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E-Learning in Singapore: A Brief Assessment

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E-Learning in Singapore: A Brief Assessment ¹

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ABSTRACT

Singapore is experiencing a rapid growth of e-learning and it was estimated that e-learning market in 2005 was around US\$ 106 million. Adequate infrastructure, rapid advancement of ICT sectors, globalization and changes in demographic profile, increasing demand for knowledge workers, outsourcing, and government incentives are the major forces responsible for e-learning growth in Singapore. Educational institutions in Singapore have already adopted learning management system to create more effective learning environment. The Singapore government initiated many IT related policies in order to promote Singapore as a regional e-learning hub. The study shows that e-learning can positively contribute to the economic growth of Singapore in many ways that include cheaper acquisition of human capital, technology transfer, rise in productivity, and increasing social cohesion. It is expected that e-learning will help create a large pool of skilled work-force in Singapore essential for sustained economic growth of the city-state Republic.

INTRODUCTION

E-learning, which employs electronic media as part of delivery system and encompasses diverse learning strategies and technologies including computer based learning, web based learning, virtual classrooms, and digital collaborations is fast becoming popular all over the world because of its distinctive features. Its cost effectiveness, flexibility of learning anytime anywhere, uniform delivery to all users reducing chances of misinterpretations, promotion of team learning and collaboration, and easier access to global community, has given it a competitive edge over the traditional method of learning. Availability of adequate infrastructure and government incentives made Singapore an ideal platform for e-learning and the city-state Republic aims to be the 'e-learning hub in the region' (see Alex 2004 for details). Singapore Technology Federation predicted that e-learning market in Singapore would reach US\$ 106.43 million and corporate users would spend US\$ 57 million in 2005⁴. Another survey shows that Singapore companies spend an average of 20-25 percent of their training budget on e-learning.⁵

¹ The views expressed in this article are those of the authors and do not necessarily represent the views of Citibank or U21Global.

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⁴ http://www.asia-elearning.net/content/conference/2004/file/05_Keynote5.pdf

⁵ http://it.asia1.com.sg/newsdaily/news008_20030510.html

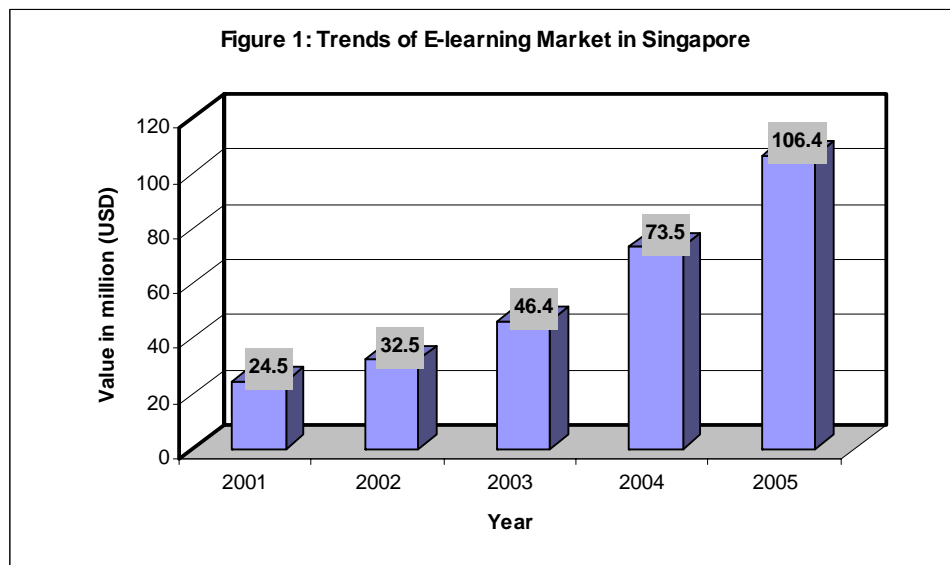
E-learning can promote economic growth by facilitating the acquisition of human capital. Human capital is usually referred to as the skills and knowledge intensity of labor force in an economy which is acquired through schooling and training. Mankiw, Romer, and Weil (1992) show that traditional growth theory can accommodate human capital. The role of e-learning on economic growth of Singapore can be viewed in many ways. First, e-learning enables more people to access education in a convenient manner. This is likely to increase human skills through accumulation of knowledge. Second, e-learning can promote technology transfer from technologically advanced countries to Singapore through foreign direct investment in the ICT sector. Finally, the relatively cheaper cost of e-learning is likely to reduce production costs in the economy.

This paper briefly examines the current situation of e-learning in Singapore and seeks to identify the driving forces behind the rapid growth of e-learning in the city-state Republic. It also reflects on the possible impact of e-learning on the Singapore economy.

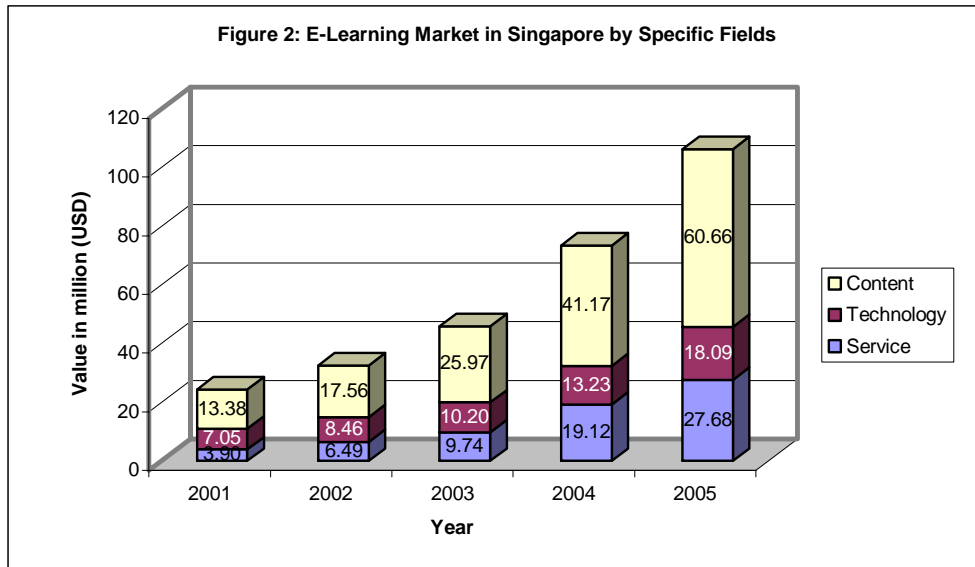
GROWTH OF E-LEARNING

Market size

Adopting data from various Infocomm Development Authority (IDA) surveys, Asian E-learning Network (AEN) reported that e-learning market in Singapore grew from US\$24.5 million in 2001 to over US\$106 million in 2005 (see Table 1), showing more than four-fold increase in this four-year period (Asia E-learning Network, 2002a). AEN also reported disaggregated data on Singapore's e-learning market. It divided the entire e-learning market into three categories- service, technology and contents. According to the report, in 2001, contents occupied 55 percent of total e-learning market amounting to US\$13.38 million, followed by technology (29 percent) and service (16 percent). Figure 2 shows the e-learning market in Singapore by specific fields.

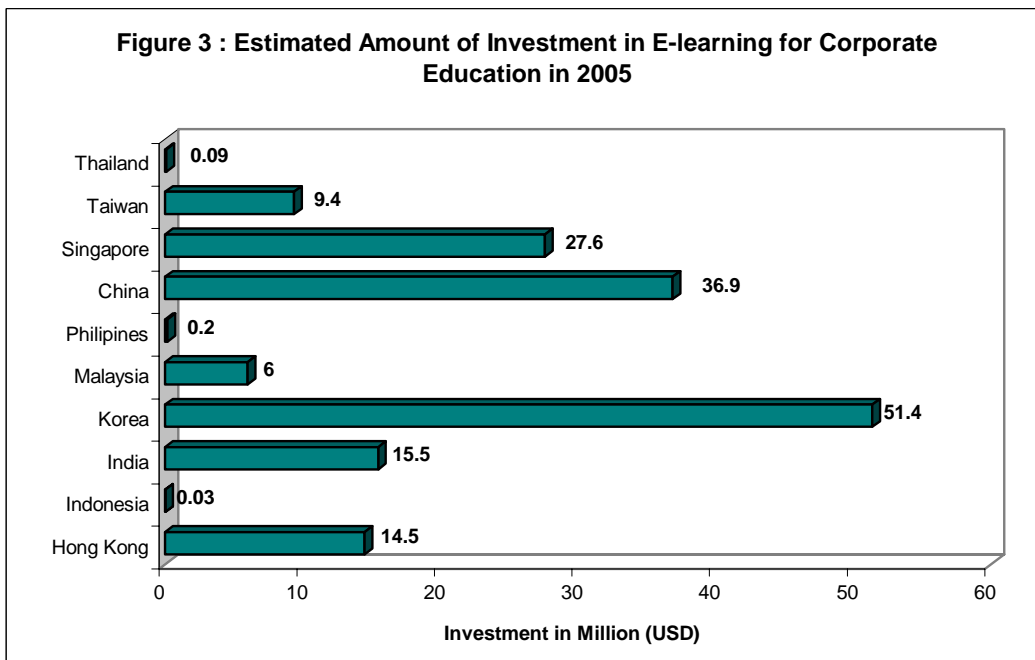


Source: Asia E-learning Network (2002a).

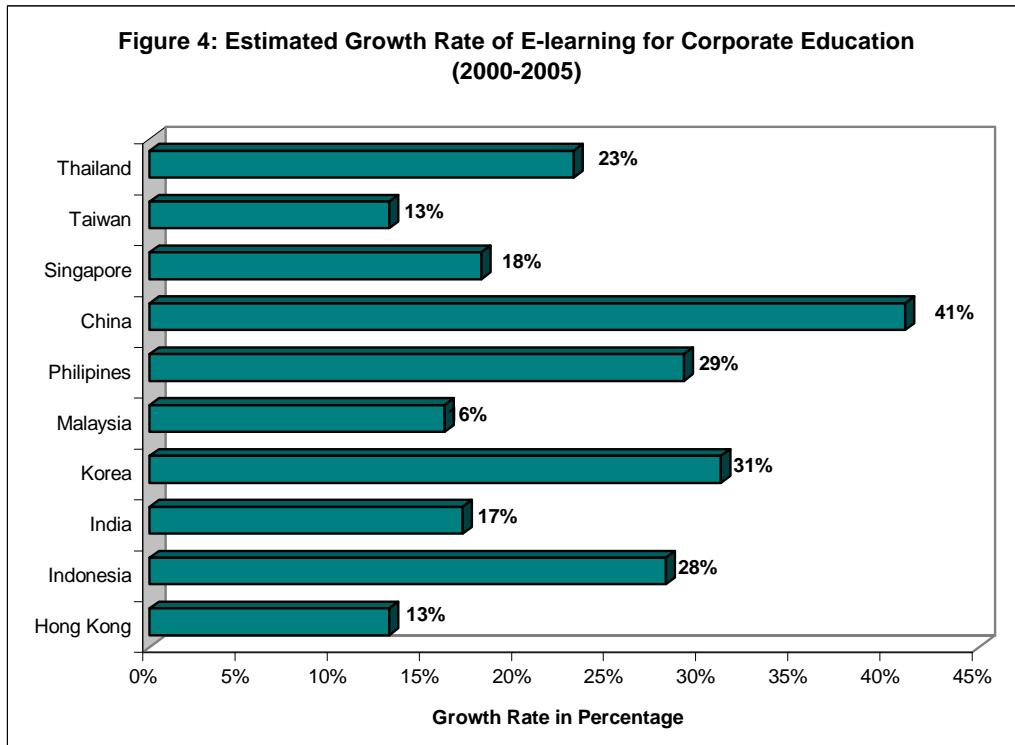


Source: Asia E-learning Network (2002a).

In corporate e-learning market, it was expected that Singapore would be the third largest in Asia after South Korea and China and the market size was estimated to be about USD 27.6 million for 2005 with a growth rate of 18% (Asia E-learning Network, 2002b). But, in per capita terms, Singapore's corporate e-learning market is the largest in Asia. Other Asian markets like Indonesia and the Philippines are growing more than Singapore in corporate e-learning market, since Singapore has already experienced a high growth rate in e-learning. Figures 3 and figure 4 show the estimated market size and growth rate of e-learning in selected Asian countries for 2005.



Source: Asia E-learning Network 2002b



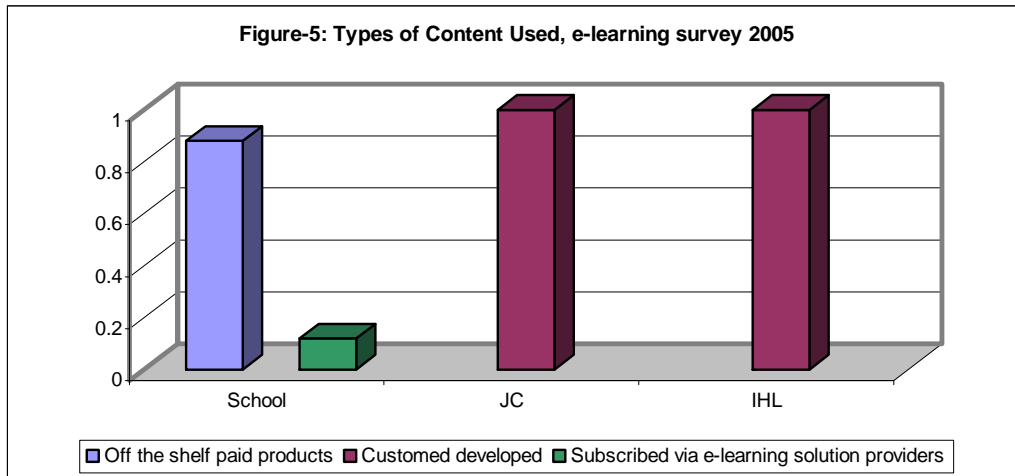
Source: Asia E-learning Network 2002b

E-learning in Schools and Colleges

Education plays a very important role in Singapore and it contributes roughly 2.2 percent to the GDP and employs 52,000 people (Damien, 2004). Singapore government is actively working with private sectors to encourage technology based learning system to enhance learners' understanding of abstract concept as well as to increase their interest in learning. According to Master Plan for IT in education report 2001, more than 70% of surveyed pupil reported that IT helped to increase their knowledge.⁵ The report also shows that more than 80 percent of surveyed pupils confirmed that use of IT makes lessons interesting. More and more schools in Singapore are now adopting technology based learning in order to ensure efficient learning management.

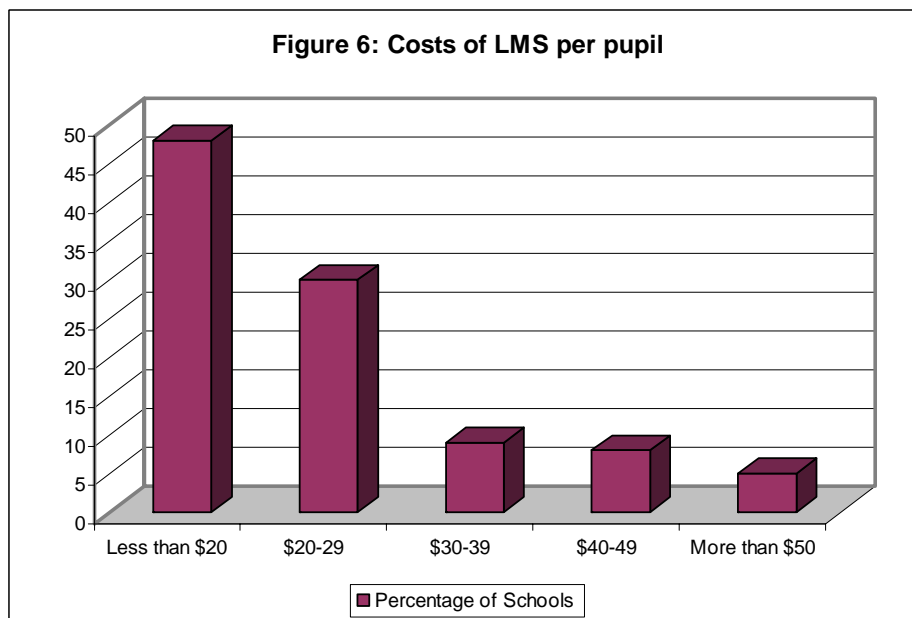
In 2005, the information technology standard committee (ITSC) performed an e-learning survey among the schools, institutes of higher learning (IHL) and junior colleges (JC) in Singapore. The survey shows that schools usually subscribe to e-learning solution providers while the IHLs and JCs use custom developed content as shown in figure 5.

⁵ <http://www.moe.gov.sg/edumall/mpite/achievements/index.html>



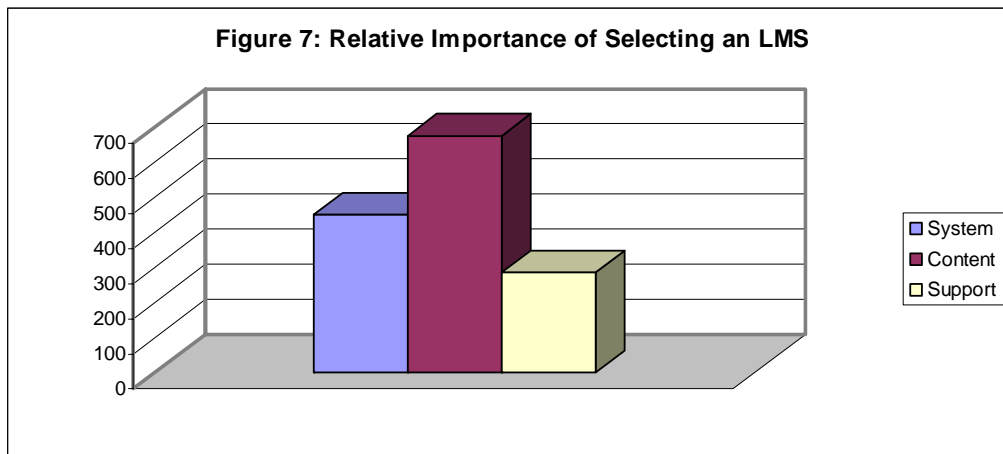
Source: ITSC (2005).

Another interesting finding is that over 80 percent of e-learning courses are available to staff and students in schools, whereas in JCs, e-learning courses are available only to the students. In April 2005, educational technology division of Ministry of Education (MOE), Singapore conducted a survey to determine the extent of use of Learning Management System (LMS) in schools. The survey confirms that 75 percent of schools own or subscribe to LMS. The survey also reveals the cost of LMS per pupil as shown in Figure 6. From the figure, it is clear that in about 48 percent of schools, cost is less than S\$ 20. According to the report, the cost of procuring an LMS has dropped from a range of S\$50 to S\$80 in 2003 to less than S\$20 to S\$50 in 2005.



Source: Ministry of Education, Singapore (2005).

62 percent of schools reported that they prefer to procure their own LMS. Among the three important criteria, 58.1 percent of schools rank content as the most important criteria for selecting an LMS, followed by system features. Figure 7 shows the relative importance of selecting an LMS.



Source: Ministry of Education, Singapore (2005).

E-learning in the Universities

In order to prepare the nation to meet challenges of the knowledge economy, Singapore government has been investing a lot of resources in tertiary education sector. Currently, there are three full-fledged public universities in Singapore which offer quality higher education backed by the state of art technology - National University of Singapore (NUS), Nanyang Technological University (NTU) and Singapore Management University (SMU). Along with these universities, some polytechnique institutes and offshore campus of foreign universities also offer higher education in Singapore. The government is encouraging more foreign universities to set up their campus in Singapore. In 2001, U21 Global, a consortium of leading universities, has chosen Singapore for its global headquarters to develop and deliver online education. All these universities use modern technology to provide an interactive and efficient learning environment.

National University of Singapore, one of the leading universities in Asia Pacific region, offers multi disciplinary courses with an enrollment of more than 23500 undergraduate and 9000 graduate students⁶. Since 1997, the university offers Integrated Virtual Learning Environment (IVLE), a web based tool for resource and learning. Through IVLE instructors can distribute a wide variety of course materials easily and quickly. IVLE offers both synchronous and asynchronous learning environments such as discussion forum, chat rooms, online quizzes, assignment repositories, video web casting, archiving of lectures and sending of announcements to students by SMS to supplement class room learning. Students can access to IVLE at any time from any place. IVLE is acting as a virtual class room, providing an excellent medium for enhancing communications. Currently, IVLE hosts 2500 discussion forums and 3000 assignment repositories.⁷ IVLE has become a powerful learning management system through facilitating online interaction of learning and is designed and maintained by NUS Centre for Instructional Technology (CIT).

⁶ <http://www.nus.edu.sg>

⁷ http://www.microsoft.com/singapore/mssg_docs/1749.aspx

Founded in 1955, Nanyang Technological University (NTU) has become an internationally acclaimed national institute of education which is recognized as one of the best communication and information schools in Asia⁸. In the year 2000, NTU launched its innovative S\$6 million e-learning program named edveNTUre. EdveNTUre facilitates 23000 local and distant learning students as well as 1300 academic staffs to access online resources. This online oriented education allows dynamic content to be delivered to any student at “anytime, anywhere”. EdveNTUre offers discussion forums for collaborative knowledge sharing, personalized learning, dynamic content delivery, and other automated e-learning tool which complements the traditional lectures (NCS 2005). Within three years of implementation, about 90% of courses in the university have started using online resources. EdveNTUre survey 2003 shows that among the 2,771 NTU students, 87% expressed satisfaction with the course sites and edveNTUre system (Daniel, 2005). NTU is now aiming to humanize e-learning to create a more interactive student-professor learning environment. The Centre for Educational Development (CED) of NTU maintains the system.

U21 global, a joint venture between Universitas 21 and Thomson Learning, offers highest quality online education designed to create future leaders for the global economy⁹. The university intends to cater to a large unmet demand for higher education that is estimated to consist of approximately 32 million students around the world. U21 Global, headquartered in Singapore, offers completely interactive online programs featuring a high degree of communication between faculty and students. Innovative interface design, thoughtful integration of web-based resources, productive use of interpersonal interaction and support services are the unique features of U21 programs. U21 Global delivers program through integration of state-of-the-art technology and world-wide-web. The premier online university offers high quality graduate education which is reviewed by an international body of distinguished academics.

E-LEARNING PROVIDERS IN SINGAPORE

E-learning industry in Singapore has been growing and many companies are now engaged to meet the high demand for e-learning. An increasing number of companies are now implementing e-learning training as a learning tool. In 2002, the E-learning Competency Centre (ECC) published a directory of e-learning providers in Singapore. ECC listed the companies which provide e-learning service to corporate and consumer market as well as education market. In corporate and consumer market, 32 companies are providing e-learning services, while 23 companies are actively participating in education market. There are duplications if the same company provides service in both markets. Activities of the companies engaged in corporate and consumer e-learning market can be categorized into four: IT, Personal development, Business and Vertical market. Table 1 depicts their activities in corporate and consumer market.

⁸ <http://www.ntu.edu.sg>

⁹ <http://www.u21global.edu.sg/cgi-bin/corp.dll/portal/ep/home.do>

Table 1: E-learning Content Providers for Corporate and Consumer Market, 2002	
<i>Field</i>	<i>Number of Companies</i>
IT	25
Personal development	26
Business	21
Vertical Market	17

Source: E-learning Competency Centre (2002)

Similarly, the education market can be segregated into four levels: primary, secondary, A-level, and certificate and above. Table 2 shows the number of e-learning content providers in segregated education market.

Table 2: E-learning Content Providers for Education Market, 2002	
<i>Field</i>	<i>Number of Companies</i>
Primary	10
Secondary	10
A-Level	4
Certificate and Above	13

Source: E-learning Competency Centre (2002)

Major vendors and corporate users of e-learning in Singapore are listed below:

Table 3: Major E-learning Vendors in Singapore, 2002			
	<i>Content Vendors</i>	<i>System vendors</i>	<i>Service Vendors</i>
Local	Purple train, ISS, ASPonline, Dnium, SDC Asia	Inchone, National Computer System (NCS), Wizlearn, CrimsonLogic	ICUS, Knowledge Platform, SCS, TTS Asia, IKS, Inkstudio
International	SmartForce, NETg	Saba, Docent, Intralearn	HP Education

Source: Asian E-learning Network (2002c)

Table 4: Major Corporate Users of E-learning in Singapore, 2002	
Local	SingTel, Singapore Airline, DBS Bank, CityCab, Infocomm Development Authority of Singapore (IDA), NTUC, Singapore Power
International	Citibank, Nokia, Motorola, ST Microelectronics

Source: Asian E-learning Network (2002c)

FACTORS FOR E-LEARNING GROWTH IN SINGAPORE

The major drivers of e-learning market growth in Singapore are adequate infrastructure, rapid advancement of ICT sectors, globalization, demographic changes, rising demand for knowledge, outsourcing and government incentives.

Infrastructure

Availability of adequate infrastructure helps Singapore to become the e-learning hub in Asia. Singapore has most advanced telecommunication infrastructures among the Asia Pacific countries. The country spends a good proportion of its GDP in information technology sector. Table 5 shows data on IT spending for selected Asian countries and it is evident that Singapore ranked number one in terms of IT spending as percentage of GDP in 2004. Data in table 6 reveals that Singapore has the highest PC owners per 100 people in Asia followed by Hong Kong. In Singapore, about 62 percent owns personal computer while the figure is 54 percent for Japan and 52 percent for Korea. In terms of total telephone subscribers per 100 people, Singapore is one of the top ranked nations in Asia. Singapore's number of internet users per 100 people is second in Asia after Korea but ahead of Japan, Taiwan and Hong Kong. Highly developed IT and telecommunication sectors offer greater access to Internet in Singapore. According to Information Society Index (IDC 2004), Singapore ranked 13th in the world and 2nd in Asia. This Information Society Index is developed by IDC which is based on 15 variables including IT spending, internet uses, telecommunications and social factors. Table 7 shows the Information Society Index for 2004 for some selected Asian countries.

Table 5: IT Spending in Selected Asian Countries for 2004			
	<i>IT Spending in mil</i>	<i>GDP in mil</i>	<i>IT as % of GDP</i>
China	29342	1532517	1.91
Hong Kong	3050	168429	1.81
India	6560	613857	1.07
Indonesia	1527	218078	0.70
Japan	99188	4558805	2.18
Korea	13895	671217	2.07
Malaysia	2694	109660	2.46
Philippines	976	83112	1.17
Singapore	3367	97462	3.45
Taiwan	5105	301428	1.69
Thailand	2236	153041	1.46

Source: IDC (2004¹⁰)

¹⁰ <http://www.idc.com/groups/isi/main.html>

Table 6: Information Communication Indicators in Selected Asian Countries for 2004				
	<i>PC per 100</i>	<i>Telephone per 100</i>	<i>Internet hosts per 10K</i>	<i>Internet User per 100</i>
China	4.05	49.43	1.24	7.19
Hong Kong	60.55	173.19	1132.74	50.32
India	1.20	8.39	1.32	3.22
Indonesia	1.36	18.12	5.01	5.04
Japan	54.15	118.22	1286.80	50.20
Korea	51.70	125.11	1130.06	65.68
Malaysia	19.16	74.5	52.81	38.62
Philippines	4.46	44.01	7.91	5.32
Singapore	62.2	139.88	1202.15	57.87
Taiwan	52.78	159.94	1389.65	53.81
Thailand	5.83	53.68	56.56	10.95

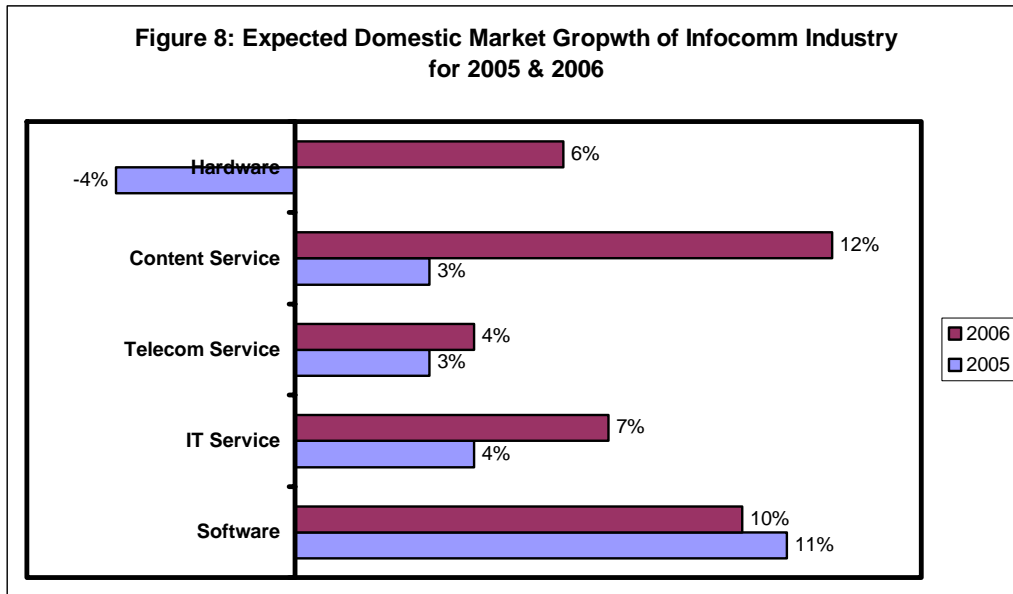
Source: International Telecommunication Union (2004a,b)

Table 7: Information Society Index Rank	
<i>Country</i>	<i>Index Rank</i>
China	44
Hong Kong	11
India	51
Indonesia	53
Japan	18
Korea	8
Malyasia	36
Philipines	49
Singapore	13
Taiwan	20
Thailand	42

Source: IDC (2004¹¹)

Singapore experienced rapid advancement in infocomm industry after government's initiative to liberalize the telecommunication sector in 1999. In 2004, 74 percent of the households in Singapore owned computers while the figure was 59 percent in 1999 (IDA, 2004c). The survey also shows that household internet penetration rate increased by nearly 5 times in the last seven years, from 14 percent in 1997 to 65 percent in 2004. According to annual survey 2004, the infocomm industry shows a positive growth rate of 6 percent in 2004 and it is expected to grow with a cumulative annual growth rate of 4.5 percent over the next two years (IDA, 2004a). Overall R&D expenditures in infocomm industry are also expected to grow positively over the next two years. Figure 8 shows the expected domestic market growth of infocomm industry for 2005 and 2006. From this figure, we can see that content service is expected to grow more rapidly in future.

¹¹ <http://www.idc.com/groups/isi/main.html>



Source: IDA (2004a)

The advancement of IT sector makes education accessible and affordable to millions of people. The explosive growth of internet penetration in Singapore opens the door of “anytime anywhere” studies. Teachers in the schools now can easily use technology to support classroom instructions. Technology oriented training can be more effective in terms of content retention in the workplace. Moreover, organizations can reduce time and cost by adopting technology based e-learning.

Globalization

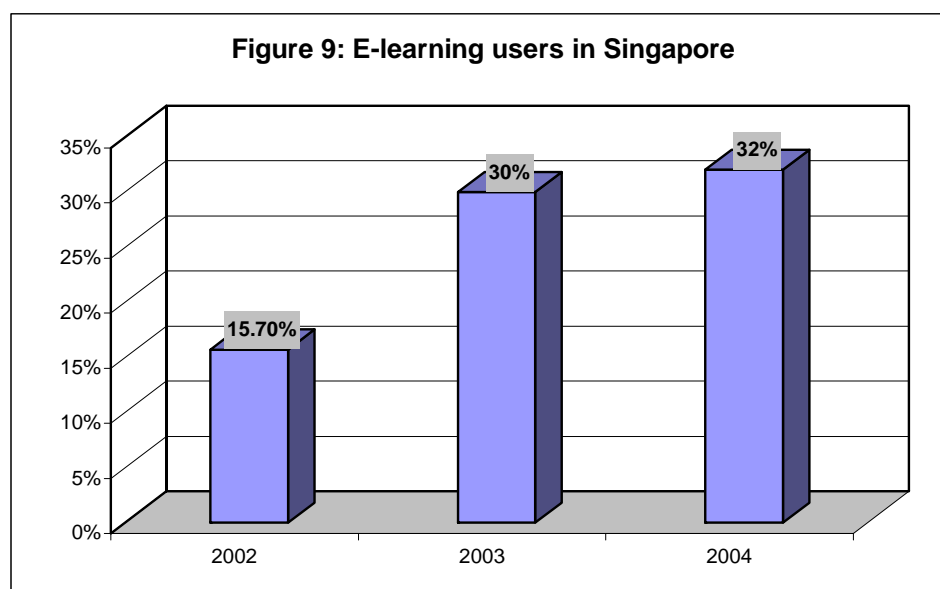
Liberalization of trade and rapid growth of information technology have made the world much smaller than ever before. Businesses are now moving all around the world in order to get cheap labor and capital. A large number of mergers and acquisitions have taken place in the past few years for the sake of competitive advantage. Such business expansions helped many companies to emerge as a global company. Singapore is the regional hub of many multinational corporations, which have work forces with diverse cultural and educational backgrounds. Providing training to the staff is becoming more challenging for these companies in Singapore. Fortunately, e-learning is emerging as an efficient tool of training for them. Annual survey on infocomm usage in business (IDA, 2004b) reveals that 82 percent of the companies in Singapore use infocomm to assist in skills development and knowledge acquisition. Table 8 shows reasons for infocomm use in business companies in Singapore for 2003 and 2004. The survey also discloses that almost all (98 percent) companies with more than 10 employees used infocomm appliances in 2004.

Table 8: Motivation of Infocomm Usage		
<i>Top 3 motivations to infocomm usage (% rating 3 and above)</i>	<i>2004</i>	<i>2003</i>
Assistance in skills development and knowledge acquisition	82%	81%
Financial assistance and grant for IT implementation	81%	80%
Assistance in needs analysis for infocomm usage	77%	76%

Source: IDA (2004b)

Demographic Changes

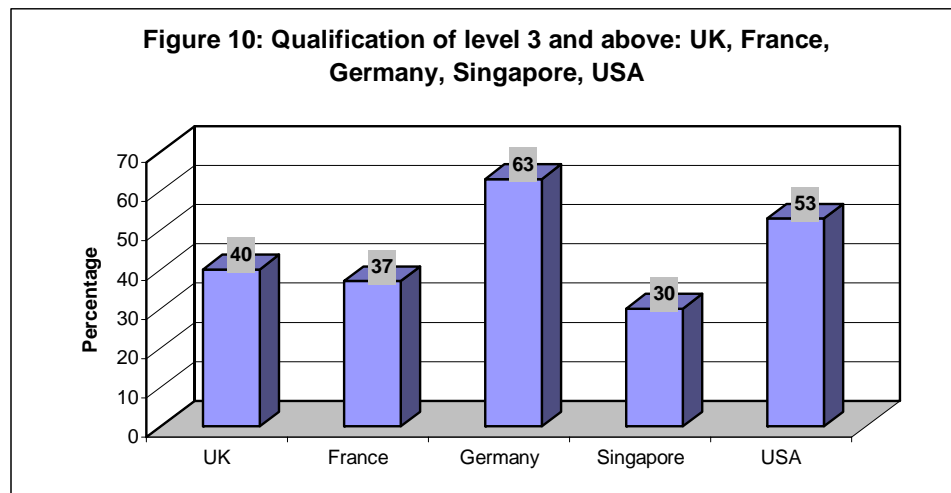
Demographic attributes of Singapore society changed dramatically over the past decade. Proportion of aging people in Singapore increased significantly. In 1994, 31.7 percent of population was over 40 years of age, whereas this figure increased to 41.7 percent in 2004. In addition, total fertility rate reduced to 1.24 in 2004 from 1.71 in 1994. In order to keep this aging workforce productive, continual training and retraining are required. This demand for learning and training fuels e-learning growth in Singapore. The training participation of elderly people increased from 18.9% in 2000 to 19.6% in 2005 (Ministry of Manpower, Singapore, 2006). The IDA survey on infocomm usage shows that more and more Singaporeans are taking up e-learning to keep them competitive in tight labor market (Annual survey of infocomm usage in households and by individuals for 2004). The survey reports a robust increase (16%) of e-learning users from 15.7% in 2002 to 32% in 2004.



Source: IDA (2004c)

Demand for Skilled & Knowledge Workers

Singapore is fast moving towards a knowledge economy which requires higher level of education, computer literacy, analytically skilled human resources. Ironically, there is a pronounced dearth of skilled manpower and Singapore is striving hard to fill the gap by producing additional knowledge workers. It is expected that Singapore will need about 250,000 ICT workers to achieve its master plan by 2010.¹² According to international comparison of qualification report 2004, Singapore has lowest proportion of active population (age between 16-64 years) with a level 3 key skills qualification compared to other four knowledge-based economies (Hilary et al 2004). Key skills qualifications refer to the skills that are needed for success in education, training, work and life in general. Figure 10 shows the comparison of key skills among the five countries- UK, France, Germany, Singapore and USA. E-learning is considered very effective for the development of such skills and Singapore is aiming to meet the shortfall of knowledge workers by wider applications of e-learning tools.



Source: Hilary et al (2004)

Outsourcing

Higher demand for outsourcing is another factor that drives e-learning market growth in Singapore. In order to achieve core competencies, many companies in Singapore are now concentrating on core businesses and outsourcing supporting activities like human resource training and development. By adopting outsourcing, organizations can benefit in many ways such as reduction of human development and training costs. I-admin, an outsourcing firm, is currently serving 20 major blue chip companies in Singapore including Citibank, UOB, HSBC, Sun Microsystems and General Electronics¹³. According to I-admin, companies can save as much as 30 percent of its cost over time from outsourcing. As companies outsource more and more to manage their training and human resource development programs, e-learning can play an important role to accomplish these training objectives at the shortest possible time.

¹²<http://www.ida.gov.sg/idaweb/marketing/infopage.jsp?infopagecategory=factsheet:aboutida&versionid=1&infopageid=1860>

¹³<http://www.i-admin.com/march82004.html>

Government Initiatives

The Singapore government has already adopted strategies to develop a large pool of highly skilled manpower and net savvy workforce as the city-state aims to become infocomm hub in the region and to develop a globally competitive workforce for sustaining her high growth momentum. E-learning is considered a key strategy for future human capital development in Singapore. Various government bodies like IDA and Ministry of Manpower (MOM) are collaborating development of e-learning infrastructure and promoting online education.

To meet the skilled manpower requirements for economic growth, the IDA together with MOM has already launched Strategic Manpower Conversion Program (SMCP). The main objective of this program is to prepare a pool of skilled manpower for e-learning industry. The government provides 50 percent of course fee capped at S\$ 4000 as a subsidy for this program¹⁴. Moreover, the government provides more tax incentives and financial assistance for e-learning related organizations in order to attract more entrepreneurs to this industry. The government is actively working with private enterprises to facilitate technology based education from school level. In 2002, Microsoft Singapore and Ministry of Education signed a US\$ 5 million memorandum of understanding (MOU), aiming at enhancing the competencies of educational community through access to infocomm technology¹⁵.

In order to realize the vision of becoming an e-learning hub in the Asia Pacific region, Singapore government has already established adequate infrastructure to spur widespread adoption of e-learning. In addition, the government offers financial incentives to encourage organizations in early implementation of e-learning based training. The government is also working with private and international organizations to promote e-learning activities in Singapore. In 2006, Singapore celebrated 25 years of its infocomm development after launching the first national computerization plan in 1981.

Infocomm 21

In December 2000, the Singapore government announced Infocomm 21, a five year strategic plan for harnessing infocomm technologies aiming to further boost the national competitiveness. The vision of Infocomm 21 is to transform Singapore into a prosperous e-economy and an infocomm savvy e-society. Infocomm 21 has following six strategic drives:

- i) To make Singapore a premier infocomm hub in Asia Pacific region.
- ii) E-powering the private sector and promoting Singapore as a global e-business hub.
- iii) E-powering the public sector and developing the concept of e-government
- iv) E-powering the people sector and encouraging people to adopt e-life style.
- v) To become the center of infocomm talent by establishing Singapore as an e-learning hub in the region.
- vi) To work out policies to ensure a competitive and transparent environment for enterprises and consumers.

¹⁴ http://www.nicc.org.sg/products/esmcp_support.aspx

¹⁵ http://backpack.com.sg/pressRelease_310704.html

To support Infocomm 21 vision, the Infocomm Development Authority (IDA) took following initiatives to develop infocomm manpower skills:

- i) Establish world class infocomm education
- ii) Enhance capability of infocomm manpower
- iii) Develop net savvy workforce.
- iv) Develop infocomm skills standards.

IT Master Plan II (2003-2007)

In July 2002, the Singapore government unveiled second master plan for IT in education. The IT master plan II, a five year strategic plan, focuses on engaged learning and interactive use of technology to enhance educational process and structures. The plan, based on the successful execution of IT master plan I of 1997, seeks to achieve the following objectives:

- i) Effective use of IT for active learning.
- ii) Use of IT to integrate curriculum, instruction and assessment in a systematic way.
- iii) Effective use of IT for professional and personal growth of instructors.
- iv) Capacity and capability building of IT use in school level.
- v) Promote research of IT in education.
- vi) Infrastructure building to support widespread IT use.

iN2015 Master Plan

In order to enhance the economic competitiveness, the Singapore government unveiled initial intelligent nation 2015 or iN2015 master plan in 2005. iN2015 is a 10 year master plan that aims to transform Singapore into a global city, powered by infocomm.¹⁶ iN2015 has the following two key aspects:

i) Next Generation National Infocomm Infrastructure (NII)

A high speed broadband network is a pre-requisite for economic development now-a-days. The government realizes that the existing infrastructure, Singapore One, may not be able to meet the connectivity demand in future. iN2015 focuses on ultra high speed national broad band network which is expected to help Singapore maintaining its leadership as regional infocomm hub. Another component of NII is to establish a nation wide wireless network for broadband access from anyplace in Singapore. This wireless network is expected to contribute substantially to Singapore's future growth potential.

ii) Infocomm manpower

The infocomm manpower development roadmap is another key aspect of iN2015 master plan. This S\$120 million roadmap is a 5-year plan which is developed with a joint partnership between the government and industry partners. It has three key components: National infocomm scholarship launched in 2004 by IDA that aims to attract top talents in the infocomm industry; Infocomm club, a joint effort of IDA,

¹⁶ http://www.mica.gov.sg/pressroom/press_060303.htm

MOE and industry partners with a view to use infocomm applications to nurture students' creative and entrepreneurial spirit; develop various programs that will assist the work force to enhance their infocomm skills.

IMPACT OF E-LEARNING ON SINGAPORE ECONOMY

One key issue for policy makers is to figure out how e-learning can contribute to the economy as a whole. Modern economists have attempted to demonstrate how education and human capital can expedite the process of growth in their 'growth models'. Robert Lucas, for example, in his 'endogenous' growth model used education as the critical variable that generates technical progress in an economy (Lucas, 1988). He shows that education and the creation of human capital are responsible for both the differences in labor productivity and the differences in overall levels of technology that can be observed from the real world data.

Does e-learning really matter for economic growth of a country? In a recent paper, Khan and Williams (2006) argue that e-learning can accelerate the process of growth by making the acquisition of human capital cheaper and easier. The authors also claim that e-learning has the potential to reduce poverty in less-developed countries by empowerment of the socially disadvantaged and less privileged in society including lower-income groups, the handicapped, sick and disabled (particularly those with writing, speaking and hearing impairments), members of ethnic minority groups, and women affected by cultural and religious prejudice. This is possible largely because, as the authors argue, physical location or ability is not critical for successful e-learning.

Few studies attempted to analyze the impact of e-learning in Singapore. Tan (2002) mentioned that 71% of the companies, surveyed by Productivity and Standard Board, perceived e-learning is more effective than traditional training. According to Tan (on the basis of Knowledge Platform survey), the most important perceived benefit of e-learning in Singapore was that it can be deployed faster and to more people. He also added that cost saving was not considered as the most important benefit. On the other hand, employee's acceptance and adjustment towards e-learning was ranked number one barrier to e-learning implementation in Singapore. Lim (2004) pointed out that e-learning in multinational companies (MNCs) of Singapore are administered by their respective headquarters.

E-learning can enhance labor productivity through cost saving and knowledge accumulation. For example, Cisco System offers a one-stop application based learning portal called Partner E-Learning Connection (PEC) which provides personalized training to each employee of partner companies. PEC helped generate US\$ 41 million in savings for the partner companies in fiscal year 2003 (Kelly and Nanjiani, 2005). Of that, US\$ 32 million (about 80%) was from cost reduction (like travel, lodging etc.) and remaining US\$ 9 million (about 20%) was from time efficiencies. Prime Learning.Com (2001) reports a comparative result of six companies who have switched to online training from traditional training and Table 9 shows excerpt from that report. The report highlights that 67 percent of traditional training costs are associated with travel expenses and interactive training through e-learning can eliminate such expenses.

Table 9: Comparison of e-Learning and Traditional Training				
<i>Company</i>	<i>No. of Employees Trained</i>	<i>Original costs of training</i>	<i>Costs after switching to online training</i>	<i>Total Savings including travel expense</i>
Hewlett-Packard	700 engineers	USD 7 million	USD 1.5 million	USD 5.5 million
Cisco	-	USD 1200-1800 per learner	USD 120 per learner	USD 1080-1680 per learner
Novell	-	USD 1800 per learner	USD 700-900	USD 900-1100 per learner

Source: Prime Learning.com (2001)

In Singapore, many companies have already switched to e-learning training and started to enjoy similar benefits from e-learning. Citibank Singapore is one of the pioneer companies which launched e-learning training in 2001.¹⁷ By the end of 2003, more than 17 percent of Citibank's training was administered through online, which provides access to employees anytime training, resulting in a flexible and comfortable training for employees. Citigroup's human resource department estimates that e-learning accounts only 6 percent of traditional training cost. Citibank's online management certification courses are designed to develop core managerial skills of its managers. Another leading knowledge management solution provider, Fuji Xerox Singapore, reported a cost saving of SGD 700,000 per year resulting from e-learning training program.¹⁸ The company estimated a cost saving of SGD 900,000 by the year 2005.

E-learning can also help attract more foreign direct investment to Singapore through technology transfer from other knowledge economies. Many foreign companies have already invested in the booming e-learning market of Singapore. For example, in 2003, the PSB academy of Singapore signed a partnership with UK eUniversities (UKeU) to provide online degrees from leading UK universities. UKeU is an e-learning specialist which is backed with S\$172 million funding from the UK government. The Sun Micro System has committed a 5.6 million pound investment to UKeU in order to develop an advanced and powerful e-learning platform. Initially UKeU invested S\$ 250,000 in Singapore and further investments are expected to take place in line with the development of more UKeU programs in Singapore¹⁹. Thus, foreign affiliates can bring new opportunities and challenges which can create more jobs in Singapore economy.

¹⁷ http://careers.asia1.com.sg/st_recruit/r20031108b.html

¹⁸ <http://www.fujixerox.com.sg/index.php?option=content&task=view&id=275>

¹⁹ http://www.psbcorp.com/news_release20030314.shtml

CONCLUSION

Adequate infrastructure and appropriate government policies helped boost the growth of e-learning in Singapore. E-learning is contributing to Singapore's economic growth in many ways and it is expected that long-term vision of the government will help to position Singapore as an e-learning hub in the Asia-Pacific region. There is a high potential growth of e-learning market in Singapore and it is likely that e-learning will be the next generation education tool in Singapore. In order to make e-learning more effective, higher level of standard and quality must be ensured. Balancing technological and pedagogical innovation will be the key to e-learning success in Singapore. Leveraging e-learning benefits, it is expected that Singapore will maximize productivity of its work force that is essential to sustain its high economic growth.

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