Chapter Six

Information Technology Policy

Introduction

Information Technology (IT) planning is the most important agenda of science policy in Malaysia, in the last decade of 90s. The information technology policy of Malaysia is relatively the most developed policy, in terms of vision, formulation, and infrastructure development. Two important themes run through the IT planning in Malaysia. (i) The recognition that IT is the strategic technology to Malaysia's socio-economic development planning. (ii) The understanding of IT revolution as more than any other technological change. In short, IT is viewed to have a fundamentally progressive impact on the economy (especially in terms of efficiency) and in the improvement of the quality of life of the general population.[298]

This chapter discusses IT policy and management in Malaysia. The discussion in this chapter centers on the vision and mechanisms of developing an Information Society and the efforts made by Malaysia to achieve this goal. In addition, this chapter looks at the development of institutions for IT development

[298] Government of Malaysia, *Industrial Technology development: A National Plan of Action*, (Kuala Lumpur: MOSTE, 1990), p.45.

as well as the development of institutions such as MIMOS, JARING, NITC, MDC, and MSC and its Flagship Applications.

Information Technology: Definition

Information Technology is defined as a convergence of computers, telecommunications, and information.[299] In broad terms, IT embraces the scientific, technological and engineering disciplines including the management of techniques used in information handling and processing, and their applications. In addition, IT, as a discipline, also addresses the interaction of computer with man, and associated social, economic and cultural matters.[300] In Malaysia, IT is understood in these broad terms.

As projected in the various government documents on IT, it is apparent that IT is not treated as an isolated instrument developed outside the parameters of the society. It is understood in the context of Information Society. The latter is Malaysia's national vision of a future society whose mainstay is IT. Information Society is defined, in this context, as 'an emerging state of human social and cultural development where information and knowledge are the key factors of progress. They provide people and societies with new ways of creating value in all its forms: economic, political, material, physical, intellectual and even spiritual.'[301]

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[299] Brian K.Williams, Stacey C. Sawyer and Sarah E. Hutchinson, *Using Information Technology: A Practical Introduction to Computer & Communications*, (USA: Richard D. Irwin, Inc, 1995), p.2.

[300] *Concise Encyclopaedia of Information Technology*, (Gowen Publishing, 1982), pp.1-2.

[301] Tengku Mohd. Azzman Shariffadeen, "Moving Towards More Intelligent Use of Human Intelligence", *MIMOS IT papers,* No. 11., (Kuala Lumpur: MIMOS, 1995), p.2.

IT is, then, not understood simply a technology (or the convergence of technologies), but one that enhances human capacity to acquire and use information and knowledge.[302]

Moreover, Information Society is rooted in the notion of development of human intelligence and knowledge. In this, the development of human intelligence and knowledge are ends in themselves rather than merely means to the material development of life. The latter characterizes the industrial society.

Information Society

The assumption embedded in the definition of Information Society is that it will rise in all nations, catalyzing the process of social change and transformation of the people's values, behavior and culture. These changes are driven by and structured around an enhanced role of information and knowledge in life and work.[303]

It has been argued that IT is not merely a convergence of technologies, it is also a convergence of nations, cultures and people.[304] It follows that, the information revolution-taking place is not merely a technological change; it is a socio-cultural change as well involving a transformation in culture, beliefs, values and behavioural patterns of the people.[305]

It is a sociological change expressing a pattern of human behaviour conditioned by a multitude of factors: cultural, economic and technological. The

[302] Tengku Mohd. Azzman Shariffadeen, "Information Technology and Rural Development in Malaysia" *MIMOS IT papers*, No.7., (Kuala Lumpur: MIMOS:1994), p.12
[303] Ibid.
[304] ibid, p.13
[305] ibid.

difference here is that the moderating factor is IT. It is IT that is the key influence on the rapid rise of the Information Society. However, but by itself IT is only an opportunity it is society that acts as the ultimate arbitrator of its actual importance.[306]

Among the most important concept of knowledge society is the epistemological distinction between knowledge and Information. Information is concerned with quantity, which comes with the perceptions of 'more the merrier', while knowledge itself is more factual and is embedded in a society's culture and values.[307]

Owing to the diversity in cultures and values and social structures there cannot be a single model of Information Society applicable to all. In order for each society to make good use of these opportunities, their vision of Information Society should be based on the values and socio-cultural settings of their society. To Malaysia, this emerging society is the Knowledge Society, where knowledge is the foundation of their value and social structure.

Malaysia's preference for a knowledge society over information society is rooted in the notion that information is concerned with qualities which is less substantive than knowledge.

Thus, in this model of Knowledge Society, human values and cultures take precedence, governing the process of technology development.[308] This is so

[306] Ibid, p.10.
[307] Ibid.
[308] Tengku Mohd Azzman Sharifadden, *MIMOS IT papers*, No.11., p.18.

because the fundamental shifts in society are not simply the outcome of technological push but are predominantly due to new perceptions of human needs and new ideas about tool inventions.[309]

To accomplish her vision of Knowledge Society Malaysia has embarked a three-pronged strategy. The first strategy is to build and develop the appropriate IT infrastructure, the second strategy aims at creating and developing the demand-driven enrichment systems or IT-based applications. The third strategy focuses on the human development effort, which would involve all educational and training systems, whether formal or informal, all the way from the primary to the tertiary including continuing education system.[310]

These strategies translated into policy planning have been translated to meet three key requirements. First, application of the most advanced technologies, second, employing a phased yet focused approach (in terms of geographical location) and third, the application of new technologies in economic and social development.[311]

The development of such an envisioned society is heavily conditioned by the availability of, among others, the IT infrastructures and human resources. Realising this, Malaysia has established various IT institutions and supporting projects. Institutes like MIMOS, JARING, NITC, MDC, and projects like MSC and its flagship applications discussed below.

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[309] Ibid, p.6.
[310] Kamarul Yunus, "PM - Gates to be on MSC Board", *Business Times, New Straits Times*, 16 August, 96
[311] Tengku Muhamad Azzman Shariffadin, *MIMOS IT papers*, No.11., p.17.

IT Infrastructure

The development of IT infrastructure in Malaysia has taken place mostly in the last decade of the 90s. It is therefore expected that the IT industry in this country to be relatively underdeveloped and largely owned by the foreign MNCs whose business and technology plans are driven by their particular commercial goals.[312] Currently the technologies brought into the country by the MNCs IT industries are limited to specific narrow disciplines such as semiconductor assembly, testing and production. In addition, the linkages between MNC-owned companies and local suppliers are weak, for instance most of the materials and components used in the production are imported.[313]

This situation is a challenge that need to be addressed in order to promote the development of IT in Malaysia as envisioned by the IT policy. Indeed several initiatives taken by the government has improved the IT infrastructure in the country. Perhaps the more important was the establishment of the first institute called the Malaysian Institute of Microelectronics (MIMOS) was established. Other institutions such as NITC, and the MDC later followed this.

MIMOS

MIMOS, a research and development institute was established in 1985 under the Prime Minister's Department. It was later transferred to the Ministry of Science, Technology and the Environment in 1990. In November 1, 1996 MIMOS became corporatised body became MIMOS Berhad.[314]

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[312] Tengku Mohd Azzman Sharifadeen, "IT and Development - Malaysia's Experience" *MIMOS IT papers*, No.2., Kuala Lumpur: MIMOS:1987), p.1.
[313] Ibid.
[314] www.jaring.my/mimos/bi/corp/overview2.html "MIMOS: An Overview", 1997, p.1.

The main thrust of MIMOS is to promote microelectronics and IT as strategic technologies for national development. Other objectives of MIMOS are to develop an integrated electronics industry that would enhance industrial innovation and competitiveness. MIMOS also develops effective and efficient processes in production, manufacturing, commerce and services.[315]

It is also part of the country's long-term strategy to develop a strong indigenous capability in microelectronics and information technology. Therefore, MIMOS is to work in partnership with companies and government agencies in a wide spectrum of activities, particularly in the field of R&D.[316] In developing R&D, MIMOS has undertaken six main programs; they include: *Centre for Intelligent Machines*, *Computer Systems Technologies*, *Integrated Circuit Design Centre*, *Semiconductor Technology Centre*, *Advanced Electronic Manufacturing*, and *Broadband Telecommunication Technology*.[317]

Although being relatively new in the area, MIMOS has successfully carried out some of these projects. In the Computer Systems Technologies, for example, major research programs undertaken by MIMOS include; Bahasa Malaysia Technology, Computer Networking, and Computer in Education and Management Information System (MIS).[318]

So far, a Bahasa Malaysia word processor *(BMTech)* has been developed that includes Bahasa Malaysia spellchecker and other e-mail facilities. Moreover,

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[315] MIMOS, *MIMOS: Service to Industry*, (Kuala Lumpur: MIMOS, n.d.), pp.2-3.
[316] MOSTE, *Annual Report 1994* , p.38.
[317] http:\\www.jaring.my/mimos/bi/rd/rdproject.html , "MIMOS: R&D Projects", 1997., p.1.
[318] http:\\www.jaring.my/mimos/bi/rd/tek-komputer.html

in the area of Computer Networking, MIMOS has established JARING. The later is a computer network that provides global Internet services to hundreds of thousands of individuals and big number of institutional and commercial clients.[319]

In the field of education, MIMOS with the Ministry of Education and the computer industry has jointly planned and executed a national program to apply Computers in Education (CIE). This has led the production of an authoring tool called ComILS (Computer Integrated Learning System) and a low cost computer - ATOM.[320], MIMOS has developed two Office Automation Systems using client-server technology; Personnel System and Filing Systems.[321]

MIMOS's Integrated Circuit Design Center (ICDC), provides and develops local expertise and comprehensive solutions for Application Specific Integrated Circuit (ASIC) applications. ICDC provides a variety of cores which includes RISC and DES processors, telecommunication chips and DSPs. The Center also develops better design methodologies for these high-level building blocks which can be integrated on ASIC to provide cost effective and reliable solutions.[322]

Furthermore, MIMOS has also gone into developing of semiconductors for local as well as international markets. To affect this it has established Semiconductor Technology Center. The Center, capable of handling submicron processes, is used both for R&D as well as small-scale production and prototype development. As a first step the Center has undertaken three major research

[319] Ibid.
[320] Ibid.
[321] Ibid.
[322] http:\\www.jaring.my/mimos/bi/rd/icdc/icdcprof.html , "MIMOS: ICDC", 1997, p.1.

programs, they include; Failure Analysis and Reliability Testing, and Interconnection and Packaging.[323]

Failure Analysis and Reliability Testing program helps to set-up infrastructure for failure analysis and reliability testing of VLSI integrated circuits. Interconnection and packaging facilitate the R&D activities in integrated circuits (IC) packaging technology and pave the way for moving into multi-chip module technology.[324]

From the early days of 1985, when MIMOS began with only six staff, the Institute has grown to employ more than 250 people currently. This figure will swell to more than 1,000 people by the year 2000. Mimos is set to become one of the region's biggest employer of researchers and scientists specialising in microelectronics and Information Technology.[325]

JARING

Joint Advanced Research Integrated Networking (JARING) a computer network, was launched in 1991 as an extension to *Rangkom*, which was a smaller computer network developed under the Fifth Plan.[326] JARING is a computer network developed by MIMOS Berhad that links Malaysia to other networks around the world via leased-line connections to USA/Canada, Japan and Singapore.[327] It has initially establish an integrated data communication network. Apart from providing data and information, JARING is also involved in studying and evaluating the use of data communication technology and its impact on the

[323] http:\\www.jaring.my/mimos/bi/rd/bts/rdbts.html , "MIMOS: R&D", 1997.p.1.
[324] Ibid.
[325] www.jaring.my/mimos/bi/corp/10th/human.html , "MIMOS: Human Resources", 1997, p.1.
[326] *The Sixth Malaysia Plan*, p.458.
[327] http://www2.jaring.my/jaring/info/index.html, "Jaring", 1997, p.1.

socio-economic activities.[328] JARING has offered access to at least 63 countries with thousand of databases dispersed world-wide and more than 20 million computer users.[329]

So far, JARING has installed its switching nodes in most major towns in Malaysia – Kuala Lumpur, Penang, Alor Setar, Ipoh, Kuantan, Kuala Trengganu, Kota Bharu, Seremban, Melaka, Seri Gading, Johor Bahru, Kuching, Sibu, Bintulu, Miri and Kota Kinabalu.[330] Within the Klang Valley area, the nodes are in Damansara, Brickfields, Petaling Jaya, Shah Alam, Klang, Kajang and Bangi.[331] See JARING Topology in the next page. In these areas JARING users can access JARING/Internet through dialup lines or leased (dedicated) lines of either analog (low speed) or digital (high speed) type as well as ISDN access.[332]

Moreover, to ensure equitable and affordable access by people in both urban and rural areas, a new node in Miri, Sarawak was added on 6th October 1995. Other nodes in Sibu, Bintulu, Seremban, Tawau, Sandakan and Kudat are in the pipeline. The number of access nodes has reached about 100. This network will eventually be fully integrated with the new development in the Putrajaya Intelligent City and Multi-Media Supercorridor.[333]

The existing circuits totals 5,000 km which run at 64, 128, 256, 512, 768 or 1,536 kbps (depending on localities) will be upgraded to run at multi-megabit per second (mbps) speeds as the demand grows. Some circuits may even run at

[328] Ibid.
[329] www.jaring.my/mimos/bi/corp/10th/9195.html, "Jaring", 1997, p.1.
[330] Ibid.
[331] Ibid.
[332] Ibid, p.3.
[333] Ibid.

more than 100 mbps. High-speed backbone network will be required to support multi-media applications for commercial transactions, distance education, health services, and government administration.[334] For example, JARING, provides the platform to develop JARING ILMU - an integrated nation-wide library information system that connects local and international databases.[335]

As a result of these efforts by MIMOS, in the past few years the IT industry has grown rapidly. The impact of IT on the industry, economy and society is now more visible. Nevertheless, the rapid growth of IT in Malaysia and its impact on people's life have raised fundamental questions as regard to the further impact of IT on society and its institutions. To address these questions and to co-ordinate MIMOS activities in ensuring the right use of IT by the society, the government has taken the initiative to formulate policies and frameworks for IT industry in the country. The government has established an independent council (National Information Technology Council) that is in charge of policy formulation for the IT.

National Information Technology Council

The NITC is an initiative by the Malaysian government, in the field of IT, to enhance the development and utilisation of IT for national development. The NITC acts as a think-tank at the highest level and advisor to the Government on matters pertaining to the development of IT in Malaysia.[336] The Chairman of NITC is the Prime Minister of Malaysia and the Deputy Chairman is the Deputy

[334] Ibid.
[335] http:\\www.jaring.my/mimos/bi/rd/tek-komputer.html "MIMOS: R&D", 1997, p.1.
[336] NITC, *National Information Technology Council*, (Kuala Lumpur: MIMOS, n.d.), p.1.

Prime Minister. The President and Chief Executive of MIMOS Berhad is an ex-officio member and the Permanent Secretary to the Council. The Secretariat to the Council is emplaced in MIMOS Berhad.[337]

Membership of the Council comprises representatives from the public and private sectors on a 50:50 ratio. They represent the interests of various aspects of IT development such as microelectronics, telecommunications and computer technologies. The Prime Minister appoints members for a three years term.

The objectives of NITC include formulation of strategies for IT utilisation and development, and management and co-ordination of activities pertaining to the use and development of IT. NITC also undertakes activities to establish IT standards, to monitor the implementation of programs and projects pertaining IT, and support the HRD in the field of IT. Finally, NITC aims at enhancing the use of IT with the objective of improving the performance of organisations and individuals performance at all levels of society.[338]

To achieve this, four essential roles of the NITC have been identified: strategic planning, co-ordination and evaluation, technology assessment and forecasting, and promotion.

Strategic Planning: Strategic planning encompasses activities such as formulating development programs to enhance national competitiveness. This will be done through identifying national priorities, determining the objectives of IT

[337] Ibid.
[338] Ibid. p.2.

development and enabling the restructuring of key organisations and institutions to take advantage of IT.[339]

Co-ordination and Evaluation: In co-ordination and evaluation area, the Council focuses on co-ordinating the following activities: monitoring and tracking progress in development programs. This includes human resource development. formulating performance indicators and IT standards. It also focuses on evaluating the effectiveness of IT use in organisations by building the appropriate legal framework for regulation and development of the sector and providing incentives for accelerated growth.[340]

Technology Assessment and Forecasting: In technology assessment and forecasting, NITC aims at assessing and forecasting future technology trends and their likely impact on the economy and society which is crucial for proactive planning. This is to monitor future trends that are needed to construct and disseminate widely in order to increase awareness and facilitate planning.[341]

Promotion: Promotion in this context refers to the promotion and explanation of the potential of IT for the transformation of society in all its dimensions. In this area, NITC is involved collects basic data and information and than directs them to the key users. It also include disseminating awareness, holding appreciation programs, and initiating focused programs for important target groups. Finally, since these programs involve a wide cross section of the people, NITC will have

[339] Ibid.
[340] Ibid, p.3
[341] Ibid.

to cooperate with a diverse group of organisations: public sector, private industry, trade unions and NGOs.[342]

Furthermore, NITC functions as an advisory and consultative body rather than as a regulator. It is believed that, any attempt to regulate and control will only constrain creativity and limit progress due to the rapid rate of technical advancement in IT which requires organisational restructuring and change in work and culture. For this reason, it is left to the organisations themselves to take the responsibility for its planning and implementation, guided by the principles established by the NITC.

Multimedia Development Corporation (MDC)

MDC is a government-appointed, government-backed corporation established to lead the development and management of the MSC.[343] The MDC's mission is to ensure that the goals of MSC are rapidly and efficiently achieved. To ensure this, MDC aims at shaping a world-leading environment, attracting leading edge and world-class companies. It also facilitates knowledge transfer, wealth creation, and builds a well-mandated, value-based, highly effective institution.[344]

While owned and funded by the government, the MDC closely works with private companies in setting up operations in the MSC. The MDC serves as promoter and facilitator.[345] In addition, MSC provides written information and advice to the companies interested in entering in the MSC. MDC will also assist

[342] Ibid, p.4.
[343] http://www.mdc.com.my/mdc/index.html, "Multimedia Development Corporation", 1997, p.1.
[344] Ibid.
[345] Ibid.

in expediting and license approvals, and introduces companies to potential local partners and financiers.[346]

Multimedia Super Corridor (MSC)

The MSC is a 15-by-50 kilometre (9-by-30 mile) zone extending south from Malaysia's present capital and business hub, Kuala Lumpur. The MSC is currently the most significant national initiative in IT development application of Malaysia. The MSC is expected to provide the catalyst for IT development in the country through demonstrating the effectiveness of multimedia in increasing efficiency and productivity in the production and delivery of goods and services both in the public and the private sectors.[347]

MSC is expected to be the major catalyst in creating supply and demand for local the multimedia industry and for the world market. This includes ensuring the installation of appropriate technology to maximise the utilisation of the infrastructure available in the MSC. The latter include the the KLIA, Putrajaya, the transportation network and the electronic super highways.[348]

The creation of MSC is in line with the policy to leapfrog Malaysia into leadership in the Information Age. The policy is to be realised in three phases. First, the creation of MSC with the milestones of 1 corridor, fifty world-class companies, 7 flagship applications, world-leading framework of cyberlaws, and the cyberjaya an intelligent city.[349] The second phase starts with linking the MSC to other cybercities in Malaysia and world-wide. This include creating web of

[346] Ibid.
[347] *The Seventh Malaysia Plan*, 1996-2000,p.464.
[348] Ibid.
[349] NITC, *MSC Vision: 2000 to 2020, Building the Malaysian Multimedia Super Corridor*, (Kuala Lumpur: MIMOS, 1997, p.1.

corridors, 250 world-class companies, setting global standards in flagship applications, harmonising global framework of cyberlaws, 4-5 intelligent cities that will be linked to other global cybercities. The third phase which is the completion phase transform Malaysia into a knowledge society. In this stage MSC will cover the rest of Malaysia with 500 world-class companies, global test-bed for new multimedia applications, international CyberCourt of Justice MSC, and 12 intelligent cities linked to global information highway.[350]

The companies with firm commitments to set up R&D facilities include, Fujitsu, DHL, Mitsubishi, NCR, NEC, British Telecoms, Reuters, Nortel, NTT, Siemens, Sumitomo, SUN Sharp, HCL, Sapura, MIMOS, AIMS Worldwide, PNB, TV3, Telekom Malaysia, Alam Teknokrat, Renong Solutions, IOI Multimedia, and CSA. The joint venture agreements include seven agreements in the U.S., two agreements signed in Kuala Lumpur: Alta Vista and Sun Microsystems. Two agreements were signed in Canada and two were signed in (University Putra Malaysia) UPM .[351] The first phase of MSC development has already began with the launch of its Seven Flagship Applications.

Flagships Applications

Seven Multimedia industries have been targeted for development by the year 2000. The Government in partnership with the private sector will initially develop the flagships. These Flagships include; (i) *Electronic government*, (ii) *Smart schools*, (iii) *Telemedicine*, (iv) *R&D clusters*, (v) *National multipurpose card*, (vi) *Borderless marketing centers*, and (vii) *Worldwide manufacturing webs*.

[350] Ibid
[351] Ibid

(i) Electronic Government

Envisaged as a multimedia networked and paperless administration, the electronic government is to link government agencies in the capital, with other government centres around the country. This is to facilitate a collaborative government environment and efficient service to business and citizens.[352]. The concept of electronic government is based on the notion of efficiency, and high quality in administrative services to citizens as well as business community. In addition, the electronic government is aimed at streamlining government's internal process in terms of quality of services with reduced costs and increase productivity. Other objectives of the electronic government include ensuring the following: data security, citizens' participation in government, transparency through good documentation, and effective communication.[353]

By the year 2000, the Prime Minister's office will be the first administration in the country to use the multimedia technologies. Other selected ministries and departments will follow suit. Gradually, most of the inter-departmental communications interactions with the public will be conducted via electronic and multimedia channels including card-base birth and marriage registration, and driver's license.[354]

Consequently, at the intra-governmental level the electronic government will provide interconnected IT infrastructure for all agencies (e.g. common databases). This includes electronic registration and archiving, paperless

[352] Ibid, p.2.
[353] Ibid.
[354] http://www.mdc.my/flagship/elecgov/index.html, "MSC Flagship Application: Electronic Government", p.1.

workflow and advanced multimedia communication tools.[355] Other than this, the multimedia facilities will further facilitate citizen-to government relation by providing 24 hours on-line access to government services for all citizens via multipurpose cards.[356]

The 24 hours online access will also provide a 24-hours 'one stop-shop' for all government information services via high capacity data links. This is expected to accelerate government decision processes and improve quality and customer orientation services.[357]

In the electronic government the communications and transactions between government agencies, citizens to government and corporations to government, are to be carried out excessively through electronic means. For example, when an-MSC citizen is born, his birth will be registered electronically. When he reaches 18 years of age, he will register electronically for his identification card, where his voice, palm print or retina would be recorded for security purposes. With this facilities and access to government agencies the citizens can practice his democratic rights and cast his vote electronically.[358]

With these functions, the electronic government is set to achieve two major objectives in the MSC. It will reinvent the concept of government through connectivity, and catalyse the MSC's rapid development.

As its first impact, the electronic government will redefine the relationships of government to citizens, to business, and to itself. To citizens, the

[355] Ibid.
[356] Ibid. p.2.
[357] Ibid.
[358] Sharifah Kasim, "MSC Sparks Interest Worldwide", *Computimes, New Straits Times*, July 31, 1997, p.5.

new relationship will mean dramatic improvements in services, enabling them to have greater access to more convenient, more responsive, higher quality, and potentiality less expensive government services.[359]

To the business and industry, electronic government will improve their relationships with the government and enhance greater responsiveness to applications and approvals. Not only that, this new relationship means improved information flows and superior communication between the components of government. And improvements in the co-ordination of government resources and the utilisation of analytical and decision support tools.[360]

As one of the seven MSC Flagship Applications, electronic government will also contribute to Malaysia's rapid development. It will spearhead the conversion to paperless offices throughout the country. By doing so, the improved productivity of the public sector will stimulate increased productivity in the private sector. The combined effect would be to sustain Malaysia's rapid economic growth.[361]

(ii) Smart Schools

The concept of Smart Schools refers to a network of schools and other educational facilities, using multimedia technology to develop a thoughtful school culture and develop world-wide linkages.[362] Smart Schools have the same physical structures as any other school except that they are equipped with up to date information technologies, including computers, Internet facilities and interactive

[359] http://www.mdc.com.my/flagship/elecgov/index.html, "MSC Flagship Applications: Electronic Government" 1997, p.2.
[360] Ibid.
[361] Ibid.

communication tools. What makes these schools smart is not the presence of these facilities, but the kind of new learning environment it provides. A kind of environment that will radically transform and improve teaching practices, school organisations, and student performance. Consequently, Smart Schools will accelerate development of student learning, critical thinking, and creativity and enhance IT literacy.[363]

The objectives of Smart Schools are bifocal. They can be tabulated into two categories. One category focuses on the individual as the recipient of the information, while the second category relate to overall impact of the new learning process on the society. At the individual level, the Schools will encourage all-round development of the individual student including the intellectual, physical, emotional and spiritual domains. This takes place as a result of providing opportunities for the student to develop his or her own special strengths and abilities.[364]

The impact of this on society will be the production of a thinking workforce. A workforce that is innovative, creative and self-sufficient. However, the smooth running of Smart schools requires changes in the education system. Thus, Smart schools will democratise education such that, every child has equal access to learning. This also means that an increasing the participation of all

[362] MIMIS, *MSC Vision: 2000 to 2020,Building the Malaysian Multimedia Super Corridor*, 199, p.2..
[363] Ibid.
[364] http://www.mdc.com.my/flagship/border/indx.html, "MSC Flagship Application: Smart Schools", 1997, p.1.

stakeholders such as parents, the community and the private sector, in the education process.[365]

To ensure that the Smart Schools make a positive impact on the individual and society, the Malaysian government has formulated an integrated set of strategies. The strategies, at the curriculum level, emphasise thinking, language, and values that are necessary for nation frog leaping into the information age.[366]

One issue, among others, that concern the policy makers, is the problem of information overload that might result from the application of the Smart Schools. This is a cause for concern because it is believed that information overload will cause overheating on students. The students might be pushed to learn which goes beyond what his age requires. To prevent overheating, the concept of 'vertical integration' has been introduced, in which the students progress at their own pace, yet remain with their own age cohort.[367]

Moreover, Smart Schools greatly changes the role of the teacher in the class room. With the change in the learning environment, the role of teacher changes too. In the conventional type of school, the teacher is the *purveyors of knowledge*, but in the new environment this role changes, and the teacher becomes the *facilitators of learning*. As a result, learning becomes to a large extent self-directed, where the student will have more sources of information than a teacher does.[368]

The smart schools based on the present concept covers two areas of

[365] Ibid.
[366] Ibid

education: the *teaching/learning process* and the *school management process*. The teaching/learning process involves curriculum development, courseware development and assessment. The school management process covers student affairs, administration and technical progress.[369]

To achieve the development and maintenance of the Smart Schools, the government, as a first step, has launched three pilot applications.[370] These projects are build within the MSC and then will be rolled out to the rest of schools. The MSC Status companies will have the opportunity to shape the Smart School concept by developing software applications, curricula, courseware, teacher and staff training, and infrastructure.[371]

The three pilot projects for the Smart Schools are:

Teaching Learning Materials: Under this application teaching-learning materials will be prepared for four selected subjects for all grades. These include Bahasa Malaysia, English, Science, and Mathematics. All of the materials will be network-based, teacher-based and courseware-based.

Assessment System: The assessment system is expected to give a more accurate and comprehensive feed-back of children's progress and achievement. The administration will also be more flexible and involve on-line multiple delivery of test items that will take into account students' readiness for assessment.

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[367] Ibid.
[368] Ibid.
[369] Ibid
[370] Ibid, p.3.
[371] Ibid,

Management System: The management system enables school administrators to efficiently and effectively manage resource and processes required to support the teaching and learning functions within Smart Schools.

The curriculum for Smart Schools and its evaluation system are expected to be fully developed, by the year 2000. Gradually, by then the majority of MSC schools and selected schools in each state will be with Smart School facilities. In addition, majority of MSC teachers would have acquired training and smart school certification, and majority of schools nation-wide will have Internet connection.[372]

(iii) Multipurpose Card

Multi-Purpose Card (MPC) is physically a plastic card embedded with a chip or microprocessor that has the capability to perform a wide range of functions, including data processing, storage, and file management. The new smart chip not only contains information that is more secured -- which makes it more difficult to tamper with, counterfeit, or modify -- but it also has more memory than current information systems.[373]

Smart card will be issued to all Malaysians supporting key government, financial, healthcare and affiliated applications. It enables the Government and private application providers to implement smart card solutions without duplication of effort and environment.[374] MPC establishes efficient card reader, transaction, and processing infrastructure to support all applications.[375] This card

[372] Ibid, p.4.
[373] Ibid.
[374] http://www.mdc.com.my/flagship/card/index.html, "MSC Flagship Application: National Multipurpose Card", 1997, p.1.
[375] Ibid.

can serve as a national identity card, an 'electronic purse' for purchasing small-ticket items, a credit card, telephone card, club membership card, and will ultimately be used in all electronic transactions with the government. The smart card is due to be commercially released before 2000.[376]

Furthermore, the MPC is viewed as a tool and medium for other MSC initiatives, and not as an isolated project. For instance, the Electronic Government Flagship Application will be designed new operational methods and processes around various interfaces that will utilise the MPC as an 'Access key" and transaction vehicle.[377]

Two broad categories of applications have been identified for the MPC: *Chip Applications* and *Access Key Applications*.[378] In addition, eight applications have been selected for inclusion in the initial MPC roll out. These include; National ID, Driving License, Immigration, Health Card, Electronic Cash, Debit, ATM, and Credit Card.[379] And the access key applications supported by MPC include; EPF transactions, Voter Registration, bill Payment, Ticketless air Travel, Student Card, and Car Park Access, to name just a few.[380]

(iv) R&D Cluster

The concept of R&D Cluster refers to a web of corporate multimedia R&D centres and universities involved in developing multimedia technologies.[381] R&D Cluster aims to create a cluster of collaborating multimedia R&D centres and universities to produce leading-edge products/technologies. Its objectives also

[376] Ibid, p.1.
[377] Ibid, pp.1-2.
[378] Ibid, p.2.
[379] Ibid.
[380] Ibid, p.3

include; promoting multimedia technology transfer to Malaysia, to encourage local high-tech start-ups, and to increase local R&D activities.[382]

The reason, or rather the need, for the creation of R&D cluster and locating it in the MSC is that, Malaysia has been investing substantially in R&D. in recent years. Under the Seventh Malaysia Plan (1996-2000), the sum of RM1billion has been allocated for funding research projects under IRPA.[383] And the sum of RM200 million, under MSC R&D Grant Scheme (MGS), allocated for the direct funding support for multimedia research, for each implementation period.[384]

The success of these projects and schemes depend on the availability of the environment where the necessary infrastructure is in place. Where creative and risk-taking activities are promoted and shared, and experts find living conditions most attractive. The MSC guarantees such an environment and Malaysia aims, through this unique environment, to promote the development of next-generation multimedia technologies by forging collaborative R&D efforts among leading-edge corporations, public research institutions, and universities.[385]

Moreover, the R&D Cluster Flagship Application makes MSC is an attractive location for companies to develop next-generation multimedia technologies and innovations. Because, it encourages corporate R&D; creates a new Multimedia University; and develops large-scale R&D pilot projects.[386] In

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[381] *MSC Vision: 2000 to 2020*, 1997, p.3.
[382] Ibid.
[383] *The Seventh Malaysia Plan*, 1996-2000.
[384] http://www.mdc.com.my/flagship/rd/index.html, "MSC Flagship Application: R&D Cluster",p.3.
[385] Ibid, P.2.
[386] Ibid.

addition, companies locating in the R&D Cluster within the MSC will operate in an environment that by the year 2000 will have core clusters of:[387]

1. At least 15 corporate R&D centres of leading-edge multimedia companies and universities.
2. At least 10 R&D collaborative centres between foreign companies and universities and local firms/institutions.
3. At least 10 local R&D centres.
4. A Multimedia University operating at Cyberjaya to support the R&D Cluster
5. 8-10 large-scale pilot projects for emerging multimedia technologies

Although the whole idea of R&D clusters look idealistic when first encounter, there are however, reasons for optimism. Huge sums of financial resources have been devoted to R&D in each development accompanied by various incentives and support schemes. The RM1 billion in the Seventh Malaysia Plan and the RM 200 million in MGS, quoted above, are example of this. All companies participating in the MSC will benefit from this strong level of support as well as improved R&D infrastructure.

Other reason for optimism would be the unique opportunities, R&D Cluster, provides for companies to benefit from Malaysia's location. Malaysia's population shares close cultural ties with the world's most populous nations, India and China, which also have two of the world's fastest-growing economies. The proximity to these and other booming economies will entrench multimedia and information technology companies based in Malaysia for success in the years to come.

[387] http://www.mdc.com.my?flagship/rd/index.html, "R&D Cluster", p.2.

The MSC's excellent physical infrastructure enables companies to deploy the latest technologies, and also to develop new technologies for the future. There will be no artificial constraints imposed on their efforts to experiment -- such as bandwidth resources or censorship of Internet contents. In an environment where collaboration, creativity and risk sharing are fostered, companies will find the MSC the place to experiment with new ideas and new partnership models.[388]

And Finally, the Growing Business Opportunities And the implementation of such Flagship Applications as Electronic Government, Multi-Purpose Card, Smart Schools and Telemedicine will uncover real R&D needs. The R&D Cluster Flagship Application will take the lead in developing the latest technologies and products to meet these needs and to market them competitively.

The R&D Cluster is not isolated from the general R&D activities in other government institutions and universities. There are a number of institutions that will provide supporting materials and ideas for the R&D cluster. They are:

The Multimedia University. This will be located in Cyberjaya to meet the manpower needs of R&D companies operating in the MSC. The University has already commenced operations in temporary premises, and is expected to be operational in its new campus by the end of 1998.

Other Universities. Companies located in the MSC can also draw on the expertise of existing universities located within and near the corridor. They are University Putra Malaysia, National University of Malaysia, MARA Institute of Technology, University Malaya, Tenaga Nasional University, Universiti Telekom Malaysia,

[388] Ibid.p.3.

Technology University of Malaysia and the Malaysia University of Science and Technology.

The Malaysian Institute of Microelectronics Systems (MIMOS). MIMOS is located in the MSC, which is the national focal point of technological competence in microelectronics and information technology. Its main objective is to develop an indigenous capacity in the rapidly changing multimedia environment. It is currently undertaking two flagship R&D projects relating to wafer and chip technology, and national broadband communications test bed.

The Technology Park Malaysia (TPM): TPM located in the MSC aims to promote high technology by offering a comprehensive range of incubation and other support facilities particularly to start-up companies. Presently, there are 40 companies housed in the TPM of which 29 are involved in multimedia/IT activities.

Finally, all companies can have access to on-line patent search and technology scanning services maintained by the Ministry of Domestic Trade and Consumer Affairs. Additionally, companies can access databases maintained by the Ministry of Science, Technology and the Environment, for expert information on technology trends and development of key technologies. Such services are meant to assist companies in their efforts to enhance their technological capabilities.[389]

[389] Ibid.

(v) World-wide Manufacturing Web

The World-wide Manufacturing Web (WMW) refers to a hub of manufacturing companies and manufacturing service companies involved in creating high value added, and multimedia intensive manufacturing support services in the MSC.[390] Its main activities include *R&D, design and product development*, *Engineering Support and consultancy*, *logistics distribution*, *procurement*, and *manufacturing control centers*.[391]

Research and Development: The MSC will provide an ideal regional research and development center for many companies. Foreign researchers working for MSC-status companies will enjoy freedom from strict immigration procedures and the opportunity to co-operate with Malaysia's growing pool of science and technology talent. The MSC's excellent telecommunications infrastructure will ensure R&D centres can stay in close touch with both manufacturing plants and other research centres globally. Furthermore, results of all R&D activities will benefit from full Intellectual Property protection through the Cyberlaws.[392]

Design and Product Development: With increasing global competition and growing complexity of customer demands, design is more challenging than ever. In the MSC, companies can operate design centers that work very closely with their regional customers and manufacturing plants. Using the high-bandwidth fiber optic network, sophisticated CAD/CAM design diagrams can be transferred

[390] Ibid.
[391] Ibid.
[392] http://www.mdc.com.my/flagship/wmw/index.html, "MSC Flagship Application: World-wide Manufacturing Web", 1997, p.2.

immediately, and libraries of components can be established for sharing of design resources.[393]

Engineering Support: As companies expand their manufacturing and marketing operations, the cost of providing engineering support increases. The MSC offers a location for companies to centralise and train their engineering support professionals. In addition, the MSC with its telecommunications and physical infrastructures enable those professionals to resolve problems efficiently and implement projects effectively either online or face to face.[394]

Manufacturing Control: The MSC provides a test bed for experimenting with new multimedia-based manufacturing processes. Real-time images and production data from manufacturing plants around the region can be transmitted to a control center in the MSC that monitors key production parameters and generates on-line commands to improve efficiency of plant investment. To this extent, manufacturing plants can even operate in a lightness environment as production processes can be completely automated and controlled from a central hub.[395]

Procurement: The ability to procure and obtain high-quality components at low cost is becoming an increasingly important competitive advantage for manufacturing companies. The MSC is strategically located in the middle of a large and growing supplier base. From the MSC, companies can use the latest multimedia technology to interact closely with their suppliers to ensure favourable quality and pricing for products.[396]

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[393] Ibid. p.3.
[394] Ibid, p.3.
[395] Ibid, p.4.
[396] Ibid, p.4.

Logistics and Distribution Support: The advanced logistics infrastructure and telecommunications networks make the MSC ideal as a regional distribution and logistics centre. Documentation can be transmitted to different parties involved in a transaction at the same time that goods are being transported from nearby international airports or ports. By actively managing the physical flow of components, products and inventory in the MSC, companies can enjoy all the benefits brought by Just-in-Time production in the region.[397]

(vi) Borderlines Marketing

Borderless Marketing is an initiative designed to create an environment in the MSC for companies to use multimedia technology to create and deliver marketing messages, customer services, and information products to their customers.[398] This Flagship Application will spearhead the growth of multimedia-based service industries in the MSC. It will also create value for local and foreign companies by providing a platform for them to interact with their customers, thus facilitating their existing businesses, and generating new business opportunities.[399]

So far, four areas have been identified for development: *Telemarketing*, *Online Information Services*, *Electronic Commerce*, and *Digital Broadcasting*.

Telemarketing: MSC with its sophisticated telecommunications technologies will provide an opportunity for the companies to centralise their call operations. Locating in the MSC, catalogue retailers can sell their products to a large and growing customer base in the Asia-Pacific. Other companies can provide customer or technical services to their customers. Moreover, Third-party

[397] Ibid,p.5.

telemarketing bureaux can offer their services. All these companies can leverage the unique multi-lingual and multi-cultural talents of Malaysia to penetrate regional markets.[400]

Online Information Services: Online Information Services will be developed to provide companies to keep up with the latest information to maintain a competitive edge, and to satisfy customers' requirements for more timely extensive coverage and for more innovative products.[401]

Furthermore, in the MSC, the online news and information providers can also set up their information hub to collect, store, process, and distribute their information world-wide. The MSC's advanced yet cost-competitive telecommunications infrastructure will guarantee reliable bandwidth connection to every location around the world for seamless information exchange.[402]

To achieve this, the government is committed to ensure free flow of information in and out of the country. This is evident in its recent initiative to abolish the 12-year-old policy that required all news and information to be distributed through the national news agency.[403]

Electronic Commerce: Electronic Commerce (EC) that eventually will revolutionise industry processes and structures and redefine the competitive landscape for businesses around the world. In Asia-Pacific, it can offer exciting

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[398] http://www.mdc.com.my/flagship/border/index.html, "MSC Flagship Application: Borderless Marketing Centres", 1997, p.1.
[399] Ibid.
[400] Ibid, p.2.
[401] Ibid.
[402] Ibid, p.3.
[403] Ibid.

opportunities as the dynamic country leapfrog into the Information Age as evidenced by growing penetration of personal computer and Internet usage.[404]

MSC with its conducive regulatory environment and a comprehensive framework of Cyberlaws, led by Digital Signature Act is being drafted to facilitate the growth of EC. The high bandwidth telecommunication network can support the most demanding EC applications. The forthcoming over-the-counter stock market MESDAQ, will provide funding opportunities to small yet innovative EC companies.[405]

Digital Broadcasting: MSC as a regional hub with its access to the Malaysian East Asian Satellites (MEASAT 1 and 2), and with a footprint that covers more than 2.5 billion people in the Asia-Pacific region provides the entertainment companies for production and broadcasting.

Production and post-production studios can produce, localize, and add special effects to programs. The high bandwidth telecommunications infrastructure can support applications such as virtual studios where production can be done in a truly collaborative manner, with involvement from experts around the world. The commitment of large Malaysian industry players like TV3 and Measat Broadcast Network Services to establish their regional broadcasting operations within the Corridor will ensure that a ready pool of creative talent is available and that opportunities for strategic alliances will be plentiful.[406]

This Flagship will eventually create a regional hub for companies to create and deliver marketing messages, customer services and information products to their

[404] Ibid.
[405] Ibid, p.3.

multi-cultural and multi-national customers using multimedia technology. The benefits for Malaysia will be that, it will become a regional centre for information-based services and products, establish Malaysian leadership in emerging electronic commerce market places, develop marketing and content creation know-how in Malaysia and increase opportunities for local companies to sell products internationally.

(vii) Telemedicine

Telemedicine is a multimedia network linking all the relevant agencies of the health care system.[407] By doing this, Telemedicine is expected to enhance the quality of medical services and improve outreach in urban and in particular in rural areas. It is also expected to reduce delivery time and save costs. Eventually it will become a regional Centre of Excellence in Telemedicine Development, and delivers leading edge health care products and services.[408]

In a nutshell, Telemedicine aims to provide:[409]

Information: A 24 hours on-line access to medical knowledge database, and nation-wide access to virtual patient.

Education and Training: This includes continuous medical education of practitioners, distance training in rural areas, and innovative training.

Consultation and Collaboration: Telemedicine will create worldwide R&D collaboration, and electronic house calls for patient follow-up.

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[406] Ibid, p.3.
[407] *MSC Vision: 2000 to 2020, 1997*, p.3.
[408] Ibid.
[409] Ibid.

Diagnosis and Treatment: These include remote assessment of chemical parameters and remotely controlled surgical procedures.

It is important to note at this point that, Telemedicine in its present concept is not another technology but a process. In that, it focuses on the individual to provide greater access and increased knowledge on healthcare. It empowers the individual to manage his/her own personal health, and integrates information to allow the smooth flow of services and products throughout the healthcare system. Telemedicine will play an increasing role in future healthcare and offers a mechanism for reversing the healthcare pyramid.[410]

Moreover, Telemedicine aims to go beyond the traditional delivery modes to provide greater access to smoother and higher quality healthcare to all Malaysians. By taking advantage of existing multimedia and information technology, and developing new technological solutions, this MSC Flagship Application will ensure Malaysians enjoy a high quality of healthcare. It will also support the development of Malaysia into a global hub for Telemedicine services, products and education.[411]

To Malaysians, the new processes will dramatically improve information and access to healthcare. Linkages with other Flagship Applications and agencies will also support the delivery of health services and lead to more effective use of resources throughout the country.

The Malaysian Government has invited leading Malaysian and

[410] http://www.mdc.com.my/flagship/telemedice/index.html, "MSC Flagship Application: Telemedicine", 1997, p.1.
[411] Ibid.

international companies to develop pilot applications that will be implemented over a five-year period. The applications will be tested at several sites both within and outside the MSC. The MSC site will provide the ideal test environment due to its superior infrastructure, while the site outside the MSC will be representative of the rest of Malaysia in terms of infrastructure and other, including behavioural, constraints.[412]

Cyberlaws

Cyberlaws are a set of laws introduced by the Malaysian government to electronically govern and legally administer activities in the MSC.[413] The Cyberlaws which will transform the Malaysia's legal and regulatory framework, has been introduced to facilitate the new administrative capital, Putrjaya, to govern activities within the MSC and its supporting companies.

So far, three types of Cyberlaws have been introduced: (i) the commerce-enabling Cyberlaws, (ii) the societal Cyberlaws and (iii) the application-specific Cyberlaws.[414] The commerce-enabling Cyberlaws provide bases for digital contract (admissibility as legal evidence in court etc,), digital signature, electronic money/cyber payments, and digital intellectual property protection[415] The societal Cyberlaws include laws related to computer crime, cyberfraud, content regulation, privacy protection, consumer rights protection, and equity and access.

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[412] Ibid, p.2.
[413] Azlyn A. Rahman, "Help, Teja to hold Seminars on Cyberlaws", *Computimes, New Straits Times*, September 25, 1997, p.10.
[414] *MSC Vision: 2000-2020*, 1997, p.3.
[415] Ibid.

Application-specific Cyberlaws include laws that regulate activities in the Seven Flagship Applications.[416]

The areas covered by Cyberlaws so far comprise the Data Signature Act, the Multimedia Intellectual Property Act, the Computer Crime Act and the Telemedicine Development Act.[417]

The Digital Signature: is an encrypted of piece of code attached to an electronic message and allows verification by a third party. Under the Act, digital signature is defined as the transformation of a message using an asymmetric crypto system that a person receiving the initial message and the sender's public key can accurately determine. A controller of the certification authority is also to be appointed by the Government to license certification authorities and to monitor and supervise the activities of the authorities. The certification authorities must be licensed under the law.[418]

The Multimedia Intellectual Property Act. This cyberlaw gives multimedia developers full intellectual property protection through the on-line registration or works, licensing, and royalty collection.[419]

The Computer Crime Act: This cyberlaw provides law enforces with a framework that defines illegal access, interception, and use of computers and information; standards for service providers; and outlines potential penalties for infractions.[420]

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[416] Ibid.
[417] Kang Siew Li, "Malaysia's First Cyberlaws to be Implemented in 1997", *Business Times, New Strairs Times*, 29 October 96.
[418] Ferina Manecksha, "Adopting digital signatures in local banking industry", *Computimes, New Starits Times*, 21 August 1997, p.28.
[419] http://www.mdc.com.my/msc/infras/laws/index.html, "MSC Flagship Application: Cyberlaws", 1997, p.1.
[420] Ibid.

The Telemedicine Development Act: This cyberlaw empowers medical practitioners to provide medical services from remote locations using electronic medical data and prescription standards, in the knowledge that their treatment will be covered under insurance schemes.[421]

The Electronic Government Act: This cyberlaw allows politicians, public servants, and the public to communicate electronically with each other using established and secure formats and standards.[422]

The government, in this, has adopted top-down approach. Driving the development of the Flagship Applications are government ministries and agencies that report directly to the MSC Implementation Council, chaired by the Prime Minister of Malaysia and his Deputy. These agencies work in close partnership with leading international and Malaysian multimedia companies to clarify the concepts and create detailed implementation plans.[423] Joint government-private sector teams have developed concrete proposals for each Flagship Application between December 1996 and June 1997 and these have now entered the implementation phase since July 1997.[424]

The MSC Flagship Applications are divided into two distinct categories:[425] *Multimedia Development* Flagship Applications offering concrete business opportunities to facilitate the MSC's development, and; *Multimedia Environment* Flagship Applications providing an optimal environment that supports multimedia companies entering the MSC.

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[421] Ibid.
[422] ibid.
[423] http://www.mdc.com.my/flagship/index.html , "MSC Flagship Applications: Introduction", 1997, p.1.
[424] Ibid.

The *Multimedia Development* Flagship Applications have long-term objectives that reach far beyond the MSC's borders. Supporting Vision 2020, they aspire to transform core elements of Malaysia's technology infrastructure and social systems in areas such as education or public administration, using multimedia technologies as a critical enabler in the process.

For each of these four Flagship Applications, teams comprising MDC, lead agencies and private-sector representatives have developed "Concept Request for Proposals" (CRFPs) that describe the requirements of identified pilot applications and give consortia of private sector companies the flexibility required to innovate and deliver the best solutions.

The 'Multimedia Environment" Flagship Applications will provide both Malaysian and international companies with the opportunity to operate in an environment of close co-operation with leaders in the multimedia industry, research and academic institutions, and customers, in one of the world's most attractive business regions. These applications will also allow companies to build centres of value-added services to companies throughout the region, and innovative entire business by taking full advantage of the MSC's unique environment and infrastructure.

Conclusion

"MSC has been packaged well because it covers IT applications, society and the government as well as political leadership".[426] The development of IT and its

[425] Ibid, p.2.
[426] Sharifah Kasim, "MSC Sparks Interest World-wide", *Computimes, New Straits Times*, July 31, 1997, p.5.

management, in Malaysia, is without any precedent in history, in this field. The MSC is the first of its kind in the world. However, the impact of these development and that of IT in general on Malaysian society will be enormous and without any precedent too.

Although, the government, the private sector (to some extend) as well as individuals have began debating this issue, however, the direction to which the IT revolution will lead is unclear to many. For example, the concept of Knowledge Society instead of Information Society is an epistemological construct that is difficult by many players in the field of IT to appreciate. The business enterprises are mainly concerned about their profits, they invest in creating contents that bring them profits.

Therefore, the only body that talks about social-pool is the government and individuals who will eventually have limited access to control the direction of this transformation. Malaysia being a multi-ethnic and multi-religious society needs to take these issues seriously.

The IT will open their society not only to information but also to outside influences. Malaysia being a homogenous society will be exposed to many types of challenges. At the core of which is the notion of globalisation, which if not understood properly will lead to neo-colonialism.

For these reasons, the success of the IT projects such as MSC and its Flagship Applications lies not only in technology-push but also in social-pull. In other word, the success of the MSC is not solely in bringing and developing technologies, but rather in applying these technologies in developing the people.

Conclusion

The belief that S&T is the leading contributor of continued and enhanced societal well-being is evident. This belief is enhanced by the apparent impact of S&T in three areas of contemporary societies: military power, economic strength and medical well-being. For instance, the sides that used the superior scientific and technological capabilities won the outcome of the great wars of Europe. The role of S&T in economy is perhaps the most apparent in the Post-WWII and cold war eras. Technology influences economic productivity and economic growth and in increasing the standard of living. Reportedly, technological change has been credited as responsible for almost half of the increased economic growth achieved in the emerging newly industrialising south-east Asian economies. The sum contributed by technology is greater than the combine contribution of capital and other resources.

S&T has evidently contributed to the improvement and efficacy of medical care in this century. These range from advances in diagnosis and surgery to vaccines, therapeutic drugs, prosthetic devices, and rehabilitative apparatus. Just like military strength and economic well-being, the substantial individual and

public health benefits afforded by technical advances achieved in recent decades are widely recognised and highly valued in contemporary societies.

A less obvious but not less important aspect of modern life which has been greatly influenced by S&T is beyond doubt the intellectual dimension of S&T. Beginning in the eighteenth century science replaced tradition as the major source of knowledge. In the twentieth century, secular science has become recognised as the leading source of cognitive authority in modern Western life. When there is a dispute over reality, people in most instances turn to science and not to sacred books or religious sage as used to be the case in the past. In a recent dispute over abortion, people turn to scientist to define life and determines its origin, when traditionally the definition of reality, life and man's destiny were once the purview of religion.

Finally, S&T has been centrally involved in many of the episodes widely viewed as notable human successes in recent decades. Examples of this include the landing on the moon, polio vaccines, civilian jet aircraft transportation, the discovery of the double-helical structure of deoxyribonucleic acid (DNA), the green revolution, antibiotics, the personal computer and the invention of the Internet. Whilst, failure side of the ledger includes the Bhopal, Chernobyl, the pesticide DDT, building collapses and aeroplane crashes were blamed on defective engineering and human error.

However, apart from defective engineering and human error, there are other factors determining the outcome of scientific and technological practices. These factors are deeply rooted in the prevailing understanding of S&T emanating in the West and now becoming the dominating international view of S&T. This

Western understanding of S&T as pragmatic knowledge and utilitarian tools for defining man's destiny and nature are believed to be directly responsible for the manner nature and its resources have been used and abused

This at once raises the question as to whether the prevailing practice of science is the only way of doing science? Historically speaking, nature has been subjected to different forms of interpretation, reflecting the diversity of human beliefs and perceptions. Civilisations have regarded science as sacred or profane. Civilisation that viewed nature as sacred will adopt a similar version of science. On the other hand, a civilisation that treats nature as profane entity having no more than a material content, will be equally reflected in the kind of science that they produce. Modern science is nurtured and developed within the Western civilisational context. Arguably the context was a particular experience and episode out of the many possible manifestations of what can be collectively termed as the European culture. It is then one possible way of doing science. Europe has seen other versions of science being practised in its intellectual history. The possibility that in a given societal context that there can be different approaches to the study and applications of S&T is probable and acceptable.

The contemporary view of S&T is basically Western. This view has acquired international acceptance in part owing to the scientific and technological superiority of Western industrialised countries. The non-western countries imitating the Western model of socio-economic growth and development have naturally adopted the Western notions of S&T. The latter has greatly influenced scientific and technological activities and planning of these countries.

However, the Western view of S&T and nature is significantly different from, for instance, the Asian civilisational understanding of nature and S&T. The modern Western scientific knowledge emphasises observation and experimentation go hand and hand with secular view of nature: a physical and quantitative one. In contrast nature in earlier civilisations, and in fact in many current Asian societies, has been seen as having a richer character: full of symbolism and spirits. To them nature has a physical as well as a metaphysical essence. However, this latter view of nature and S&T are absent in the activities of practicing "mainstream" Asian scientists as well as in evidently in the many decisions on S&T management.

One reason for this is perhaps the unavailability of the non-western views to the modern scientists and decision makers. In contrast the Western version f scientific simplicity and methods of inquiry are established in all forms of modern mainstream education. Another reason perhaps is that non-western knowledge including the knowledge of nature and S&T has been kept out from mainstream practice for so long, enough to acquire a view as unsuitable in modern life. An obvious example of this is the view on the sacredness and symbolic character of nature which are considered as remnant of superstition and mythologies. In spite of the apparent failures of modern S&T manifested in acute pollution, flooding and global warming, it is unthinkable for the modern scientists to ever contemplate that their view of nature and practice of S&T may be at fault.

Confirmation of this attitude of scientist can be easily found in the formulation of many mainstream S&T policy. The prevailing modern understanding of S&T are so dominant that contemporary S&T policy studies take

the role of epistemological and methodological aspects of S&T for granted. Contemporary S&T policy studies have concerned themselves exclusively with the proper management of funds, resources allocation, the management of manpower requirements, and the management of R&D. The exclusive emphasis on these aspects has overshadowed the importance given to fundamental intellectual issues associated with S&T policy studies. These issues include issue of the suitability of paradigms of S&T adopted by a society, the axiological or value systems embedded in S&T, and the impact of the Western secular S&T on the indigenous world view and cosmology.

The epistemological analysis of this study focuses on the intellectual issues of S&T policy adopted in Malaysia. The study finds that in several dimensions of the country's S&T policy there is an attempt to include epistemological premises that are uniquely Malaysian in the management, planning and application of S&T. This is apparent in various policy statements and intellectual discussions on S&T related issues. The latter is more evident in the area of IT planning where IT has been understood just as a means for transforming society and not as a tool to dominate or subjugate.

The main concern and activities of the nations' S&T policy, however, are directed towards economic growth and wealth creation, rather than concern with providing alternative view of S&T, of nature and other epistemological issues of S&T. The mainstream S&T policy is formulated in the context of socio-economic planning. In this, S&T is fundamentally understood as tools for socio-economic development. This view is evident in the many official documents on the assessment of the impact of S&T on society.

However, the official government literatures recognise the moral and spiritual dimension of S&T. This seems to be a departure from the mainstream Western view. When speaking of development through S&T, the spiritual and moral development of the members of the society is given equal emphasis beside economic development. Recognising this dimension implies tacitly accepting the notion of S&T as value laden. This can be described as a distinctive feature of S&T policy in Malaysia. The official documents, however, expectedly do not engage in any explicit theoretical discussion of S&T.

A more important aspect of science policy that deserves attention is the politics of S&T. Politically driven motives are evident in Science policy. In Malaysia this is reflected in the role of government in the S&T management. The other indication is in the role of the government in S&T planning as that of pace setter and co-ordinator. For example, in R&D, one can see clearly the area of government directed policy statements and measures in enhancing technology innovation, standard and quality. At the conceptual level of guidelines used including the definition and determining of the scope of R&D are adopted from others, the OECD countries. The government allocates the fund directly to the executing R&D agencies. The latter have the prerogative of distributing the fund based on the priorities of the agencies. Regarding the relation of government with the private sector, the government provides grants to small companies that conduct research beneficial to society and conducive to economic growth.

The active role of government can also be clearly discerned in the other areas of focus of S&T policy notably in HRD, and IT. The role of politics in HRD is more complex. Although HRD planning has been largely influenced by socio-

economic imperatives, official documents do reflect a more holistic concern. The latter was in part driven by the Islamic consciousness that has been gradually introduced into the bureaucracy by the government since the 1980s. One of the manifestations of this holistic concern is the emphasis on a balanced attainment of both technical skills and spiritual development. Indeed, one of the distinctive features of HRD planning in Malaysia is the explicit focus on both physical as well as spiritual development of man. This view is reflected in the official government documents that emphasises the role of S&T in spiritual and moral development of man beside his physical development. This is beyond doubt a departure from the Western secular approach which emphasises the physical well-being of man mostly at the expense of his moral and spiritual dimension.

A multi-dimensional and holistic approach to the role of S&T for development seems to be more lucid in the IT planning. First and foremost IT is considered as a tool for social transformation. In addition, owing to its role in economic growth, IT in Malaysia is recognised as the strategic technology. Unlike any other technologies IT is believed to have a fundamentally progressive impact on the economy in terms of efficiency and improvement of the quality of life of the general population.

In IT planning a major epistemological debate takes place over the idea of an information society. The latter is believed to be the culmination of the social transformation made possible by the advent of IT. One feature of this society is that IT is not a passive instrument in this society, but the catalyst that develops inside the parameters of the society and transforming it in the process. Information Society is not a technological society it is a socio-cultural society where

information and knowledge are the key factors of progress. In such a society IT provides its members with new ways of creating value in its all the major sectors: economic, political, material, physical, intellectual and even spiritual.

Malaysia's IT planners aspires eventually to attain from a stage of Information Society to a stage of knowledge society. The belief in the view is embedded in a society's culture and values while information is quantitative. This distinction is epistemologically valid since conventions dictate that knowledge is far more superior than even processed information.

Another, important issue to take up here is Malaysia's scientific and technological capability, as this is related to its future direction of science policy. Malaysia's capability in the field of science is difficult to determine. This is especially true in the field of pure science. The current initiatives are largely technology based. The latter is driven by the view that technology is essential for growth and productivity, Thus the disproportionately large allocation on research in technology development. This emphasis is at the expense of research in the field of pure science. The present picture seems to suggest that research in pure science is very small and without any clear direction and focus.

Under the IRPA applied research (manufacturing-oriented research) receives most of the fund allocated for S&T development. The level of manufacturing-oriented research supported under IRPA is one-third higher than otherwise indicated under the present five sector classification system. Research oriented towards *new and emerging technologies* accounts for 11% of total IRPA grant allocations, and of this amount two-thirds was allocated to biotechnology-related areas.

In the long term, this situation is a cause for concern. Because, pure science, which is given lower priority, is essential for indigenous scientific and technological development. The investment in pure science is actually the way to increase the stock of scientific knowledge vital for technological development which will remove the existing dependency on foreign imported technologies and scientific knowledge.

In official documents such as The Seventh Malaysia Plan the essential role of the assessment of technological capability was underscored. Technology foresight and assessment studies are directed primarily to look at two aspects: (i) the existing technological capability of the country, and (ii) the country's access to the global stock of technology. An important strategy in technology development and technology transfer, in Malaysia, is the emphasis on indigenous technological capability. This is because sophisticated technologies, especially robotics, automation and computer technologies are brought into the country and controlled by the multi-national companies.

Relative to most industrialised countries, Malaysia has a low level of local technology development. This is reflected in the allocation of fund to R&D which less than one per cent of its GDP, this is less than average 2.5 % normally allocated for R&D. Much of the technology that are needed locally come from beyond her borders.

The other reasons are the unavailability of skills in the fields including R&D both in terms of quality and quantity and also the unavailability of support services. Although efforts are made now to address this; for instance by the establishment of MASTIC which provides information and logistic support,

however this is still in its infantile stage. Another important factor restraining technological capability is the limited local capital resources. Owing to its recent elevation as a member of NIC countries and the tense competition in the international technology markets, Malaysia has to be selective in choosing the sort of technologies to acquire. All these have greatly influenced Malaysia's technological capability.

Moreover, Malaysia like any other newly industrialising country has limited access to global technology markets. This is again linked to Malaysia's market penetration as well as technological background. Malaysia acquired its independence in 1957 and during the British rule its technological capability was expectedly primitive. Post-independence initiatives have managed to elevate her status from raw producers of industrial materials to manufacturing and industrial country. However, Malaysia still requires continuos upgrading of her technological capabilities. One of the hallmark of this achievement was the emphasis on the smart participation between the public and private sectors to achieve development targets, and this include technology development.

Despite being a late comer in industrialisation and scientific and technological development, Malaysia has made some achievements. However there remain some important issues that need to be addressed which are crucial to the long term S&T policy. There are important areas that need immediate attention. These are the areas of influence on technological capabilities that are vital for building technological capability in Malaysia. Among the major influences on technological capability acquisition that have been identified include:

- the importance of efficient technology utilisation and high rates of productivity growth.
- skills availability, in terms of quantity and quality, as well as in the formal educational system and work-related skill-upgrading efforts.
- technical information and support services availability, especially with the appropriate development of the national 'science and technology infrastructure', particularly to address market failure problems due to the 'public good' characteristics of certain crucial technological functions.
- availability of financing for such investments, requiring unconventional financing mechanisms for technological capability development,
- government technology development policies, especially the regulation of technology imports and foreign direct investment as well as focused R&D strategies, but also other direct policies such as fiscal and other incentives for technological development, procurement policies and other forms of support, as well as targeted technology development initiatives.

Finally, the different meanings of S&T and the variety of philosophical theories of science, are grounds for concern about the theories and meanings of S&T, and the extent which the latter come to influence in the formulation of S&T policy. Perhaps none other aspect of social policy could equal the potential impact that an S&T policy would have. It is therefore both an intellectual and a moral imperative for the policy makers to formulate their policy guidelines based on an epistemologically correct understanding of the S&T. The latter includes the kind

of understanding that would give a balanced view of nature and takes also into account the impact of S&T on social and moral transformation of the society.

This study has shown that although Malaysian S&T policy is unconsciously predicated upon a particular view of S&T, by and large, Western and secular. However, in the case of IT policy there is a conscious effort to adopt a view of S&T that is holistic and comprehensive. Perhaps a deliberate analysis and focus on the kind of S&T paradigm that should be adopted will go a long way to assist in a formulation of an S&T policy that is Malaysian.

Glossary

Aesthetics. The subject whose philosophical consideration is theories of art and its aspects, e.g., style, genre, etc. More generally, an investigation or theoretical interest in the beautiful and similar appreciations.

Applied Research. Original investigation to gain new scientific or technical knowledge directed primarily directed towards a specific practical aim or objective.

Development. Learning oriented activities that involve both personal and organisational growth.

Education. Learning of new skills, knowledge, and attitudes.

Human Resource Development. An approach to change work-related behaviour, using a range of learning techniques and strategies.

Indigenous Technology. Technology native to a particular place, people or region.

Information Technology. A convergence of computers, telecommunications, and information. IT embraces the scientific, technological and engineering disciplines including the management of techniques used in information handling and processing, and their applications.

Positivism. The philosophical position that limits knowledge to the results of empirical methods, especially those of the natural sciences.

Pure Research. Systematic investigation for the sole purpose of pursuing solutions of problems posed by the very nature of science. It aims to extend

human knowledge and understand the laws of nature without penetrating the field of their utilisation.

Research and Development. The process of advancing knowledge through systematic investigation. It is scientific investigation undertaken to obtain information or understanding that goes beyond knowledge or accepted practice.

Science. The organised, well-founded body of knowledge of natural phenomena: a field of systematic inquiry in which such knowledge is sought; a distinctive form of human cultural activity whose practitioners include professional scientists; and the total societal enterprise devoted to the study and understanding of natural world.

Scientific Revolution. The towering intellectual achievements of sixteenth and seventeenth century European astronomy and physical science. A new mechanistic theory of nature triumphed over both the traditional Aristotelian world view that held sway in the Middle Ages and the tradition of hermetic natural magic that flourished in the Renaissance. In short, the Scientific Revolution marks the emergence of modern science.

Technology Transfer. The transmission of the complex of knowledge, materials, and methods pertaining to all activities associated with the production and use or operation of the techniques or technical systems. It also includes transfer of knowledge, like feasibility studies, machinery installation, selecting and setting industrial processes, operation of production facilities, maintenance, training of personnel, and marketing..

Technology. The material product of human fabrication; the complex comprising the knowledge, materials and methods used in making a particular kind of

technique; a distinctive form of human cultural activity whose practitioners include engineers, machinists, and many craftspeople; and the total societal enterprise devoted to the research, development, production, operation, and maintenance of techniques.

Training. Activities that sought to improve individual's performance on a currently held job or one related to it. It is a transfer of knowledge from one who knows or can do to one who does not know or cannot do.

World Views. A world view is a descriptive-interpretive mental model of the universe and its phenomena. World views encompass beliefs about various fundamental matters, such as what things are real and what are illusory in the world; the origins; natures and destinies of things that exist; the primary forces at work in the world; the purposes built into the world and manifested in what transpires in it; and how human life ought to be lived.