December 1993

Development of IT Human Resouces: Trends and Practices in Singapore

Boon-Siong Neo
Nanyang Technological University

Development of IT Human Resources: Trends and Practices in Singapore

BOON SIONG NEO[1], Director, Information Management Research Centre (IMARC), School of Accountancy and Business, Nanyang Technological University, SINGAPORE

[1] The study reported in this paper was conducted in collaboration with the IT Manpower Department and the Survey Research Unit of the Singapore National Computer Board. The author would like to especially acknowledge the contributions of Ms Peggy Lim, Wong Chen Yin, and Teh Siew Mong from the NCB toward the successful completion of the study.

ABSTRACT

This paper describes Singapore's strategy for developing its IT human resources, key characteristics of its IT professionals, and the amount of expenditure business firms are investing in developing their IT personnel. It also reports on the organizational practices for the training and development of IT professionals in Singapore.

INTRODUCTION

Specifying, recruiting, and developing IT (Information Technology) human resources was ranked among the top five management issues of most concern to Chief Information Officers in a study conducted in the USA recently (Niederman et al., 1991). The IT executives who participated in the study underscored the word *developing* when considering IT human resources. Keen (1991) contends that the pace and effectiveness of business innovation through IT depend on people rather than technology. Further, downsizing in many US corporations has forced IT managers to do more projects with fewer people, thus forcing a broadening of skills. At the same time, IT professionals are often faced with projects covering a breadth of newer technologies requiring specialized skills. This constant need to acquire new knowledge and skills put tremendous pressure for IT professionals to learn continuously and make IT human resource development a key issue for an organisation's ability to exploit IT effectively (Ginzberg and Baroudi, 1988). Keen compares education for IT professionals to the maintenance required for IT systems to keep its cutting edge. Without constant education and development, today's IT professionals will be a spent force for tomorrow's opportunities.

IT HUMAN RESOURCE DEVELOPMENT IN SINGAPORE

The strategic exploitation of IT is one of Singapore's key cornerstones for building a developed nation by the turn of the century. This goal can only be achieved if there are sufficient numbers of highly trained IT professionals to initiate, develop, and maintain the IT infrastructure and applications that are necessary for Singapore to become "an intelligent island." In the ever changing world of IT, it is imperative that Singapore IT professionals continue their learning and development as a lifelong process so that new developments in IT and management methodologies are constantly evaluated and assimilated into the Singapore IT landscape. The current drive to make IT into a major export industry for Singapore ensures that there will be continued emphasis on IT human resource development so that the best talent may be employed to develop new software products and provide value-added software services to the region.

Development of an excellent high-tech IT industry requires a highly trained and skilled workforce. In 1979, when the Singapore government identified IT as a strategic enabler of future economic development, the need for qualified and trained IT professionals was identified as priority. Therefore, from its very inception in 1980, IT manpower planning and development has been at the core of the National Computer Board's (NCB) mission. The number of IT professionals in Singapore has grown from 850 in 1980 to 8300 in 1988 to 14,000 in 1991. NCB now aims to enlarge this IT professional pool to 30,000 by the year 2000 (NCB, 1991a). NCB's strategy for IT human resource planning and development in Singapore consists of five major building blocks (NCB, 1991b): Create, Convert, Inflow, Upgrade, and Specialize.

The *creation* of entry-level degree and diploma graduates rest with the academic departments at the six tertiary institutions in Singapore, namely, the Nanyang Technological University, the National University of Singapore, the four Polytechnics (Nanyang, Ngee Ann, Singapore, and Temasek). Intakes of students into IT-related disciplines in these institutions have been increasing steadily over the years, with more than 700 graduates in 1991. The success of this concerted education programme can be seen by the impact it has on the current IT professional workforce. In 1991, 75% of the IT workforce have either a diploma or degree, with recent graduates with less than six years of experience making up the vast majority of the IT population.

Graduates from other disciplines who are keen on IT can be *converted* through postgraduate programmes offered by the Institute of Systems Science (ISS) and the Japan-Singapore Institute of Software Technology (JSIST). Both institutes offered graduate diploma courses in software development, and ISS recently offered a course in knowledge engineering. Firms also employ non-IT graduates and convert them to do IT jobs through their own in-house courses and on-the-job training. About 18%, or 400, of all IT professionals recruited by firms in 1990 fall into this category.

Inflow of graduates from outside Singapore come from Singaporeans returning from overseas studies and non-citizens recruited to work in Singapore. In line with Singapore's philosophy of attracting the best talent to contribute in the local economy, regular overseas IT career fairs and recruitment missions are conducted by NCB, the Economic Development

Board, and other multinational firms. Such *inflows* are an important source of trained IT professionals not only during the initial years of Singapore's IT development, but also in the current phase of growth where she seeks to exploit the latest technology more fully. In 1990, foreign graduates (recruited from outside Singapore or returning from overseas studies) added about 300 to the pool of available IT professionals in Singapore. By 1991, one in five IT professionals working in Singapore are of foreign citizenships.

In the ever changing world of IT, Singapore IT professionals must constantly *upgrade* their knowledge and skills to be able to exploit the latest developments in technology. Postgraduate courses offered at the tertiary institutions, and other professional courses offered by IT vendors, consultants, and training firms provide ample opportunities for Singapore IT professionals to keep up-to-date with the latest in IT thinking, products, techniques, methodologies, knowledge and skills.

Specialists and experts are required to harness the potential in emerging technologies in user organizations, to nurture IT research and development, and to attract investments in higher value-added IT industries and niche technologies. Specialized courses are offered by various institutions setup in collaboration with world class expert organizations. These include the ISS (setup with assistance from IBM), Information Communication Institute of Singapore (ICIS, setup in collaboration with AT&T), Japan-Singapore AI Centre, GINTIC Institute of Computer Integrated Manufacturing (with Grumman International), and the Software Engineering Resource Centre. Both ICIS and GINTIC offer graduate level specialist courses, in communications and CIM, respectively.

STUDY OF IT HUMAN RESOURCE DEVELOPMENT PRACTICES

An understanding of the current state of IT professional development practices in Singapore organizations is necessary to enable NCB to formulate appropriate policies and initiatives to plan for the further development of IT professionals. The Industry and Manpower Division in NCB and the Information Management Research Centre (IMARC) at the School of Accountancy and Business, Nanyang Technological University, conducted a study in 1991 to understand the trends and practices of IT professional development in Singapore. The study sought to understand the profile of IT professionals and organizational practices for developing their IT staff. This paper reports some of the highlights of the study. We will briefly describe the study and some relevant characteristics of IT professionals in Singapore. Then we will report on the organizational practices for IT professional development.

An initial field study was conducted in five organizations to understand their IT professional development practices. A questionnaire was subsequently designed and sent to a stratified random sample of 536 IT suppliers and users. 209 organizations completed and returned the questionnaire giving a response rate of 39%.

For the purpose of the study, IT professionals were classified into seven categories: 1) managers, 2) hardware professionals, 3) software professionals, 4) service and support, 5) sales and marketing, 6) training and development, and 7) research and development. IT professionals primarily employed to provide training to other IT professionals represented 3.9% of the IT workforce. The proportion employed in other IT job categories is shown in Table 1.

Table 1: Distribution of IT Professionals

Category of IT Professionals	Percentage
Managers	12.9%
Hardware	6.1%
Software	42.7%
Service/Support	17.4%
Sales/Marketing	8.9%
Training/Development	3.9%
Research and Development	4.9%
Others	3.2%
Total	100%

CHARACTERISTICS OF SINGAPORE IT HUMAN RESOURCES

IT professionals in Singapore are well educated, with 75% having at least a polytechnic diploma or university degree, compared to 58% for human resource executives (NPB, 1991). This trend reflected the government's efforts in providing tertiary-level IT training for professionals to meet the needs of the growing economy.

The Singapore IT professional workforce is relatively young, with 81% less than 34 years old, compared to Singapore human resource executives, with 57% below 35 years old (NPB, 1991). The youthfulness of the Singapore IT workforce is also evident when compared to those in the US. In a recent study, the mean age of IT professionals in the US was about 38 (Igbaria and Greenhaus, 1992).

67% of Singapore IT professionals have fewer than 6 years of working experience compared to 35% of human resource professionals with a similar experience profile (NPB, 1991). The experience profile of IT professionals in Singapore is shown in Table 2. The relative youthfulness and inexperience of Singapore IT professionals is due to the substantial growth achieved in the last few years, with many new graduates entering the IT profession only recently. The number of IT professionals grew about 69%, increasing from 8,300 in 1988 to 14,000 in 1991. The increase in the number of IT graduates have made it easier for employees to hire entry-level professionals and helped reduced the turnover rate from 17.3% in 1988 to 15.4% in 1990. Not surprisingly, employers listed the shortage of experienced IT professionals as their number one problem in IT personnel recruiting.

Table 2: Experience Profile of IT professionals in Singapore

Years of Experience	Percent
Less than 1 year	13.6%
1 to 3 years	33.8%
4 to 6 years	20.1%
7 to 10 years	14.4%
More than 10 years	18.1%

In a profession where the underlying technologies are undergoing substantial changes every year, the relative youthfulness of IT human resources may be an advantage to Singapore's attempt to exploit the latest in IT. The knowledge and skills of such professionals would still be fairly up-to-date since they had left school only recently. Being young, they are also more likely to be willing to learn newer methodologies and technologies, and incorporate these in their work patterns. The study confirmed this observation when employers reported that Singapore IT professionals like to work on interesting and state-of-the-art projects, and are more likely to stay with an organization that provides systematic professional development opportunities that increase their knowledge, sharpen their skills, and shape their attitudes. The study also found that inadequate emphasis on professional training and development was ranked third among reasons that IT vendors and business user organizations reported for the turnover of their IT professionals. The government departments and statutory boards seemed to fare better in this respect, and the lack of emphasis on IT professional development was not a major cause of turnover. However, the relative youthfulness of IT professionals may constraint the ability of organisations to pick from among them leaders who would have the knowledge, maturity and experience to manage the growing level of IT investments and resources.

The need to understand the trends and practices of IT professional development in Singapore is thus a matter of some urgency. The challenge for the development of IT professionals in Singapore is thus threefold: 1) To keep pace with the worldwide developments in IT, 2) To provide adequate training and guidance to a relatively young professional workforce, and 3) To identify and prepare IT professionals to provide leadership in various areas of IT careers. The implication for organizations that depend increasingly on IT for their survival and strategic success is clear: they would have to give adequate emphasis, structure, and time for IT professional development in order to retain their best IT expertise and keep them on the cutting edge of "best practice."

TIME SPENT IN IT TRAINING AND DEVELOPMENT

Singapore firms are investing more in the training of their IT professionals. IT professionals spent about 13.2 days each in training and development in 1991, an increase of about 2 days (17%) from 1990. In every job category, IT professionals are spending more time in training in 1991 compared to 1990. Job categories that spent more than the average training days per year were R&D staff (17.1 days), software professionals (14.7 days), sales and marketing staff (13.7 days) and hardware professionals (13.6 days).

Newly recruited IT professionals spent considerably more time in training as expected. On average, they spent 18.5 days each in training in 1991, about 5 days (40%) more time than other IT professionals. The pattern of training intensity for different job categories are similar to those of more experienced professionals, with R&D having the highest training days at 35.2 each.

The absolute time spent by new IT professionals also showed an increase over 1990 though by a smaller margin of 0.8 days or 4.5%. The biggest increase in training time was in the IT R&D category. This is not surprising as many organizations were just beginning to set up their R&D units and the increase reflected the start-up training and exposure given to their newly recruited R&D professionals. The time spent by IT professionals in training in 1990 and 1991 by job categories is shown in Table 3.

Table 3: Average Number of Training Days Per IT Professional Per Year

IT Job Categories	Existing IT Profs		New IT Profs	
	1990	1991	1990	1991
IT Managers	10.7	11.1	12.8	13.1
Hardware	11.2	13.6	17.4	17.5
Software	13.5	14.7	21.0	21.7
Service/Support	10.5	13.1	18.2	18.6
Sales/Marketing	12.2	13.7	15.5	16.9
Training/Education	11.6	11.8	17.6	18.5
Research & Devt	16.9	17.1	28.2	35.2
Overall	11.3	13.2	17.7	18.5

EXPENDITURE FOR IT TRAINING AND DEVELOPMENT

All collected measures of expenditure showed that organizations in Singapore are spending more in providing for the development of their IT professionals. In 1991, the median expenditure for IT training and development per organization was $25,500, up from $15,000 in 1990 and $10,000 in 1989. On the average, organizations in Singapore spent about $2,600 for the development of each IT professional in 1991. Expenditure for IT training from 1989 to 1991 is shown in Table 4.

Table 4: Expenditure for IT Training for 1989 to 1991

IT Training Expenditure $	1989	1990	1991
$10,000 or less	51.5%	37.6%	36.3%
$11,000 to $50,000	25.3%	40.0%	34.2%
$51,000 to $100,000	10.1%	8.0%	15.1%
More than $100,000	13.1%	14.4%	14.4%
Median Per Firm	$10,000	$15,000	$25,500
Average Per IT Professional	NA	NA	$2,682

Firms spent about 5% of their IT payroll on IT training and professional development in 1991, up from 3.6% in 1989. This is substantially higher than the average 2% of payroll that Singapore firms spent in 1990, and even higher than the 4% goal that the National Productivity Board is seeking to achieve (NPB, 1990). IT training expenditure as a percent of IT payroll is shown in Table 5.

Table 5: IT Training Expenditure as a Percent of IT Payroll

IT Training Expense as a % of IT Payroll	1989	1990	1991
2% or less	24.5%	22.5%	19.1%
2.1% to 4%	34.0%	19.2%	25.8%
4.1% to 6%	10.6%	18.3%	13.9%
6.1% to 8%	4.3%	4.2%	9.6%
More than 8.1%	26.6%	35.8%	31.6%
Median Per Firm	3.6%	5.0%	5.0%

Expenditure on IT training has also been growing faster than the growth in total IT expenditure. IT training expenditure as a percent of total IT expenditure grew from 2.0% in 1989 to 2.1% in 1990, and 2.7% in 1991. IT training expenditure as a percent of total IT expenditure is shown in Table 6.

Table 6: IT Training Expenditure as a Percent of Total IT Expenditure

IT Training Expense as a % of Total IT Expense	1989	1990	1991
1% or less	32.6%	19.8%	20.6%
1.1% to 2.0%	20.2%	28.8%	23.1%
2.1% to 3.0%	12.4%	12.7%	9.5%
3.1% to 5.0%	10.1%	9.9%	15.8%
More than 5.0%	24.7%	28.8%	31.0%
Median Per Firm	2.0%	2.1%	2.7%

IT HUMAN RESOURCE DEVELOPMENT PRACTICES

About 25% of responding organizations indicated that they had specialized groups or departments catering to the training and development of their IT professionals. Among IT vendors, which have higher concentrations of IT professionals, the percentage is higher at 30% compared to 21% for user organizations. About 51% indicated that they have structured training plans for IT development, and about 52% indicated that they spent more on training for IT professionals compared to other professionals. These organizational arrangements for IT professional development reflect their perceived importance and the commitments that organizations are willing to make to train their IT staff.

Table 7: Organizational Arrangements for IT Professional Development	% of Respondents
Have specialized training department for IT professionals	24.6%
Have structured training plan for IT professionals	51.2%
Spends more on training for IT professionals vs others	51.7%

In one organization, management demonstrated their commitment to the development of IT staff by supporting a structured one-year programmme that require all IT professionals to spend a half-day each week of company time to work through it. In our field studies, we found that the structure of IT professional development were very much influenced by the number of IT professionals employed and general organizational culture and practice. Firms employing large numbers of IT professionals tend to be more structured in their planning for training and are more likely to devote organizational resources to develop and monitor training.

In terms of training methhds, the most popular is on-the-job learning followed by classroom courses either conducted in-house or by external parties. This pattern was similar to the training methods used for human resource executives (NPB, 1991). The rankings of methods used for IT professional development is shown in Table 8. The predominance of on-the-job training as a primary method may be due to the unique culture, policies, systems, procedures, and work patterns adopted by each organization, and the desire of many organizations to socialize their new recruits and existing personnel with such adopted practices. Many organizations recruit IT professionals that have the basic knowledge and technical training, and allowed them to learn by doing the specific methodologies, processes, technical platforms, and procedures used by the organization. In terms of training courses, organizations seem to adopt both planned and opportunistic approaches. There would be some courses (e.g. object-oriented programming) identified for specific employees to equip them for specific tasks or projects. Other courses tend to be opportunistic, and organizations respond to employee requests to attend courses, or scan through information sources (brochures, newspaper advertisements, etc.) that announce courses that are being offered by various groups.

Computer-based packages or self-study ranked fourth and job rotation ranked fifth in terms of their use for IT professional development. The cost of sponsoring employees to degree/diploma programmes and residencies may have led firms to be selective on who among their employees should get the sponsorship, and therefore use these training avenues less frequently. The cost of these programmes goes beyond the direct fees involved. Our interactions with firms indicate that many are concerned about the opportunity costs involved With a prevailing shortage of IT personnel and backlog of projects, many organizations are reluctant to release their IT professionals for extended periods of time for formal courses.

Table 8: Methods used for IT Professional Development (By rank order)	
1.	On-the-job training
2.	External seminars and courses
3.	In-house classroom training
4.	Computer-based training/Self-study
5.	Job rotation
6.	Degree/Diploma educational programmes
7.	Conferences
8.	Industrial attachments/residencies

TRAINING FOR NEWLY RECRUITED IT PROFESSIONALS

Training for newly recruited IT professionals consisted largely of orientation to the company, observing experienced staff perform an assignment, and some form of courses or self study. The rank order of methods used for training newly recruited IT professionals is shown in Table 9.

Further, 58% of respondents indicated that they assigned an experienced staff to be a mentor to the new recruit. 85% of these mentor were assigned for periods of greater than three months. The distribution of mentoring period is shown in Table 10.

Table 9: Methods Used for Training Newly Recruited IT Professionals

Methods for Training Newly Recruited IT Professionals	% of Respondents
Orientation to the organization	85.9%
Observing experienced staff	71.7%
Attend external courses	69.3%
Attend in-house training courses	68.3%
Self -study	66.8%
Computer-based training packages	49.3%
Specially-tailored assignments	39.0%
Sponsorship to degree/diploma courses	25.4%
Job rotations	16.6%
Industrial attachments	5.4%

Table 10: Mentoring for Newly Recruited IT Professionals

Average time for assigned mentor	% of Respondents
2 months or less	15.0%
3 to 5 months	38.3%
6 months or more	46.7%

MANAGEMENT ISSUES IN IT PROFESSIONAL DEVELOPMENT

The issues raised by respondents included the high fees for IT courses, the busyness of staff, and the uncertainty concerning the value of such courses to the firm. Firms are concerned about the out-of-pocket fees and the opportunity costs of work left undone because of time spent attending courses, especially for firms employing relatively few IT professionals. Some firms have indicated that IT developmental courses have not resulted in direct benefits to the firm. The concerns raised here are certainly valid when we consider the amount of expense that firms are spending on IT training. The issue of evaluating the value of training and development also surfaced during our field studies. While some managers see IT professional development as a long-term investment and therefore do not see it necessary to ascertain the benefits of every course, other managers were concerned that their organizations were not getting enough payback from IT training. Other issues are also listed in Table 11.

Table 11: Rank Order of the Most Significant Issues in IT Professional Development

1.	Fees for courses are too high
2.	Staff are too busy to attend courses
3.	Desired courses are not available
4.	Value of courses are uncertain
5.	Courses have not resulted in any direct benefits to the business
6.	Staff unwilling to relocate overseas
7.	Company do not view IT professional development to be important

DEVELOPMENT COURSES FOR IT PROFESSIONALS

Table 12 lists for each IT job category, the seven courses that organizations perceived to be most important for developing their IT professionals. The courses listed were not unexpected and reflected the job priorities and expectations of each category of IT professionals. The list in Table 12 provides a base for organizations wishing to develop a structured training roadmap for their IT professionals. For IT vendors providing training courses, Table 12 provides the basis for designing courses that may be marketed to user organizations.

Table 12: Important Development Courses for Different Categories of IT Jobs

IT Managers	**Sales and Marketing**
IT planning	Presentation skills
People management	Sales techniques
Project management	Negotiation
New IT developments	Interpersonal communicatio
Interpersonal communications	Marketing management
General management	New IT developments
Presentation skills	Consulting
Software professionals	**Training and Education**
Development methodologies	Presentation skills
Systems analysis and design	Interpersonal communicati
Interpersonal communications	New IT developments
Programming languages	Software development
Project management	Communications/Networki
Database	Programming languages
Communications/Networking	People management
Hardware professionals	**Research and Developmen**
Computer architecture	New IT developments
Machine-specific languages	Software development
Interpersonal communications	Communications/Networ
Systems programming	AI/Expert Systems
Computer security and control	Objected-oriented technol
New IT developments	Programming languages
Project management	Systems programming
Service/support professionals	
Interpersonal communications	
Communications/Networking	
Computer security and control	
Database	
Machine-specific languages	
Programming languages	
Quality assurance	

CONCLUSIONS

The practices and trends reported in this paper came from

the first study of IT professional development in Singapore conducted in 1991. It provides a baseline to track the progress of IT professional development practices. Future studies will continue to monitor the trends identified and also seek to assess the value and effectiveness of different IT professional development practices. The major conclusions from the current study are:

1. A high percentage (75%) of IT professionals in Singapore have strong educational qualifications at the diploma or degree level. This trend will continue as local polytechnics and universities continue to expand their intake of students into IT and IT-related disciplines.

2. The Singapore IT professional workforce is young and relatively inexperienced. This increased the value and urgency for appropriately structured IT professional development programmes that may impart knowledge, skills, and attitudes so that Singapore IT professionals may accelerate their learning and maximize their contributions to their organizations.

3. IT professionals recognized their need for on-going training and development, and had been willing to leave their existing employers when they do not adequately provide for such training and development.

4. Organizations in Singapore are investing more time and money to the professional development of their IT human resources. Not only are absolute time and expenditure increasing, training and development expenditure are increasing at a faster rate than IT payroll and other IT-related expenditure.

5. The dominant method of training for IT professionals is on-the-job training. For newly recruited IT professionals, company orientation and role modeling were widely used. Attending courses, whether in-house or external, is also an important mode of professional development adopted by many organizations. In using external courses, organizations were concerned both about the high fees charged for such courses and the value that such courses add to the skill profile of their IT people.

REFERENCES

Ginzberg, M.J. and Baroudi, J.J. "MIS Careers - A Theoretical Perspective," Communications of the ACM, May 1988.

IBF 1991. Manpower and Training Needs for the Financial Sector, a special report published by the Institute of Banking and Finance, Singapore, 1991.

Igbaria, M. and Greenhaus, J.H. "Determinants of MIS Employees' Turnover Intentions: A Structural Equation Model," Communications of the ACM, February, 1992.

Keen, P.G.W. Shaping The Future, HBS Press, 1991.

NCB 1989. Singapore IT Manpower Survey 1989, published by NCB, 1989.

NCB 1991a. National Computer Board 1990/1991 Annual Report.

NCB 1991b. IT Manpower Planning Framework, published by NCB, 1991.

Niederman, F., Brancheau, J.C., and Wetherbe, J.C. "Information Systems Management Issues for the 1990s," MIS Quarterly, December 1991.

NPB 1990. National Productivity Board 1990 Annual Report.

NPB 1991. 1990 Survey on Human Resource Management Practices in Singapore, report published by the National Productivity Board, 1991.