β units of final output, which is taken to be the ‘innovation cost’. After this initial cost the new capital good incurs a marginal cost of η units of final output. It is possible to acquire an infinitely-lived patent to this invention at zero cost which would then give the producer monopoly supply of the good.

Under these assumptions, the rental rate that a given capital goods producer receives, R_i , will be independent of time. Further, the demand for the capital good at that rental rate as well as the interest rate on financial assets, r , are likewise independent of time. Profit, Π_i from the innovation of a new variety of capital is thus

$$\Pi_i = R_i K_i / r - (\beta + \eta K_i) \quad (3)$$

The first term on the right-hand side represents the present value of the infinitely-lived flow of revenues, whereas the second term is the cost of innovation and production for the new capital good. Maximising (3) with respect to (2) gives the profit maximising rental rate

$$R_i = \eta r / (1-\alpha) \quad (4)$$

Whilst (2) gives the associated production level for K_i . If there is free entry into R&D then profits are forced to normal and hence $\Pi_i = 0$. Substituting into (3) gives

$$K_i = \beta (1-\alpha) / \alpha \eta \quad (5)$$

Combining (2), (4) and (5) and solving for r yields

$$r = A (1-\alpha)^{2-\alpha} (\alpha/\beta)^\alpha \eta^{\alpha-1} \quad (6)$$

From (4), (5) and (6) it is evident that K_i , R_i and r are all time invariant. To find the growth rate of consumption, g , combine (6) with the standard intertemporal optimality condition for an infinitely-lived consumer, where δ is the discount factor and γ is the elasticity of consumption for a constant relative risk aversion utility function:

$$g = (r - \delta) / \gamma \quad (7)$$

which would yield a growth rate of

$$g = [A (1-\alpha)^{2-\alpha} (\alpha/\beta)^\alpha \eta^{\alpha-1} - \delta] / \gamma \quad (8)$$

The growth rate is decreasing in both the cost of innovation, β and the cost of capital goods production, η . By substituting (5) into (1) we can obtain the output function

$$Y = nA [\beta(1-\alpha) / \alpha\eta]^{1-\alpha} \quad (9)$$

The engine of growth in the model, therefore, is the expansion of varieties through n , which grows at the same rate as consumption. As noted in the text, this growth rate is not socially efficient, as the rate under a benevolent social planner, g^* , is

$$g^* = [A (1-\alpha)^{1-\alpha} (\alpha/\beta)^\alpha \eta^{\alpha-1} - \delta] / \gamma > g \quad (10)$$

which implies that the rate of innovation is too low in a decentralised economy.