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# ACTION PLAN FOR INDUSTRIAL TECHNOLOGY DEVELOPMENT: MALAYSIA'S PREPAREDNESS FOR THE 1990s

by

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## 1. Introduction

If Malaysia were to advance to an industrial nation status, it must ensure the fastest rate of industrialisation possible, selecting those industries that will sustain it export-led growth during the 1990s and beyond. Such a pace can only be realised with a massive advance in industrial technology supported by an effective programme in human resource development. But, at the current stage of the country's industrial development, Malaysia in many respects is still technologically lagging behind the industrialised countries.

While considerable progress has been made in the areas of agriculture through R&D activities, the domestic manufacturing sector is still constrained by a relatively underdeveloped science and technology (S&T) infrastructure, low level of technology application and exploitation, and inadequate appreciation of the key role of technology in development. As such the tasks assigned to S&T would require continuous and vigrous emphasis given their widespread and pervasive impact on the overall economic development of the country. That S&T is an integral part of the country's economic development has already been amply emphasised in both the Fifth Malaysia Plan (1986-90) and the Industrial Master Plan (1986-95), and reiterated in the recently-launched Action Plan for Industrial Technology Development (APITD). In line with the principal objectives of the latter, Malaysia must therefore be prepared to implement a strategic approach to technological enhancement.

Following from the above, this paper will principally examine Malaysia readiness to face the decade of the 1990s in terms of its strategy to expand the country's industrial base through the enhancement of technological capability. More specifically, the

paper will examine two critical issues that will significantly influence the country's future industrial performance; and these relate to the global investment and technology trends and their impact on domestic industries and the development of the country's human resource. Equally important, other related issues will also be examined, and these will include the rationale for technological advancement, the role of the government in managing technological change, and the need for public sector-industry interaction.

## 2. Global Investment and Technology Trends

As implied by the Action Plan, the formulation of any future industrial strategy will have to consider the rapidly changing external economic environment. This changing global environment, generally influenced by the ever increasing competition for market niches especially among the more industrialised countries, is likely to be translated into economic adjustments within each country including Malaysia. If such adjustments are not made, then the economy will increasingly lose its competitive edge.

In the Asia-Pacific region, two principal changes since the mid-1980s seem to have a tremendous impact on the economic performance of most countries in the region; firstly, the rapidity of internationalisation of industrial production including the relocation of industries from the industrial countries to the developing countries and secondly, the increasingly important role of the Asian newly industrialised countries (NICs) in international trade. It is becoming increasingly evident that the multinational companies (MNCs) of the advanced industrial countries, in tandem with their respective government policies, have successfully "internationalise" the development of off-shore production facilities. The massive spread of these facilities during the last few years adds a new dimension to the relationship between industrial countries and the developing countries, exhibiting a division of labour in the world economy largely superimposed by an intra-firm division of labour within the MNCs.

The emergence of new technologies and innovations in the industrial countries will significantly influence the economies of

all countries and alter international trade relationships in various ways. Firms or industries which create innovations will benefit either through the marketing of new and improved products and processes or through the use of improved production techniques which the technologies provide. In the industrial countries, and to a lesser extent within the NICs, these developments offer possibilities for creating new industries, revitalising productivity in the old ones, and generally restructuring the industrial base; thus leading to a competitive standing for these countries in world trade.

The intra-firm division of labour mentioned earlier strongly implies that, particularly in manufacturing activities, the MNCs will accentuate their control over technology and innovation, while the routine and standardlised products and production processes are located in the developing countries. Such control is further facilitated by the increasing integration of national economies via a perfected structure of coordination among dispersed production units together with a worldwide marketing system. While this allows the MNCs to widen their market shares, it indirectly stifles the entry of newcomers through product differentiation, thus lessenening the opportunities for "latecomers". Their strength in R & D activities, driven by the desire to remain at the frontiers of technology development, has consolidated their oligopolistic positions. The manner in which the MNCs dominate world trade tend to make export-led industrialisation a complex task for most developing countries without the partnership of the MNCs, at least at the initial stages of their industrialisation.

For instance, there appears to be limited options for a small economy like Malaysia to develop export-oriented industries in sectors such as electrical and electronic products, consumer durables, chemicals, transport equipment and even textiles without the necessary links with the MNCs. This, of course, has a crucial influence on the pace by which domestic industries will develop their own technological capabilities. The manufacturing sector should therefore ensure that there is effective technology transfer as well as the enhancement of the spin-off effects of

direct foreign investment (DFI).

The emergence of the Asian NICs, including South Korea, Taiwan, Hong Kong and Singapore, as major exporters of more mature consumer products to the industrial countries has become the focus of a new international division of labour, especially with the expansion of the NICs' multinationals and their extremely successful export performance. Undoubtedly it has a significant "demonstration effect" on the industrial strategies of other developing countries of the region. What is perhaps more significant, in terms of lessons to be learnt by other developing countries, is the strategic response of the NICs to the rapidly changing economic and technological environment within which they have to operate internationally. This is made possible by clearly defined strategies enhancing their export-led growth.

For many developing countries of the region, Japan will remain dominant as a net exporter of capital and technology-intensive goods during the 1990s, although the Asian NICs will probably become net exporters as they are already doing in some areas. ASEAN on the other hand will continue to depend on imports of capital goods from Japan, other industrial countries and the Asian NICs. The latter will in fact diversify from the processing of products into design, R & D, testing and marketing and will increasingly become important exporters of technology which include complete plants, capital goods, consultancy and training services, (See Chen & Wong, 1989; p.204-239). In this global and regional economic context, the future thrust for Malaysia would thus have to be in finding a niche in international markets, expanding the industrial base through the enhancement of technological development.

3. The Need for Technological Advancement

The need for rapid technological diffusion within the economy becomes more decisive in the light of global macroeconomic adjustments and technological changes and breakthroughs, especially during the last decade. The continuing industrial restructuring in the advanced countries and the prevailing mood of

protectionism which creates an environment of instability in the world economy become more disconcerting for developing economies. This is further complicated in view of the rapid development of new emerging technologies in areas such as microelectronics, biotechnology and advanced materials which are primarily driven by intensifying competition and shifting competitive advantages among the Japanese, American and EEC multinational companies, (See, for example, Commonwealth Secretariat, 1985; p.32-42).

Despite the abovementioned complexities, there is an inherent advantage of being an industrial "latecomer"; i.e. the ability to acquire proven technologies from the industrial countries and thereby minimising the development costs of such technologies while allowing domestic industries to achieve high productivity and efficiency levels. But, simultaneously, the pace of technological innovation is convincingly more rapid to-day than at any previous time, so that product life cycles are being strikingly compressed. This means that developing countries like Malaysia requires a remarkable accentuation of their learning curves to "catch up" technologically. Even a strategy of "reverse engineering" requires very substantial investments and considerable flexibility to respond immediately to market changes. A critical component of technology development must therefore be related to the country's capability to muster the human, financial and other resources needed to maintain continued access to new technologies.

## 4. Managing Technological Change Role of Government

A critical issue for Malaysia is in terms of managing technological change to ensure the most efficient use of the available resources within the country. Managing this change has become more critical given the increasing complexity of S&T as well as innovations, emanating principally from the industrial countries. In this sense, it is imperative that the government intervenves to affect the technological change needed to sustain industrial growth.

The government's role becomes crucial given that technological

development requires substantial infrastructure support of all kinds, including education and training, technical extention services, development of public-private sector linkages, and a S&T institutional framework. Without the policyand financial support from the state, the output of skilled and trained manpower and the amount of R & D activity in society would become less than optimal. For Malaysia, it is even more difficult to manage this technological change in view of the increasing pace of technology development and innovations which require shorter response time from product development to commercialisation. Increasingly there is specialisation of skills and complexity of systems bringing with it the need for proper interfacing of manpower and disciplines and integrating critical skills from various sources.

In essence, it is thus critical that the government, especially in countries seeking to industrialise themselves, seek to strengthen its grasp on S&T development in terms of Policy direction and direct Involvement. While technological progress has more frequently resulted from planning and intervention rather than as a response to invisible market forces (See Tuma, 1987; p.403-407), there is a need for a well-defined industrial strategy integrating technological development with economic planning.

Policy direction and the government's direct involvement could be translated through two broad objectives; i.e. 'to increase political commitment and public awareness with respect to technology development and to minimise the widening technogical gap between Malaysia and the more industrialised countries. Within these two broad objectives, other second-tier objectives must also be achieved; and these include:-

o To develop an appropriate environment that will foster technological self-reliance in selected or priority areas; and as a precondition there must be a high degree of indigenous technological capability; and

o The integration of S&T planning with the national development process; strengthening the organisational structures and linkages

with regard to policy development, allocation of funds and other resources and effective R&D delivery mechanisms.

With this regard, the government recognises that indigenous technological capability will become increasingly essential for sustaining the industrialisation process in the future. Thus, the Fifth Malaysia Plan (1986-90), states that:-

> "the current uncertainties in the international environment, coupled with the difficulties in maintaining the competitiveness of manufactured products, necessitates an even greater role of S & T in the industrialization programme of the country. A strong base in S & T and vigorous support of R & D will, therefore, be crucial. During the Fifth Malaysia Plan period, the role of S & T as an effective tool of development will be further intensified, especially in the light of emphasis on increasing agricultural productivity and intensifying resource-based industrial development as well as expanding the manufacturing base to include heavy and high-technology industries. Greater private sector involvement will be encouraged. Opportunities will be provided for interactions between both primary and secondary industries and R & D institutions, including universities".
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> (Malaysia, 1986; p. 261-262)

## 5. Public Sector-Industry Lingkage

While it is crucial that the government provides the leadership to enhance technological change, it is equally important that the public sector and the industry collaborate closely. The industrial experience of Japan and to a lesser extent South Korea bear testimony to the necessity for such a collaboration (See Yoo Seong-min; 1989, p.80-104). In both these countries, government intervention in the economy has been extensive and readily visible

compared to earlier industrialised economies of Western Europe and North America and was done at both the macro and micro levels. The Economic Planning Agency of Japan and the Economic Planning Board of South Korea initiated economic plans which were somewhere between indicative and command planning, stipulating priorities of both the governments and indicating to industry the direction in which the governments want the economy to move, (See Blumenthal & Lee, 1985: p.221-235).

The experiences of the Asian NICs have shown that they been especially successful in utilising trade as a vehicle not only to accelerate economic growth but also to enhance technological capability. High volumes of production for exports have permitted them to reap substantial benefits in productivity increases via economies of scale and the learning process. This sort of learning, however, is localised to a limited number of activities associated with low cost manufacturing of standardised products. Continued dependence on such products to sustain export expansion is becoming increasing difficult, and thus may erode their competitive edge.

To be able to move to a different sort of competitive advantage based on product or quality enhancement will therefore require a new set of skills which demand additional investments in newer imported technologies as well as in complementary R&D activities. At the same time considerable investments in marketing and distribution will have to be made, and these could be more substantial than investments in R & D given the global competitive environment. Even then, there is no guarantee of success as the international environment is far less favourable at present for continued strong export expansion than it was in the 1960s and 1970s when the Asian NICs first embarked on their export-led growth.

Even in Hong Kong, where state intervention is kept at the minimum level, government policy has in recent years shifted from a posture of non-involvement to increased intervention as the promotion of high-technology, skill-intensive industries are considered as crucial for enhancing technology transfer,

innovations and productivity improvements (Ng, 1987; p.467-478). Even in the United States, state governments have been urged to take an active part in promoting university research to fulfill the needs for innovation; and this is done with the formulation of long-range policies for the utilisation of S & T resources, the identification of needs and opportunities for innovation, and fostering greater university-industry research interaction (Lindsey, 1985; p.85-90).

Of the innumerable ways in which the government can affect technical innovation, some of the most important are through the creation of demand, subsidies to firms, regulation, technical and scientific infrastructure, support of innovative firms and through a banking system well adapted to the needs of innovative industries. The most important role of the government is thus to establish an environment that stimulates firms such as engineering-based firms, ancillary goods producers and capital goods suppliers to engage in ongoing technological efforts and to develop added technological capabilities that would ultimately improve productivity and overall economic performance. The state can also intervene directly to induce choices of techniques that are socially most appropriate, foster imports of technology on the best possible terms, and stimulate the development of specialised technological agents (See, Dahlman & Ross-Larson, 1978; p.759-775).

The government as an initiator of industrial strategies must take the lead in promoting R & D by industry using inducements such as fiscal incentives, establishing an effective delivery/information system and creating special R & D funds. Market forces alone may not be sufficient to generate technological advancement and industrial growth during the present phase of Malaysia's development. This has been recognised in countries such as Japan and South Korea, where the state interventionist policies have greatly shaped the extent and depth of their respective technological development. However, once a high level of technological development has been achieved as in the industrial countries, research institutes are no longer the only source of R&D activities. In fact industry plays a leading role in

fundamental research as well as developing applications of new technologies.

In Malaysia, however, industry does not as yet have a tradition in industrial R&D and technology development, although there are some exceptions. This arises because of the fact that both the earlier import-substitution and export-led industrialization were dependent on direct foreign investments, and thus imported technologies. Since the private sector responds to market signals, and since its planning horizon is relatively short, the private sector, in fulfilling its corporate interests, does not have the incentive to undertake projects in industrial technology development whose returns may not be immediate. This is particularly relevant for most locally-owned manufacturing enterprises whose production capacities are relatively small in comparison to the foreign-owned MNCs. The market therefore fails to work as sufficiently adequate mechanisms for allocating resources to R&D efforts because decision-making at the firm level is based principally on the profit motive.

An increase in R&D expenditures commensurate with the domestic absorptive capacity needs to be emphasised in any future S&T strategies. Apart from the government's policy direction and participation in industrial R&D, it is crucial that a significant portion of this increase be undertaken by industry. This would be in line with the objective of the Action Plan for Industrial Technology Development to increase industry's role in achieving higher value-added from the exploitation of the country's resources. Currently, private sector involvement in national R&D has been very minimal. Its expenditure on R&D in 1982, for example, represented only 10% of the national R&D expenditure [illegible] with 5% by the universities and 85% by the public sector (MOSTE, 1986; p.269). The Plan's target is that by 1995 R&D expenditure levels will increase to 1.5% of GDP and to 2% by 2000, with 60% from industry.

Human Resource Development (HRD)

Labour supply constraints, in terms of the shortage of

highly skilled and technology-oriented manpower and the mismatch between the supply of and demand for middle-level technical personnel, must be reviewed so that the role of the various educational and training institutions can be constantly readjusted to accomodate the changing industrial needs of the economy.

To ensure that the educational system functions effectively in terms of human resource development, it is also crucial that a number of issues be considered. Firstly, it is important that courses offered at the various institutions are relevant and consistent with the expanding needs of industry. Secondly, the focus of curriculum development is to ensure that there is a balance between content and skills so that students are trainable for effective participation in the industrialisation process. Thirdly, linkages have to be built up and increased over time between educational planners and industry in terms of training.

In the case of the universities, for example, they must play a more significant role in both S&T and manpower development during the 1990s. In order to acquire and upgrade competence in new technologies and innovations, universities must be supported with increased budget allocations to enhance their teaching and research capabilities. At the same time, opportunities for post-graduate extension and continuing education must also be increased to support these capabilities.

A highly skilled and knowledge-endowed industrial labour is more important to national competitiveness in the new technology and information-intensive industries than any other resource endowment. The two major implications are firstly, of the need for a much higher level of basic education and knowledge needed to meet this challenge. Secondly, the need to refresh and develop, if not completely renew skills and knowledge several times through a normal working life.

To ensure that there is effective planning and implementation of the above broad policy guidelines, manpower planning must strive to produce the right quality and quantity of scientists and engineers, technicians and skilled manpower, and to upgrade S & T

personnel continuously. It is also deemed essential that manpower development be effectively integrated with S & T planning. In this respect, the Ministry of Science, Technology and the Environment (MOSTE) must be involved in policy-making for HRD in the country.

As recommended by the Action Plan for Industrial Technology Development, industry participation in policy formulation for HRD will become increasingly crucial in the future given its role in the industrialisation process. With industry participation in determining the structure and relevance of training programmes it will definitely facilitate the matching of supply and demand of skilled labour in each industry. Private industry representation should thus be enhanced in the advisory boards of the various training, technical and engineering institutions. This will also provide the opportunity for increased interaction between educational institutions and industry.

The kind of private sector participation in policy-making would indirectly encourage the strengthening of industry associations or the formation of new ones in industries where they do not exist. Currently most of these industry associations are relatively inactive compared to their counterparts in the industrial countries or the Asian NICs, thus weakening their potential in terms of identifying each industry's problems, obtaining and disseminating technological and market information and forwarding their case to the relevant government agencies such as the Ministry of Trade and Industry and the Malaysian Industrial Development Authority (MIDA).

o Upgrading of Existing Skills

Greater emphasis must be given for retraining of the industrial workforce to ensure that they will acquire specialised and up-to-date skills. This can be effectively encouraged by utilising more generously the present incentives for training. It is crucial that industries upgrade the technical skills of their employees; and in this respect the Action Plan for Industrial Technology Development has proposed the establishment of a Skills Development Fund to finance programmesto upgrade skills

among workers in the industrial sector. This Fund, which is to be managed jointly by the public and private sector, will be financed through a cess collection from the manufacturing sector. However, this cess collection should not be imposed upon newly-established enterprises and small-scale industries as such measures would only jeopardise their potential to establish themselves and to expand their activities respectively. One option that can be considered is to institute this proposal on a selective basis, to be based on the firm-size or on 'priority industries'.

Besides upgrading existing skills, grants can also be made available from this fund for manufacturing firms to pursue R&D activities considered vital to the needs of the sector. This will enable firms to obtain grants or seed capital to develop new products and processes or to substantially improve upon their existing products or processes. The fund can thus complement the Industrial Technical Assistance Fund (ITAF) announced in the 1990 Budget under which a $50 million funding will be provided by the government to increase R&D activities among the small and medium-scale industries. The ITAF fund will be used to reimburse 50 per cent of the total project costs incurred by firms to undertake feasibility studies, quality and productivity improvements, product and design development, and market development.

The level of quality awareness in most domestic enterprises does not permeate the full range of industrial activities, thus lacking initiatives in responding to changes in consumer's demand. It is therefore critical that these enterprises adopt a positive approach to quality management, apart from acquiring competence in areas such as industrial design, engineering design and product design. Apart from ITAF, the implementation of a quality enhancement programme which is readily available to industries must be supported by the establishment of Regional Quality Centres in a number of strategic urban locations.

With respect to the latter, is also timely that a policyreview be made regarding the establishment of private training institutes such as the Penang Skill Development Centre undertaken by the

Penang Development Corporation to provide training programmes by pooling resources of the various industries in Penang. Given the increasing complexity of new technologies and the needs of modern industries as well as the rapidly increasing government commitment towards industrial infrastructure building, the private sector ought to complement existing public sector training programmes for industry. Each State Economic Development Corporation could take the initiative towards this end with the cooperation of local industries so that the skill needs of the latter can be appropriately met. At the same time, a set of incentives could be formulated to encourage the private sector to initiate such institutes.

## 7. Concluding Remarks

The introduction of technological change must be viewed as a critical process and must be guided by medium-term to long-term strategies. Technological change is most beneficially and smoothly accomodated and absorbed under conditions of steady economic growth. The economic growth after the 1985-86 recession indicates increasing optimism which have been accompanied by a number of policy adjustments in line with the increasing pace of global economic and technological changes. This has effected structural changes which technological advances are expected to facilitate and generate.

It is in this sence that the government must take the lead not only in terms of human resource development to enhance technological capability but also in terms of creating a conducive environment for industry to participate fully in technology-oriented activities. Economic progress will always depend on the internal innovative capacities of a society, for it is human resources rather than capital equipment that create development. The pace and pattern of technological change, therefore, depends critically on the size and expansion of the country's pool of highly skilled manpower. Hence the crucial importance of a sound infrastructure relating to education, and technological and scientific research. The rapid and sustained productivity growth in manufacturing that is required to transform

the country's industrial base will therefore depend on the increased utilisation of a well-trained technical personnel.

A set of strategies or policies should then be adopted for practical implementation to ensure that domestic industries will have an adequate supply of highly skilled engineers and technicians; and this will ultimately influence the extent of the country's technological capability, including innovative capacity and creativity. However, at least in the short and medium term, given the predominance of direct foreign investment in a number of key industries, one has to note the role of foreign expertise and technical know-how in the country's technological development, both in terms of technology transfer and technology absorption.

Technological development gains momentum when a conducive environment for its popularisation is created. In view of this it is imperative that a long-term programme to popularise S&T be launced as an integral part of a technology development plan. The programme should aim at a universal desire to create awareness in every citizen to be creative and innovative at the work place. This of course will require substantial efforts at the planning level and an enormous amount of interaction between the public and private sectors. More significantly, the popularisation of S&T must be complemented by programmes at the industry level, which should ultimately accelerate the pace of technology acquisition, adaptation and innovation within domestic industries.

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