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Information technology and development -
Malaysia's experience

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INFORMATION TECHNOLOGY AND DEVELOPMENT - MALAYSIA'S EXPERIENCE *

Dr. Tengku Mohd Azzman Shariffadeen

Abstract: *In this paper we present some of the fundamental notions and concepts that underlie the development paradigm with the rise of IT. In the ensuing discussion we summarise some of the findings that are applicable to Malaysia as a small developing country that has recognised the strategic importance of IT. These findings cover issues of planning as well as implementation. The status of Islamic countries is also briefly summarised.*

1. Introduction

Information technology (IT) is widely believed to be the foundation of an emerging socioeconomic environment which will shift the dominant parameters of development from land, labour and capital to information and knowledge. While most countries appear to have taken serious cognizance of this fact, few can lay claim to have formulated a comprehensive programme of development that fully exploits the potential of IT. Two basic difficulties confront planners and implementers alike.

First, IT is itself experiencing rapid change and evolution, giving little room for people and programmes to adjust themselves.

Second, IT is placing heavy demand on human resources in specific new areas which are in short supply especially in developing countries. These difficulties make it imperative that development programmes are re-examined from a new perspective.

The basic principle influencing this presentation are the following.

First, IT will affect all societies regardless of their present socioeconomic status.

Second, the pervasive impact of IT implies that the very foundation of economic activity and social organisation will see a radical change.

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Third, because most of these changes have to occur, a proactive approach is essential in analysis and decision making.

Fourth, by emphasising the value of information and knowledge, IT has enhanced the position of the main protagonist in development the human participant.

2. Infusion Of Electronic And Information Technology.

Malaysia's electronics industry in its present form began in the early 70s when it successfully attracted multinational corporations (MNCs) to relocate their more labour-intensive operations into the country, principally in semiconductor assembly. Rapid growth and diversification resulted. In 1990 the industry's output had reached US\$7.5 billion in value, accounting for 47% of manufactured exports, and providing employment for about 150,000 people. Between 1978 and 1990 the industry grew at a compound annual growth rate of 22% in real terms. Lately the industry structure has gone through rapid transformation, moving from an exclusively semiconductor assembly operation to a more diversified mix, achieving 58% components, 22% consumer and 20% industrial goods in 1990.

Having laid this industrial foundation, it is natural that the country should perceive itself to be well placed to benefit from the recent emergence of information technology (IT). However, the situation is not as simple or straight forward.

First, since the industry is largely owned by MNCs, there is little control over its trajectory of growth. Each company has its own business plan driven by its particular commercial goals.

Second, the technologies practised in and acquired by the industry are limited to specific narrow disciplines such as semiconductor assembly, testing and production. Critical skills in areas such as IC design, wafer fabrication and product design are not acquired simply because these activities are not performed locally.

Third, the linkages between MNC-owned companies and local suppliers are weak. Most of the materials and components used in production are imported. Thus the presence of MNCs generally does not necessarily generate new opportunities for indigenous companies.

Although computers began to enter the Malaysian workplace in the 60s, the country only

began wide-scale application of IT in the 80s. Economic, social and organisational forces dictated that more automation be introduced in the work place. The market for IT products has increased rapidly, achieving an expected market size exceeding US\$740 million in 1991. This is more than US\$40 per capita expenditure which is high by developing country standards. Telecommunications has also enjoyed rapid growth especially in the 80s. The network is now capable of handling effectively both voice and data with ISDN about to be launched soon.

Rapid developments in the electronics industry per se and in IT generally have prompted the recent National Industrial Technology Action Plan (MOSTE 1990) to highlight microelectronics and IT as two of the emerging technologies which are strategic to national development. More importantly, the Prime Minister in his speech - (Mahathir 1991) outlining the country's agenda to become a fully developed country by the year 2020, declared that "in the information age that we are living in Malaysian society must be information rich". Electronics and IT, therefore, feature prominently in the country's development programme.

3. Trends In Development And Role Of IT

For many years development was believed to be linked largely to economic performance. Influential agencies such the World Bank promoted this view by emphasising GDP growth and per capita income. Lately however it has become increasingly clear that factors are more significant. Thus, for example, the United Nations Development Programme (UNDP 1990) asserts that "human development is a process of enlarging people's choices" and that "the most critical of these wide-ranging choices are to live a long and healthy life, to be educated and to have access to resources needed for a decent standard of living". It cannot be denied that economic wealth is an important enabling factor especially providing critical infrastructure for development, but other factors are becoming increasingly dominant.

In particular, the human factor has come to the forefront in the modern development scenario, especially when human development is viewed from a more integrated and holistic perspective. It is now recognised that development entails the opening of new opportunities for people to improve themselves. Furthermore, the availability and access to resources and infrastructure are essential to enable them to make effective use of these opportunities. Working in tandem with this notion, knowledge and the knowledge worker are now perceived to be the new competitive factors in socioeconomic performance (Drucker 1969). Thus the emerging trend in development is that the widening

of opportunities entails the ability to acquire knowledge and subsequently to be able to use it effectively. A specific form of knowledge has also emerged as the leading competitive factor for nations and organisations (Drucker 1969, Porter 1990), and that is knowledge in science and technology. They provide the ultimate source of value added, productivity and competitiveness in modern economic activities.

In promoting human development, IT plays two critical roles.

First, IT projects a technological dimension. Through global telecommunications networks, IT provides the mechanism for the interconnection of computers into a worldwide information system, thus facilitating the rapid flow of information which are strategic to development. This enabling mechanism greatly enhances the generation, availability and accessibility of information.

Second, IT possesses a cognitive dimension which is manifested in the information content itself. Here the information carried by the system can be employed by its human users to think, analyse, understand and apply for purposes of development and progress. This immediately enhances the ability of users to acquire knowledge and to apply it for their own needs. To summarise, IT therefore not only makes information more easily available, but also provides the means to apply it for personal and collective development.

IT is also reinforcing another trend in modern communications - globalisation. Modern trade can no longer be perceived in the domestic or even regional context. It has now become completely globalised where suppliers vie for markets worldwide in direct competition with each other; product quality, price and availability on time are becoming the new competitive factors. This trend is being further strengthened with the advent of the GATT Uruguay Round of trade negotiations, through which world trade is expected to be further liberalised. The Uruguay Round is renegotiating trade in goods, but more importantly, has placed on the agenda global trade in services.

Economists have traditionally classified the direct production of goods and services as core economic activities, distinct from the peripheral activities that support the production process (Miles et al. 1989). With the rise of IT, however, there is a blurring of the line between core and peripheral. Although information has become the critical factor in both production and support functions, it is the

information-based support services that are more information intensive. Such services have increased in importance since they provide the necessary support functions to the more production processes.

With the rise of the Uruguay Round of trade negotiations, services, as core as well as support functions, have become even more important. Trade ability of goods and services is one of the new emerging issues (Larvin 199). IT based services can now be generated anywhere on each and then consumed at any other location. Such services, being storable and highly portable and mobile, are keenly tradeable. When they support trade in good, they make the goods themselves also more tradeable. IT is therefore changing the pattern of global trade and their fundamental competitive factors.

The above discussion asserts that IT has a role far greater than the traditional view of computers and telecommunications. Its implications now touch every aspect of human life and human concern. It has social and economic impact, but now rising strongly are political and strategic ramifications that will ultimately determine the course of national progress and human development in the true sense.

4. IT Planning

As a highly pervasive technology, IT will exert powerful influence on individuals in society as much as social groups and organisations. Since it is also technology-driven, where the technology itself is evolving rapidly, technological change will have profound impact on social change and vice-versa. One of the new strategic issues faced by society today is

the rapid acquisition and diffusion of critical technologies. Effective planning mechanisms are therefore essential if society is to gain optimum benefit from technological change, which now constitutes an important source of social change.

The OECD (1988) argues that IT application development must be seen as a social process, not simply a technical process. Due recognition must be given to the interdependence or technical, economic and social change, calling for " institutional adaptation and a process which mediates between differences of interest".

There is a need to perform technology assessment and for the state to assume the function of "creative" regulator of technical change, despite the trend towards deregulation. In another study, the OECD (1989) observes that there is nothing automatic or inevitable about the response of the market to the opportunities of emerging trends in IT. Inefficiencies and dislocated movements will result from a lack of planning.

However, an overcontrolled environment will also have an adverse effect, restraining innovation by individuals and organisations alike. A proactive yet balance approach the key to successful exploitation of IT.

A planning and decision-making model has been presented by the author else where (Tengku Mohd Azzman 1991a), as shown schematically in Figure 1. Several distinct features of this model may be highlighted.

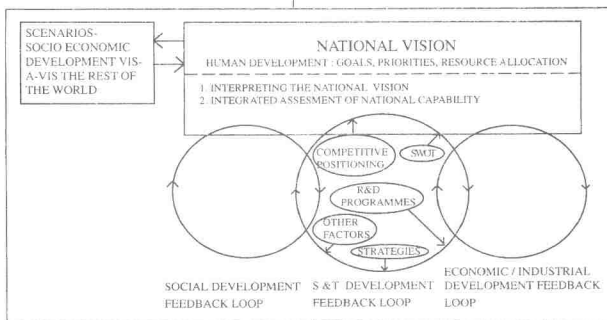


Figure 1 : Decision-Making Model

First the key component of the process is the articulation of a vision of development, from which a programme missions may be formulated.

Second, a scenario approach is employed to provide an integrated view of potential socioeconomic growth and development.

Third, the specific perspectives and expert knowledge of technical and socioeconomic development implementers are integrated in both a top down as well as a bottom - up fashion.

The top-down process takes place when the vision is translated into implementable development program. On the other hand the bottom-up process allows for the implementers to perform technology assessment in specific areas which is then passed on to primary decision-makers in order to generate or improve the vision of development, and thereby the resulting development programmes.

In the same paper the author has also proposed a technology development and diffusion model incorporating both technology acquisition as well as technology exploitation, to be described in a later section. Planning models as proposed can only work successfully if there is concerted and integrated effort by government and private enterprise. Each must understand its role and must be able to perform it in close rapport with other parties, implying the need for strong synergy between the key players. In this way, the mediating process is built in and government is able to play its role as a creative regulator without placing undue encumbrances in the way of private initiative.

5. Human Resource Development And Management

Malaysia's economy has been undergoing a major structural transformation from commodity-based to industrialisation. Industrial contribution to GDP continues to outstrip agriculture. In 1990 their respective proportions were 27% by industry and 20% by agriculture, although the latter still employs a higher percentage of the work-force at 30% compared with 24% in industry. The service sector is also showing strong growth with much evidence indicating the emergence of information-based services that support core production activities. One of the indicators is the grave shortage of human resources in all sectors, but especially so in the IT sector (MNCC 1989). This structural transformation implies that human resource development and its effective management are critical issues which must be addressed if the country is to realise its stated goal of achieving developed country status.

Growth of value added reflects another facet of this economic transformation. In the 1971-80 decade the overall growth was 3.7% per annum per worker which slowed down some what to 2.9% in the 1981-90 decade. However, growth in the manufacturing is consistently high exceeding 3%, as is the growth in the service sector.

They indicate that not only is there structural change but the migration towards higher value added downstream activities is rapidly increasing the demand for knowledge and skill content in the various sectors.

Human sources and their development clearly are the key success factors in the country's development programme (Tengku Mohd Azzman et al. 1991a). The rising level of technical content in production activities due to increasing industrialisation is creating demand for workers with higher technical skills. Even in sectors that have traditionally operated at a low level of technology, such as agriculture, the trend is clearly in the direction of increasing technology content. In agriculture, large-scale industrial farming, automation and the application of databases for production marketing are some of the new trends (Tengku Mohd. Azzman and Saiyed Rasol 1990).

The changing environment is putting pressure on human resource development by creating heavy demand for IT manpower at the basic level but more severely at the advanced level. In a demand-driven economy, skills will become quickly obsolete, requiring continuous rejuvenation through formal as well as informal remaining programmes. Since many of the anticipated changes have yet to occur, a proactive approach to planning and organisational restructuring is essential, for which most organisations have yet to adequately prepare themselves.

Five key strategies have been proposed (Tengku Mohd Azzman et al. 1991 a, 1991 b) to address these problems.

First, skilled IT manpower has to be injected into each key economic sector to develop the infrastructure, thus facilitating new information flows.

Second, the level of automation should be increased in the workplace in order to reduce direct labour content and to raise quality and productivity. Skilled man power in automation needs, to be provided by additional training as well as by introducing new staff.

Third, product research, development and engineering should be promoted to enhance the knowledge content and value added of goods and services.

Fourth, new entrepreneurs should be promoted with a special focus on the rapid diffusion of IT based services into the market place.

Fifth, management training in IT should be provided to senior management of enterprises in order to enhance their knowledge and sense of responsibility and accountability for the effective application of IT in their respective organisations.

As asserted by Drucker (1969, 1989) there is a rising importance of knowledge work and the knowledge worker. These in conjunction with increasing globalisation and IT application have highlighted the need to flatten the organisational structure and to generally decentralise decision-making. Since information and knowledge are now the key factors in individual as well as organisational performance, it is only natural that those who possess them should play their respective roles in management. As a result, the management function now has to be redistributed among multi-disciplinary teams whose members have specific knowledge which is critical to the organisation. These teams should operate autonomously but are nevertheless interlinked in a network to serve the overall interest of the organisation. This is what Drucker calls the knowledge-based organisation. Although IT is useful in putting it into practice, it is not completely essential. More important than IT is the new concept of the flat and decentralised organisation.

6. Infrastructure

Infrastructure has always been an essential component of a development programme. With the rise of IT, however, infrastructure for development takes on a new meaning. Where before the emphasis was on physical means, IT demands that two new components take precedence: *first*, skilled and knowledgeable human resources and *second*, access to and availability of information and knowledge. This radical change in perception has prompted some analysts to coin a new term: *infostructure*.

To be sure physical infrastructure is as critical as ever. Computer acquisition and utilisation is an important indicator, as is the telephone penetration ratio in the population. Without these there is no real prospect of creating the electronic information networks so essential to IT. More difficult to quantify and analyse are the manpower

and information resources available. All three sub-components are intimately linked and feed from each other.

Thus, the presence of good physical infrastructure provides the means to create effective and efficient information systems which can be made widely and easily available and accessible. This raises the potential to create more skilled and knowledgeable manpower and henceforth the feedback loop reinforces itself. On the other hand, the converse is also true: a poor physical infrastructure begets an uninformed and unskilled population. In turn they will be incapable of creating the information infrastructure required for development.

It is for these reasons that the ITU (1984) has observed that in most developing countries telecommunications has been relatively neglected and calls for a wider and more equitable distribution of telephones. Although the cost of providing telecommunication services is high, especially in sparsely populated rural areas, developing countries have little choice but to establish a sufficiently widespread and efficient system.

The experience in Malaysia indicates that privatisation is a key strategy in ensuring that a strong infrastructure for IT development is established. For example, in telecommunications, the penetration ratio of telephones is now 10 per 100 population and current plans call for 15 in 1995 and 25 by the year 2000. Such rapid growth would not be possible without telecommunications having become a private entity. Further deregulation will see more competition especially in enhanced and vertical services. However, not all is left to private enterprise. The government is still the largest shareholder of the telecommunications company entrusted with providing basic services. Its influence can be used to see that the rural population is served with adequate services.

In data communication licences are being awarded to new companies to provide network as well as information services. With the further privatisation of highways, electricity supply and railways, each of which has installed fibre-optic cables or are planning to do so, a nationwide high-bandwidth integrated data communication network may soon become a reality. Keen competition and strategic alliances will generate a business environment which encourages rapid innovation while at the same time bringing costs down.

7. Technology Acquisition, Development And Exploitation

The critical importance of technology for development in the context of IT can be perceived from two perspectives.

First, technology must be acquired in order to generate the IT-based systems required to stimulate development. Examples in this category include microelectronics, computers, telecommunications and software technology. This may be perceived as technology for IT.

Second, development requires technologies of all kinds that have potential to improve the socioeconomic status of the country and the quality of life of the people. However, focusing specifically on technologies that improve products, processes and services through the IT imperative, the idea is to make technology more widely and easily available and its application more efficient and effective.

This may be considered as IT for technology. Here the cognitive dimension of IT is mobilised to enhance "intelligence" in systems, either in gaining new technology through more intelligent information and knowledge processing systems or in designing new products, services and processes that incorporate greater intelligence.

Technology acquisition and development can only take place effectively if there is indigenous capacity to conduct R&D. In developing countries such capacity has to be built up by the government

and constitutes a basic infrastructure for development. Private sector involvement and initiative should be encouraged but government must lead the way. Capacity is indicated by the number of researchers as well as their quality as reflected in their training and experience, in addition to the physical resources in the form of laboratories and equipment. However, these are insufficient to ensure development.

To complement this potential, a coherent and focused R&D programme must exist, which must be integrated within the national development agenda. The planning methodology indicated earlier is eminently useful for this task and will enable technology selection and prioritisation to be purposefully carried out.

In concert with efforts to gain indigenous technological capacity, there is a need to generate endogenous capability. This will enable a nation to perceive itself through its own eyes and top position itself realistically and effectively vis-a-vis the rest of the world. There is an important role to be played by the government as a "creative" regulator in the application, exploitation and diffusion of technology. However, many other critical players have to be taken into account, both in the public and the private sector, if rapid technology development and exploitation is to be effected. A technology diffusion model has been proposed by the author (1991a) which identifies the stake-holder and their respective roles in an environment that generates synergy between the key players.

Briefly described the model perceives the stake-holders to consist of three layers as shown in Figure 2. The core of the process is technology with the main participation coming from technology

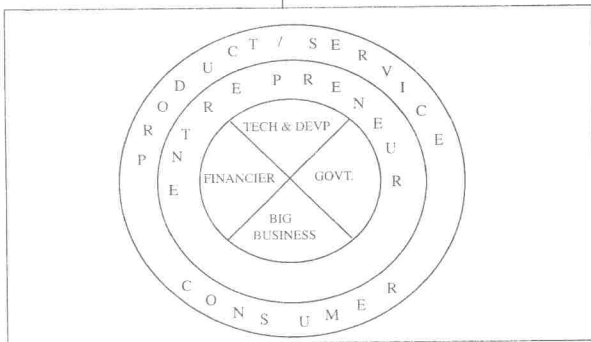


Figure 2 : Stake-Holders in a Synergistic Environment

development specialists in R & D and allied work in the public or private sector. They collaborate with government agencies, big business and financiers to identify and develop strategic technologies. However, these players are not sufficiently effective in exploiting directly the full potential of the technologies developed. This is considered to be best performed by entrepreneurs who form the next layer.

Even big business may not be adequately efficient, having their own built-in bureaucracy that tends to impede the diffusion process. For big business, however, it is possible to create entrepreneurial groups and activities through special schemes within their established organisational structure, and these would have the same status as other free entrepreneurs. Being in the middle, entrepreneurs feed from the portfolio and technologies developed by the core group, identifying new opportunities for product development and commercialisation. They are directly linked to the outermost layer of product and service consumers and will be sensitive to their need. In today's "borderless world" as described by Ohmae (1990), the well-informed consumer has ultimate control over the success or failure of product.

8. IT Programmes In Malaysia

8.1 Basic Issues

Consistent with the concept suggested in this paper, IT programmers are proceeding in a decentralised manner, with each player determining its own goals and seeking its own way of achieving them. The country is fortunate in having more than the minimum level of human resources, financial capital, infrastructure and technical experience to provide a stimulating environment for IT application and innovation.

As a result, both in the public as well as the private sector the diffusion of IT has been relatively rapid and widespread. However, the situation is by no means perfect.

First, there is a need for tighter coordination at least at the government level to see that the country as a whole is well-positioned to exploit IT effectively. A vision of the IT potential must be articulated, pointing the direction for future progress.

Second, infrastructure development must also be regulated in such a way as to stimulate growth but at the same time to preserve social and cultural integrity as well as economic equity. This applies especially to telecommunication and data services.

Third, although the private sector should be left free to pursue their own goals, the government has a role to work closely with private enterprise in order to identify new opportunities and to make sure they are properly exploited.

An example is the liberalisation of world trade in services under GATT. Although government rightfully represents the entire country in negotiations it is private enterprise that must seize the opportunities that arise. These are some of the strategic issues that need to be addressed in future planning and implementation of IT programmes.

8.2 Two Examples Of IT Programmes

We present below examples of IT programmes that are under development in Malaysia in which the author's research institute is playing a leading role. However, cooperation and coordination is the key success factor and the case studies illustrate five primary features in such planning.

First, these programmes are designed to promote the development of human and technical capability and are less concerned with the growth of the IT industry itself. Industrial growth will result but indirectly and will occur in the long run.

Second, the multi dimensional nature of IT systems is recognised and dealt with by taking into account three basic perspectives: technical, individual and organisational/cultural.

Third, these programmes focus on human resource and infrastructure development, critical roles of the government, from which important opportunities will arise.

Forth, they generate synergy between key players, such that a "win-win" socioeconomic climate results.

Fifth, they are wide-scale IT programmes with potential to change the lives and working environments of many kinds of participants, thus promoting pervasive IT education, diffusion and development.

1) A National Computer Network

A national computer network with international links for electronic mail was developed in 1987 (Mohamed, 1987) called RangKoM (Rangkaian Komputer Malaysia - Malaysian Computer Network). The main objective is to enable members of the research and academic

community to communicate with their peers locally as well as internationally. The initial success of RangKoM prompted the launching of a more powerful network in 1990, named JARING (Joint Advanced Research Integrated Networking). A national backbone network is being constructed based on lines leased from the telecommunications company. Special packet switching equipment are being installed to link users through these lines, creating a private network which is also interconnected to the public network. Greater control over network growth and lower cost of operation are some of the expected results.

The main objectives of the JARING Project are: *first*, to establish an integrated nationwide data communication network based on the OSI standard; *second*, to enhance R&D activities in S&T and the exploitation of their results; and *third*, to study and evaluate the use of data communication technology and its impact on socioeconomic activities. It is anticipated that JARING will stimulate the development and use of strategic databases and promote the development and wide adoption of hardware and software standards in IT.

2) Computers in Education

The programme consists of four interrelated projects (Tengku Mohd Azzman 1990, 1991c).

First, a cost effective school computer has been designed jointly between the author's institute, a consortium of local companies and the Ministry of Education. Twenty of these computers are being supplied to each of 60 secondary schools in the current phase, in addition to an industry-standard 386 machine which will act as a server. It is expected that the project will be extended first to the rest of the 1400 secondary schools and then to the 6,500 primary schools in the country.

Second, an authoring tool for courseware development is being written. A beta version is ready to be distributed for which a training programme for school teachers is being implemented.

Third, a nationwide educational computer network is being designed which will use the JARING network described above.

Fourth, a national educational data base system is being designed which will be accessed through the network. The four projects together make up what we have called a Computer Integrated Learning System.

The introduction of computers in education on this massive scale is expected to produce two main results.

First, a new generation of Malaysian youth will be educated to be both computer world information literate such that they are able to actively participate in applying IT for national development.

Second, teacher productivity and efficiency can be raised to a high level, enabling them to regain their status as mentors and guides in disseminating information and knowledge in the classroom.

9. The Islamic World- Status And Prospects

The author (1988) has attempted to evaluate, both qualitatively and quantitatively, the strengths and weaknesses of Malaysia in acquiring and applying IT for development. While some indicative results were obtained, they were not wholly satisfying. This arises mainly because the data and methodologies developed are geared to a socioeconomic environment where land, labour and capital are the dominant resources that support growth and progress. In the information era, these are being displaced by the capacity to gain and exploit information and knowledge. Another attempt by the author (1991b) to analyse the status of Islamic countries produced similar results. However, in both cases the picture is clear: the Islamic countries are not well positioned to acquire or to use IT for development.

In the latter study, five specific areas were examined: economic status, social conditions, technological capability, infrastructure and lastly, Human Development Index (HDI) as formulated by the UNDP (1990). Even the high-income Islamic countries do not measure up well in terms of IT capability. Economic and social conditions do not favour the development of knowledge or its application. This is clearly seen in comparative data on educational enrolment at primary, secondary and tertiary level, literacy rate, education expenditure, number of scientists and technicians and information infrastructure such as telephones, radio, TV and newspapers. Most telling of all is the HDI where only Kuwait and Malaysia fall under the "high human development" category, with all other Islamic countries relegated to the medium and low development classification.

In view of this weak position of Islamic countries, it is proposed that a wide-scale programme be initiated under the auspices of influential international Islamic agencies to wake up our Ummah to the present-day realities brought about by the pervasive impact of IT. The first task is to reformulate our development strategies to be consistent with the information paradigm.

The experience in Malaysia suggests that the key success factor in development planning and implementation is self-reliance.

10. Conclusion

This paper has summarised key ideas and concepts underlying a comprehensive programme that is unfolding in Malaysia, a small developing country, to apply a strategic emerging technology for overall human development. The analysis reveals that IT is not merely a neutral value - free technology but impinges on the very core of human existence - the human mind and spirit. Thus the critical issues that arise are not simply social, economic or even technological, but are rooted in human values and cognition.

Human resources in both quality and quantity are crucial towards ensuring successful development and diffusion of IT. Infrastructure, economic conditions and technology are strategic factors but people individuals or in organised collections normally determine the essence of IT for progress. The notion of infrastructure that unifies that physical with the cognitive is a useful basis for analysis and decision-making.

Our analysis also reveals that practically all Islamic countries are inadequately prepared for the coming information revolution. Malaysia cannot claim to be much better than others but appears to be in a better position than most to face the changing scenario. More so, because it is making positive steps towards effective acquisition, development, application and exploitation of IT. If its experience is anything to go by, the basic principle of development planning and implementation is self-reliance.

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