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Information Technology And The Singapore Experience

By

Yeo Khee Leng,
Loh Chee Meng,
Thong Pao-Yi,
&
Koh Pia Chin
INFORMATION TECHNOLOGY AND THE SINGAPORE EXPERIENCE

INTRODUCTION

1. When the first computer came out just after World War II, no one could have foreseen the impact computers could have had on the world and the societies within it. There is no denying that the computer has taken the world into the next era after that of the Industrial Revolution. Today, no one in his right mind would dismiss the computer as just another invention or fad that would become obsolescent at some near point in time.

2. Computers have enabled Man to free his mind from the mundane, routine work of tedious calculations, voluminous record-keeping, etc., and turn it to more creative and productive uses as space travel and research, robotics, expert systems, international financial trading, etc. Through data communications and telecommunications, computers have made each part of the world more accessible to the other parts. Just as the basic socio-economic structure of the Western nations changed from that of primary industry-based to service industry-based ones because of the Industrial Revolution, the Computer and the accompanying Information Revolution have also necessitated a change in existing socio-economic structures.

3. Having realised the growing importance of computers, we have to prepare for it now. This paper hence discusses the growth of the computer industry, Information Technology and Singapore's preparations to become an Information Society.
4. Information Societies living in the Information Age which has been made possible by Information Technology." A sentence full of buzzwords that are gradually becoming common place words in our vocabulary. What do they mean exactly?

5. To begin with, what constitutes information? Information manifests itself in many forms — words on paper, pictures on a screen, sound waves along telephone lines, details on an air-ticket, a story, digits on a computer. Information is the ordered representation of data. Data becomes information only when it has been processed and organised to give meaning to a concept or an idea, or an answer to a question.

6. Information Technology then is the convergence of "developments in microelectronics and telecommunications, together with the maturing of computing techniques, to bring about a further extension of the use of automated information processing systems which could extend computing power to the fingertips of everybody."(1)

7. In short, Information Technology encompasses all microelectronic, telecommunications and computing developments that help bring information to any person in the world.
The Information Age, the age of quick and ready access to information, was well under way by the late 1950s. For societies living in the Information Age, most of its workforce dealt with information rather than producing goods, i.e. the white-collar workers outnumbered blue-collar workers as never before.

Economies in the world are presently moving towards an information intensive economy where over 70% of the Gross National Product will be created by information products and services rather than by manufactured products. Information Technology did not bring about the Information Society, it only hastens the transition from mainly agri-based or primary industry-based economies to information-based ones.

GROWTH OF INFORMATION TECHNOLOGY

ENIAC, the first commercially available computer in the world, came out onto the market just after World War II. It was a very bulky, massive machine with some 18,000 vacuum tubes, expensive and difficult to operate. The computer professionals working on these first computers belonged to an "elite" group - a group of "high-brows" who, unlike the ordinary man-in-the-street, could fathom the incomprehensible depths of these mechanical monsters. Consequently, computers were used mostly in Government (especially in Defence) and academia. Computers were so confined in their use that it was estimated then that only 1,000 computers would be needed for all the applications in the world, period!
11. How then did the whole Information Society concept arise from this relatively obscure beginning and in such a short time?

12. Rapid advances in computer technology brought down the costs of computer systems. Industries realised the advantages of using computers - savings in costs due to rapid processing of data, orders, inventory checks; production, savings in labour and time - and began to use computers more and more. More application areas were found for computers - communications, payroll, finance, medical services, numerical control, simulation, graphics, etc. More technological advances yet again which brought down the costs even further. Computers became more user-friendly; no longer was it a machine worked upon only by that "elite" group, the computer could now be handled by just about anyone who was interested in it.

13. And so the demand for computers grew and grew...

14. For the local context, just as a measure of the rapidly increasing demand for computers - in 1964, the Singapore Government bought the first computer in Singapore, by 1982, there were some 1,800 computer installations, and that number is expected to double by 1985!

15. One very important historical event to bear in mind is IBM's "unbundling" of hardware and software on June 23, 1969. Previously, software had been given away with purchases of hardware. IBM's "unbundling" created a software industry almost overnight! Prior to IBM's action, software research and development (R&D) had been carried out mainly in university
research laboratories and those R&D laboratories of large computer companies like IBM, Sperry, Hewlett-Packard, etc. In one fell swoop, this event of IBM's opened up a whole new industry to individuals with some talent, innate computing abilities and some "inventive effort" to write software for the computer industry.

16. The seemingly daily advances in microelectronic technology over the past few years brought computing power to the home in the form of the microcomputer or the personal computer. The overwhelming popularity of the microcomputer brought about a correspondingly massive increase in demand for related software. This has brought the software industry into a whole new realm - meeting the needs of home users as well as those of business, commercial and public sector users.

17. The increasing popularity of the microcomputer will continue unabated for some time to come. This is especially so when the low cost and increasing processing power of the microcomputer allowed small businesses, which had previously found the cost of setting up a data processing (dp) shop with minicomputer and mainframe computer systems too prohibitive, to computerise. Some industry observers have predicted that the number of microcomputer software packages sold will account for at least 50% of the total volume of software sold by 1990.

18. The net was spreading ever wider - more and more people were gaining access to computers. Currently, some 35 million people around the world have access to computer power in one form or another. By 1992, an estimated 350 million people would have that same access.
19. All these people access computers through software; obviously, more software will be needed. In 1980 the software industry was US$3.5 billion in sales, by 1986 the sales figures are expected to top US$21 billion. With these rather large figures in mind, it would be sheer folly not to get involved in the software industry.

20. Today, the software industry still remains a fair mix of the concerted and orchestrated R&D efforts of large corporations, and the backyard operations. It still retains some of its "cottage industry" mien. Unlike the hardware industry which is very much dominated by some nations with the necessary huge financial resources and a relatively well-established framework for research, the software industry is open to nations which are strongly committed to putting its resources in human capital investment.

INFORMATION TECHNOLOGY AND SINGAPORE

21. In the 60s, we embarked upon a labour-intensive export-oriented industrialisation programme; in the 70s, having attained full employment, the emphasis was then placed on capital-intensive export-oriented industries. For the 80s, however, faced with a limited manpower resource and an increasingly more competitive world economy, Singapore has to achieve higher productivity through raising the skill level of our limited but extremely valuable manpower resource.
Consequently, Singapore's industrial strategy for the decade of the 80s is built upon high value added, technology based knowledge intensive industries. In addition to concerted efforts to raise the skill level for our workers, all sectors in our economy were called upon to automate, mechanise and computerise in order to increase productivity.

It has been recognised by many nations in the world that computers will grow in importance in the near future. Singapore is no different in having that same view. With the call to automate, mechanise and computerise, computers will play a vital role in supporting our industries in their computerisation efforts.

Hence, for the Singapore context, Information Technology has opened up a whole new dimension. In this instance, the software aspect of this new technology has two roles - that of a series of statements or programs instructing the computer to perform a particular task, and that of a basis for a new industry.

The software industry is a high technology, high value added industry - both factors very much attuned to Singapore's own desire to take the Singapore economy beyond that of labour-intensive assembly and manufacturing. The software industry enables high productivity; Singapore has embarked upon a nationwide productivity drive to increase each worker's value added contribution. Software development uses one main resource - that of manpower. Singapore has no other natural resource but manpower.
26. Singapore's economy is very dependent on the economic and trade cycles of the world. To survive, let alone thrive, we must keep abreast of developments within the world. If the world is moving towards the dominance of Information Technology and to the emergence of a new international information environment, then Singapore, and Singaporeans, must be prepared for it.

27. Along with computer education and training, other support structures had to be considered. Singapore's telecommunications facilities are constantly being developed to keep abreast of advances in communications technology. This constant development of our telecommunications facilities is crucial for the support of our computer industry as it allows our computer industry to communicate, and thus to learn from and service other countries. Efforts by the Telecommunications Authority of Singapore to develop an Integrated Services Digital Network whereby telephone, telex, microwave, data communications, etc. services are integrated into a whole will be instrumental in propelling us into the Information Age.

28. The Singapore Government also offers incentives to encourage computer usage. "Soft" loans, with interest rates of some 5%, are offered to civil servants to allow them to buy microcomputers. The cost of computer equipment can be written off in one year through the recently introduced accelerated depreciation scheme. Other types of financial incentives are available - investment allowances, Skills Development Fund, etc.
Information Technology, with its wide-reaching influence on economies, workstyles, work, leisure, etc., has a tremendous impact on society. How do we handle this new technology? What must we do to prepare the people to reap full benefits from this technology? What is the state of the computer industry in Singapore? How ready was it for the Information Age?

STATE OF COMPUTERISATION IN SINGAPORE - 1980-1982

A 1971 United Nations (UN) report entitled "The Application of Computer Technology for Development" was published after the UN had called for an examination of the situation in the developing countries with regard to computing. The report defined four levels of computer activity as shown in the table below:

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<td>Initial</td>
<td>There are no operational computers in the country. A few nationals have had contact with computing. The only local sources of information are computer salesmen.</td>
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<td>Basic</td>
<td>There is some understanding of computers in government (and private) decision centres. A few computer installations are to be found. There are some nationals involved in computer operations. There is some education and training in computer technology in the country. Computers are used in basic government operations.</td>
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LEVELS OF COMPUTER ACTIVITY

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<td>Operational</td>
<td>There is extensive understanding of computers in government (and private) decision centres. Among the numerous computer installations there are some very large machines. There are centres for education and training in computer technology and some are of excellent quality. They offer degree programmes in computer or information science. There is design and production of software and some manufacture of hardware. Computers are affecting many disciplines, particularly science, engineering and medicine.</td>
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<td>Advanced</td>
<td>Most government and administrative work is carried out by computers. There are well established professional activities and national meetings on computers. There is a complete range of quality education and training programmes. The number of computers, of all sizes, is increasing rapidly. Time-sharing, teleprocessing and remote job entry are common. There is design and production of both hardware and software. Many technologies have been or are in the course of being changed. New applications of computers are found regularly. There is strong participation in and contributions to international activities.</td>
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30. The report also analysed Singapore's state of computer development at that time as in transit from basic to operational state:

* some ministries and government departments within the Civil service had computing power for basic systems,
there were some 400 installations,

the Department of Computer Science of the National University of Singapore conducted general degree courses in Computer Science, and

the pool of computer professionals in Singapore stood at 850.

By the end of 1982:

- the user base had grown to 1,800 installations,
- there were 2,800 computer professionals,
- the Civil Service Computerisation Programme, in which 10 ministries were to be computerised in five years, had been initiated,
- other computer training institutes were opened, and
- microcomputers had been introduced at Secondary level and above in the schools.

More importantly, the National Computer Board (NCB) was established in September 1981 to formulate, coordinate, implement and monitor national computerisation policies. Having been established as the national computerisation authority to spearhead Singapore's national computerisation efforts, the NCB was hence tasked to perform three main statutory functions:

- to implement the Civil Service Computerisation Programme
- to establish and maintain standards of computer education and training in Singapore
- to promote and develop the computer services industry in Singapore with the objective of making Singapore a computer software centre.
COMPUTER EDUCATION AND TRAINING

34. One of the conclusions of that 1971 UN report was that :-

- education and training for the application of computers to accelerate the process of economic and social development must receive first priority. (3)

35. Singapore strongly supports this conclusion in her computer education and training policies. These policies are part of a national concerted effort to prepare Singaporeans for life in an Information Society. We have identified three major areas of computer training that are vital to our successful entry into the Information Age :-

- training of dp professionals
- end-user training
- promotion of computer culture.

Training of DP professionals

36. A Ministry of Trade and Industry survey done in 1980 had estimated that we would need about 6,000 - 8,000 computer professionals by 1990 to support the results of the national computerisation effort. This works out to some 600 to 700 computer professionals a year.

37. At that time, the traditional sources of computer professionals were the National University of Singapore (NUS), vendor training schemes and Computer Science graduates from foreign universities. The number of people from these sources,
however, was not enough. Hence, three new training institutes were set up; the Institute of Systems Science, the Japan-Singapore Institute of Software Technology and the Centre for Computer Studies in addition to expanding the existing facilities of the Computer Science Department of the NUS.

Computer Science Department, NUS

38. The Computer Science Department has increased its intake of students and will, from 1985 onwards, produce about 200 graduates a year or about 30% of the annual requirement for new computer professionals.

39. The Computer Science curriculum is closely monitored and revised from time to time to reflect trends in computer technology. The curriculum has just been revised to include courses that will prepare the students for more than just the technical aspects of computing, eg. Information Science rather than Computer Science per se. Seventy per cent of the syllabus is made up of courses that include management sciences, accounting, etc. with the remaining thirty per cent in computing topics like programming, languages, hardware architecture, database design, etc. In addition, a part-time Master's programme was introduced in 1982 and a fourth-year Honours programme has been developed.
Institute of Systems Science

The Institute of Systems Science (ISS) is a joint effort between the NUS and IBM, a multinational computer company. IBM Singapore will provide the ISS with educational, technical and resource support during a four-year partnership.

The ISS offers many courses and programmes, encompassing management education, advanced technical topics, end-user education, consulting services and applied research in information systems. These programmes are aimed at different audiences.

The management education programmes are designed to provide top management with some basic data processing concepts necessary for management of information systems in their organisations. The end-user education programmes provide some knowledge of computer systems to help them understand their user role so that they may be able to maximise their effectiveness in the use of dp resources.

Japan-Singapore Institute of Software Technology (JSIST)

Established in December 1981, the JSIST is a joint effort between the Japanese and Singapore Governments. Under this arrangement, the Japanese Government provides technical assistance to Singapore for the planning, establishment and operation of the Institute.
The JSIST will produce some 250 graduates a year from 1985 onwards. These graduates will have been taught skills such as systems analysis, computer fundamentals, operating systems, data communications, operations research, etc., to prepare them for jobs as programmers. The JSIST also conducts short-term user education and familiarisation courses for non-dp professionals.

Centre for Computer Studies (CCS)

The CCS is a joint venture between the Ngee Ann Polytechnic in Singapore and International Computers Limited (ICL) of the United Kingdom. The CCS was opened in December 1982 and will produce more than 200 new programmers each year after 1986.

The curriculum offered by the CCS is similar to that of the Business and Technical Education Council's (BTEC) Higher National Diploma (HND) in Computer Studies and, to this effect, the CCS' Diploma in Computer Studies has been awarded the HND in Computer Studies.

Skills Development Fund

The various programmes outlined previously are medium and long-term solutions to meet the shortage of computer professionals. It was therefore necessary to encourage the industry itself to train computer
professionals to satisfy the short-term training requirements. This type of training is usually product-specific training which takes less time to conduct. The Singapore Government supports this sort of training through the Skills Development Fund which subsidizes a percentage up to 70% of the costs of sending employees for training to upgrade their skills.

Standards

48. In our efforts to produce large quantities of computer professionals, we also look very closely at the quality and the competence of the computer professionals we are producing. The NCB has been tasked to set and maintain a professional standard in Singapore so as to gain international accreditation and recognition. This is done through publicly held examinations administered by the NCB's Professional Examination Syndicate. The NCB already has a joint examination agreement with the British Computer Society for just this purpose.

End-User Training

49. We hear many horror stories from dp professionals about bad experiences with end-users - the user does not know what he wants, the user keeps changing his mind, the user is uncooperative, etc. Appropriate end-user interaction with the dp professional is therefore, a key ingredient of any DP project implementation.
Courses for end-users are available in the ISS. The challenge now is how to get more end-users educated. More effort is thus required to teach new methodologies using user friendly tools to end users. The NCB has been studying different approaches to this and is planning a User Training Programme for the Civil Service that will be launched soon. Seminars and workshops for end-users organised by various organisation are and will continue to be encouraged.

Promotion of Computer Culture

Every Singaporean should be able to operate in an environment that is fast becoming dominated by computers. That is not to mean that we have to make everyone a programmer or a systems analyst, however, everyone must be aware of the role that computers will play and prepare accordingly.

The very first place to expose large numbers of people to computers is in the schools in which some 25% of Singapore's population study. For those not in schools, there are workers centres where worker union members go for various activities, community centres for the general public, and other centres such as those run by the Singapore Armed Forces Reservists Association and by the Government for civil servants. The Government has introduced a loan scheme to allow civil servants to buy microcomputers at very attractive interest rates.
Computer Education in Schools

53. In 1980, the Ministry of Education embarked on a programme to introduce computer education in the schools. The objective was to expose people to computers at an early age, especially since it is inevitably this generation that will be our future labour force to whom computers must be just one more tool in a whole array of tools. Every secondary school in Singapore has at least three microcomputers. Every Junior College has a minicomputer system.

Trade Unions

54. Our trade unions have also responded to the computer training needs of the general workforce and have embarked on a programme to expose computers to the general workers. Courses on microcomputers appreciation and BASIC programming have been conducted at four workers' centres since April 1982. There are plans to organise courses on database and word-processing packages as well.

Community Centres

55. The Peoples' Association runs Community Centre Computer Clubs, about 40 in all, to promote computer literacy among the general public. Most of the instructors are volunteers from the Singapore Computer Society. Some vendors have also contributed by offering good discounts or through donations. More
than 10,000 people have benefited from the various courses run by the centres.

**Singapore Armed Forces Reservist Association**

The Singapore Armed Forces Reservist Association (SAFRA) runs a microcomputer club at one of its clubhouses. These courses are conducted mainly for SAF personnel and Reservists. They present yet another avenue for those who would like to learn about computers.
55. The Singapore Government's call for automation, mechanisation and computerisation has been well received. Computer usage in Singapore has increased tremendously since the first computer was installed in 1964. In 1979, there were 400 installations, by 1982 there were 1,800 installations, and, by 1985, there should be some 3,600 installations - a phenomenal growth over the last few years and for the next few years.

56. The Information Age will bring about many changes in our lifestyles - the concept of a cashless society made possible with automated credit systems and the electronic funds transfer systems, teletext systems to bring information and shopping conveniences right to the homes, knowledge-based systems as the libraries of the future, computerised medical services, office automation, networking, etc.

57. Computers will therefore become more common-place tools in the world of the future. Hence, every Singaporean must be prepared to deal with computers for day-to-day operations. This preparation must reach all levels of our society to be truly effective.

58. Hence an extensive computer education and training plan to train every Singaporean was embarked upon at the start of the 80s. There are two key ingredients necessary to sustain these education efforts. Firstly, there must be government commitment. This we have in Singapore. The Singapore Government is firmly convinced that we must educate and train our people to accept computers and use them as tools for their jobs. To this effect, the Government has committed some S$170 million for computer education and training from 1982 to 1987.
59. Secondly, the people themselves must see the need to learn the new technology. Fortunately, the response to the Government's call for skill upgrading has been very encouraging. To date, there are about 3,000 computer professionals as compared to the 750 computer professionals in 1979. By the end of 1982, more than 15,000 people have benefitted from computer appreciation courses. When the NCB organised a series of exhibitions in conjunction with Information Week in May, 1983, more than 65,000 people turned up to find out what computers was all about. Proof indeed that the people of Singapore are curious about the computer, TIME magazine's "Machine of the Year" (1982) and are willing to learn more about it.

60. There has been a tremendous amount of effort expended on computer education and training. The work, however, has just begun. It will take a lot of time and even more effort to prepare for the Information Age with the required training for all levels of our society.
FOOTNOTES


BIBLIOGRAPHY


