The Developed Nations and the 60:40 Policy

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Abstract

This article examines the importance of science and technology for countries to become developed economies. As for Malaysia it has introduced the 60:40 policy in 1967, as the vehicle for the nation to create a scientifically and technologically oriented society. The policy envisaged that 60% of the students in the secondary schools and universities to be studying science and technology courses and 40% in the arts and social science courses. The ultimate objective is to generate sufficient knowledge based human resource to create a critical pool of professionals, scientists and technocrats in the country comparable with the developed nations. The said policy is given further impetus with the introduction of the vision policy in 1991. The principle finding of the situation in Malaysia is the said policy has still not been achieved.

Materials and Methods

Multiple Case Study – qualitative method

Keyword: "scientific and technological capabilities", "convergence", "critical mass", "integration", "productivity"

Introduction

Two important achievements after WW2:

1. Economic integration among countries to form free trade zones e.g. NAFTA, EU and subsequently ASEAN, resulting in globalization where world markets and production of goods and services become integrated and interdependent (Harrison et al, 2000, p.10). This leads to economic integration resulting in trade creation and diversion, price reduction and increased competition, the opportunity for greater economies of scale and the dynamic effects on efficiency, investment and innovation. There is rapid growth in international business activities. These businesses become more diversified and complex putting them far beyond the ability of individual government to influence or control.

2. Information communication technology (ICT) advancement has become the strategic weapon to organisations (Daft, 2004, p.286). The accessibility to information enables organisations to make appropriate strategic decisions and to remain in strategic position in the market and integration with related organisations for organisation stability, cost efficiency and effectiveness.

Both advancements have brought about one single effect on organisations, they are challenged to converge, change and adopt new technologies in order to remain creative and innovative to provide products and services to satisfy the needs of the markets.

As a consequence industries are forced to adapt or learn new scientific and technological skills and knowledge to capitalise on new efficient technology processes. This leads to the realisation that the knowledge of science and technology becomes the imperative aspect of human resource development not only in industries but the nation to gain competitive advantage. This seems to be in line with Porter's Diamond (Diagram 1).

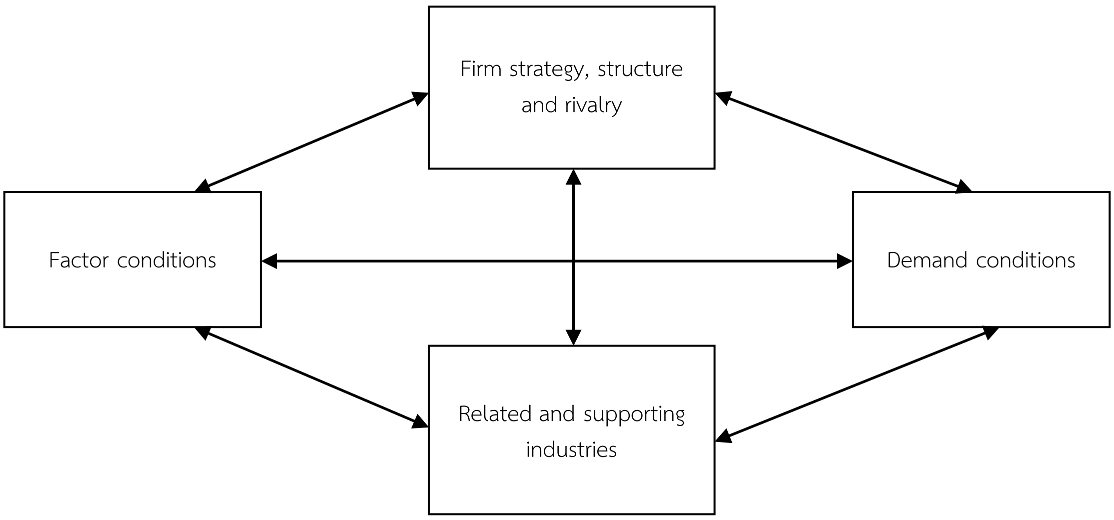

Diagram 1: Porter's Diamond

This is where the 60:40 policy can play the important role to bring about the development of the scientific and technological capabilities and skills in the human resources for a nation to become competitive.

Objectives

1. The importance of the 60:40 policy towards the achievement of the developed status of a country.

2. The creation of a critical pool of professionals, scientists and technocrats in the country comparable with the developed nations.

Concept theory framework

The developed world: Japan and Germany

After WW2 not only countries with homogeneous people like Germany and Japan but countries with plural societies with diversity of people in term of different religions, languages or cultures have developed to become new and dynamic economists. The main factor of these countries is that they have the scientific and technological capabilities to attain core competencies to gain competitiveness over other nations (Goh Keng Swee, 1986) for example the triad nations - Japan, United States and EU control more than 70% of the world trade.

Both Japan and Germany lost virtually everything such as money and stocks of physical assets but their people survived the war. Their knowledge and their work attitudes made these two countries rose from the ashes of war.

For example Japanese people applied their manual and intellectual skills to operate complex technology in large scale enterprises. Their schools are given the task to build a scientific and technological society. Their industries competed successfully with the industrial nations in almost every field in which Japanese manufacturers chose to specialise. They have beaten the competition in price, quality and reliability. They have ceased to imitate. They have become critical and creative. This is because the Japan has the technological and scientific skills and knowledge and has developed the critical mass of professionals and experts required for national development and economic competitiveness. They have developed the capacity to create and innovate, both in consumer goods and capital equipment even though Japan has no other natural endowments except 130 million people which is about half the size of the population of US and a quarter of the population in the EU.

The same situation occurred in Germany. It is no doubt that the skills and knowledge of technology and science of the surviving populations have enabled Japan and Germany to attain the developed nation status very quickly after WW2 (Abdus Salam, 1986).

Certainly, there are developing countries like Argentina, Brazil, China, Korea and India have also taken science and technology seriously. Other developing countries though realised that science and technology are the sustenance of progress and the major hope for economic betterment, have regarded science, in contrast to technology, as only a marginal activity. In the sense, that technology is given more importance than science. This is because very few developing countries realised that for long-term effectiveness, technology transfer must always be accompanied by science transfer. This is because the science of today is the technology of tomorrow and science changes every day. Furthermore the transfer of science is usually done by communities of scientists. A country needs to build up a critical size of such a community as well as to develop the necessary infrastructures for scientific literacy and science teaching at all levels especially at the higher levels for the engineers and technologists (Abdus Salam, 1986).

Looking at the development of the education systems in the countries in this region of the world provides a better perception of how these countries have responded to the challenges of globalization. Concurrently it will indicate where Malaysia stands in relation to these countries in the advancement of education. Countries in South-East Asia like Brunei, Cambodia, Indonesia, Laos, Myanmar, Philippines, Singapore, Thailand, Timor-Leste and Vietnam have similar emphasis on education and the human resource development to meet the unprecedented challenges brought about by the convergent impacts of globalization in the sense that similar technology is dispersed to countries. They consider education as of increasing importance to be the principal driver of growth and the information-technology-communication revolution. They have the same missionary zeal towards making education accessible to all their people as well as enhancing the quality of education. They are encouraging the study of science and technology in schools and higher institutions of learning. They are interested to create knowledge-based economies and have placed education as the vehicle for the development of their human resources (Ariel S. Sadiman, 2004).

Table 1: Population of Countries in South-East Asia (2014)

Countries	Population
1. Brunei	453,000
2. Cambodia	15,561,000
3. Indonesia	251,490,000
4. Laos	6,557,000
5. Malaysia	30,034,000
6. Myanmar	51,419,000
7. Philippines	101,649,000
8. Singapore	5,554,000
9. Thailand	65,500,000
10. Timor-Leste	1,200,000
11. Vietnam	90,571,000
Total	619,988,000

Together the eleven countries in South-East Asia have a total population of about 620 million in 2014 (Table 1). The number of population varies from the populous country like Indonesia with 251 million people to the least populace country like Brunei with 453,000. They are also different in terms of geography, culture and level of socio-economic development. Therefore the contribution of equality to education and learning opportunity varies among these countries and the level of achievement in the teaching and learning of science and technology also differs from country to country. The PISA scores in terms of reading, mathematics and science education for 2009 and 2012 from the different countries provide a clear indication of the different levels of learning experience among the secondary school students in different countries (Table 2). However these countries have one thing in common and it is to encourage the study of science and technology in schools and institutions of higher learning. Malaysia adopted similar approach through the introduction of the 60:40 policy from 1967 and this has remained the strategic intent of the country since then.

Table 2: PISA Scores in Reading, Mathematics and Science in 2009 and 2012

	PISA Scores								
	Rank	Reading		Rank	Mathematics		Rank	Science	
Countries		2009	2012		2009	2012		2009	2012
Shanghai-China	1/1	556	570	1/1	600	613	1/1	575	580
South Korea	2/5	539	536	4/5	546	561	6/7	538	538
Finland	3/6	536	524	6/12	519	545	2/5	554	538
Hong Kong	4/2	533	545	3/3	555	579	3/2	549	555
Singapore	5/3	526	542	2/2	562	573	4/3	542	551
Japan	8/4	520	538	9/7	529	536	8/4	539	547
Vietnam	-/20	-	508	-/17	-	511	-/8	-	528
Thailand	52/47	421	441	52/48	419	427	51/50	425	444
Malaysia	55/59	414	398	57/52	404	421	53/53	422	420
Indonesia	62/61	402	396	68/64	371	375	66/64	383	382

Source: Wikipedia: Programme for International Student Assessment (PISA) 2009 & 2012

The Importance of Science and Technology to a Nation

We examine the Asian Tiger Economies - South Korea, Hong Kong, Taiwan and Singapore in this aspect to give us a better understanding of how these four nations attained the Tiger status (Table 3).

These four states are the emerging economies. They have undergone rapid industrialisation and their annual growth rates have reached double figures. They have a close link between the aims and purposes of higher education and the needs of the economy. Their demand for an educated and skilled workforce increases in tandem with the country's rapid industrialisation. This is made possible by their institutions of higher learning to increase their capacity of enrolment in science and technical-related courses to produce the manpower with science and technical knowledge coupled with the capacity and capability to undertake research and development relevant to the requirements of the industrial and service sectors.

Table 3: Growth Rates of Selected East Asian Economies (Average % per annum)

	1977 - 1985*	1986 – 1996*	2006	2011
China	7.9	9.9	7.0	5.0
Hong Kong	9.2	6.3	7.0	5.0
Indonesia	5.7	7.4	5.5	6.5
South Korea	7.6	8.6	5.2	3.6
Malaysia	6.3	7.8	5.8	5.5
Philippines	2.0	3.7	5.2	3.7
Singapore	7.2	8.4	8.8	4.9
Taiwan	8.3	7.7	5.4	4.0
Thailand	6.6	9.1	5.1	0.1

Sources: (a) * World Economic Outlook, 1998, table 3.11, 101 quoted in Harrison et al, Table 9.1, p. 194. (1977-1985 and 1986-1996)
(b) World Bank East Asia & Pacific Economic Update 2012 Vol 1– Appendix: Table 2 p. 88 (2006 & 2011)

For example in Taiwan, 55% of students are studying either engineering or business administration. These Tiger economies also stressed the development of social and moral values as a role of higher education.

As with regard to participation in higher education, South Korea has attained 40% while Singapore has reached 60%. Hong Kong has moved in the same direction as South Korea and in line with China's advocation for science and education for industrialization and modernisation (Pepper, 1990).

The 60:40 Policy in Education: Malaysia

This education policy is calling for a paradigm shift in the development of the human resources in the schools and institutions of higher learning towards 60% of the students in the secondary schools and tertiary institutions should be studying science and technology and 40% studying arts and social sciences.

Science and technology have been accepted as the pulse for economic productivity in many sectors of the economy. The policy is asking the schools and universities and colleges to produce sufficient quality human resources in science and technology for the country to increase its productivity, to improve its innovation and to be efficient in its technology in order to compete in the global market. The policy is in a way forging the development of a pool of scientists, engineers and technocrats who have the knowledge, skills and expertise in diverse areas to contribute to the economic progress of the country in order to be comparable with the situation found in developed nations.

The significance of the 60:40 policy is realised soon after the announcement of the Vision 2020 Policy by Tun Dr. Mahathier Mohamad (the then Prime Minister of Malaysia) in February 1991. The basic aim of the vision policy covers overall achievement in terms of national unity, social integration, economic standard, social justice, political stability and improving the quality of life, both in the social and spiritual aspects as well as in instilling pride and confidence of the nation. It is expected that the future nation would have a more experienced and matured society. It also emphasizes the essence of creating a progressive society with highly *scientific and technological* achievements which will require quality human resources with a base of quality education system (Education Development Plan, 2001-2010, paragraph 1.37, pp. 1-9). It appears that the 60:40 policy becomes the backbone for the realization of the Vision policy.

The 60-40 policy is accepted in 1991 as the cornerstone for the country to achieve the status of a developed nation. From then on, it has become as one of the education development thrusts to make education access to all citizens in the country (Education Development Plan 2002-2010, Section 1.46, p. 1-10). This implies that the said policy is still very much valid today.

Education has always remained the key to bring about the development of human resources to meet the competitive needs of the country as seen in the developed countries and in countries like Japan, Taiwan, Holland, Denmark and Singapore where they do not have natural resources other than their human populations.

Results

Difficulties encountered in the implementation of the 60:40 Policy
are examined from five parameters:

1. The 60:40 Policy

It is difficult to envisage that the policy is not real or unrealistic to be achieved. Although it was conceived in 1967 it has since then grown in importance to become a national policy in 1991 and as the cornerstone for the achievement of the vision policy to make Malaysia a developed nation.

Malaysia is not the only nation that is moving in this direction, Japan and East Asian countries like China, South Korea and Taiwan are acquiring raw materials, technology and skills from abroad and improving their factor endowments by concentrating on education, the quality of their workplace and work practice and on investment in research and development. These countries cannot possibly achieve all these without having a pool of scientists and engineers to bring about scientific innovations to catapult the country to attain a strategic competitive position. These countries are placing the importance of science and technology education to develop the k-workers to meet the challenges of globalization.

Malaysia has faced the problem of not having a critical mass of scientists and technocrats to help propel the advancement of the 60:40 policy. It incurs the need to gradually building up the pool of the experts and professionals to create the landing for the policy to take off with greater speed. It involves great financial resources for the development of education and training.

2. Enrolment of students in the science and technology studies

The ratio of students enrolled in science versus non-science electives in KBSM which was introduced in 1989, had dropped from 31:69 in 1989 to 20:80 in 1993. Students preferred the non-science electives in the KBSM than the science electives. In 1995 the statistics showed that secondary school leavers favoured the social art courses at the higher institution. There were 43,610 social art base scholars at the higher institution while only 22,290 students enrolled in science base courses and 13,430 students in the technical base courses. This shows that 45% of the students were in the science and technology base courses at the higher institution in 1995. The Ministry of Education (2001) pointed out that in each year the total student's enrolment had been only 10% to 15% registered to do science and technology at the universities. According to the 9^{th} Malaysia Plan if Malaysia were to become a developed nation, it would need to have 50 persons in the science field to every 10,000 population.

The trend of enrolments of students in the science and technical stream in the secondary school level is shown in Table 4.

Table 4: Enrolments of Students in the Science & Technical Streams in Secondary Schools

Year	Enrolment
1986	31%
1993	20%
1998	25.7%
1999	31%
2000	27.7%
2006	21%
2011	20%
2015	42%

With declining students taking up the study of science and technical subjects in the secondary schools, the universities are not getting enough students for the science and technology courses.

The consequential effect is that the 60:40 policy is not progressing well in the secondary schools.

3. Implementation of Science and Technology Policy

1967 was the year that introduced the 60:40 policy for the purpose of ensuring that skilled workforce would be upgraded for national development. This policy has been in existence for the past 49 years and is yet to be achieved. This has become a problem to the Government.

The Ministry of Education implemented the science policy in the early 1970s in order to encourage students to do science by establishing full resident secondary schools and technical secondary schools and making it compulsory for bright students to follow the science stream in the higher secondary school level (i.e. Form 4, Form 5 and the Sixth Forms). However this approach has not been successful to encourage more students to take up the science and technology courses at the higher learning institutions and this can be evidenced from Table 5.

Table 5: Percentage Enrolment of Students in Science and Arts in Public Higher Institutions of Learning in Malaysia.

Year	Science Stream	Arts Stream
1990	32.82%	67.18%
1995	27.72%	72.28%
1999	35.63%	64.37%
2015*	42.00%	58.00%

Source: Trend Indicator, MOE 2001
*www.Science2action my.2015

Since 1980s, research studies have been done to determine factors that encourage students to become interested in the sciences. The factors that have been determined are as follows:

Academic capability
Family background
School environment/climate
Teacher and student characters
Studying conditions

Studies were also done to determine factors that influence students to go for higher education and they are:

The entry policy or the criteria

The selection method that has been set

Financial assistance to students from low socioeconomic level

Cost of study involved.

Many earlier studies have found that accessibility at the secondary schools and universities influenced students to do science and technology. If these factors continue to persist in the country, the problem of students wanting to do science and technology will continue to exist.

It appears that the accessibility to the universities and the students themselves have influenced students from taking up science and technology courses in schools and universities.

4. Various players involved in the policy

In the implementation of the 60:40 policy many players are involved particularly the politicians (law-makers) who are not objectively looking at the education policy as fundamentally important for the development of a k-economy but by those who are more concerned on other issues and who are afraid of the change. This makes the objective to attain the k-economy more complicated and complex. This is further compounded by the creation of short-term changes which cause more confusion to the policy e.g. the teaching of mathematics and science in English is reverted to be done in Bahasa Malaysia in the national schools and Tamil and Chinese in the vernacular schools (national type schools) in recent years.

This change has created so much of uncertainty among the parents, teachers and students. It is also noticed that in the midst of the dilemma the 60:40 policy has not been given serious consideration or given the importance as the guiding principle for the achievement of the vision policy. However there are apparently no newer ideas being suggested to achieve the said policy.

5. Macro versus Micro level of policy formation and implementation

The traditional or rationale model of policy processes distinguished two distinct stages: Policy development/formulation is done by the people at the macro-level such as the politicians and special committees or groups.

Policy implementation is done by the teachers who are at the micro-level.

The rationale model assumes that in a given set of perfect conditions, policies can produce the desired results. In reality it is not as simple as the model envisaged because it has ignored the human diversity and organisational complexity as well as the importance of the social environment and its cultural settings. The people at the micro-level can accept, resist or change the policy to suit local circumstances. Education situations like these are particularly relevant because the purposes of education are always contested and teachers claim some professional autonomy.

Another factor to note is that people who are involved in policy formulation and implementation are located at different locations and they have conflicting interests and difficulties in communication with each other. Put it simply, people at the macro-level and teachers at the micro-level have different perceptions of the policy and therefore have different commitments. The ambitious policy of key players at the macro-level is crafted by the street-bureaucrats i.e. the teachers to fit local circumstances and ambitions. Therefore the success of the said policy requires the strategic connection rather than the technical one, between the two levels of people. This can be viewed as a form of strategic alliance between the people at the macro- and micro-levels for the policy to work successfully. This does not seem to be the case when people from the micro-level are not given a greater value and due consideration. There appears the lack of trusting relationship between the formulators and implementers. People at the macro-level exercise their dominant power to suppress issues and generate conflicts between actors over key issues and as a consequence no useful learning occurred. Therefore continuous consultation between the two levels does not prevail. This situation can also be complicated by strong leadership style.

The absence of equity in the education system is another issue that develops resistance and marginalization in schools thereby hindering the proper implementation of the policy. Within the schools, teachers are not learning to accept changes in the education system as a continuing process. This is a problem in the institutionalization of change in schools. Teachers may fail to understand that the ideal situation is never there but the inspiration must always be there to change in order to reach it.

A Developed Nation

A developed nation has mature economy, high GDP, advanced technology and high level of trade and investment. It also has a service sector that provides more wealth than the industrial sector and is more industrialised than agrarian. Basing on Human Development Index (HDI), it has the value in excess of 0.8 indicating a high level of human development in terms of education and health opportunities.

Table 6: Human Resource Capital Indicators

Country	No. of professionals 2011 *	Population 2011**	Human resource capital /1,000 people
Denmark	57,170	5,515,575	10.4
Finland	54,526	5,255,068	10.3
Sweden	78,480	9,074,055	8.6
Norway	38,882	4,676,305	7.9
Singapore	37,013 (2010)	4,701,069	7.9
Japan	877,928	126,804,433	6.9
South Korea	335,228	48,636,068	6.9
Germany	562,600	82,282,988	6.8
Netherland	112,548	16,783,092	6.7
Canada	221,360	33,759,742	6.6
Australia	137,489 (2008)	21,515,754	6.4
France	392,875 (2010)	65,931,000	6.1
New Zealand	23,800	4,252,277	6.0
Russia	839,183	139,390,205	6.0
United Kingdom	358,583	62,348,447	5.8
China	2,882,903	1,365,500,000	2.1
Malaysia	57,405	28,274,729	2.0
Thailand	80,344 (2009)	67,089,500	1.2
India	391,149 (2005)	1,173,108,018	0.3
Indonesia	51,544	242,968,342	0.2

Sources: * Unesco: A global perspective on Science, Technology & Innovation (STI)
** Wikipedia: List of countries by population 2011.

Referring to the human resource capital per 1000 population, the developed nations have achieved a value between 5.8 to 10.4 (Table 6), giving an average value of 8.1. As for developing countries, their human resource capital per 1,000 population ranges from 0.2 to 2.1.

According to the World Development Indicator 2000, Malaysia has the ratio of 0.93 scientists and engineers to every 10,000 population. On the contrary, Japan has 28 to 30 scientists and engineers to every 10,000 population.

It is found by **Ramli** (1996) and **Ramirez & Lee** (1990) that there is a positive correlation between the level of number of science and technology students at the university and the level of growth of the economy especially for developing countries and the third world. It implies that more students will study science and technology when there is greater economic growth in a country. It is then difficult to ignore this important aspect of development for a country to attain the status of a developed nation.

Conclusions and Discussion

It is apparent that for a country to become a developed nation it needs to have a critical mass of professionals and technocrats to have the scientific capability to be comparable to the developed economies.

In Malaysia, the proponents of the 60:40 policy in 1967 were in fact fostering the country to develop a new identity to face the modernising world but today, the country is still far from the threshold of the value propounded in the said policy.

The implementation of the 60:40 policy is not a simple process. It involves a top-down approach where the policy is formulated by the politicians and public administrators while its implementation is done by the schools and other institutions of learning. However, the implementers do not get the full understanding of how to bring about the change that is intended by the policy formulators or to get the objectives of the policy achieved without delays and difficulties. Structural flexibility is lacking to enable close collaboration and coordination between the formulators and the implementers to take place and this creates a power dichotomy that hinders the successful implementation of the said policy.

One of the most critical factors that has impeded the implementation of the policy is the lack of interest of students to take up the study of science and technical subjects at the secondary schools.

Going back into the history of Japan, it is found that the Japanese had the national ambition to acquire science as the basis for the economic development of the country that has hardly any natural endowments. This happened towards the end of the last century when the new Meiji Constitution was proclaimed. One of the national policies was towards science: "Knowledge will be sought and acquired from source, with all means at our disposal, for the greatness and security of Japan." What is this "knowledge"? This is what the Japanese physicist **Hantaro Nagaoka** wrote in 1888 from Glasgow to his professor **Tanakadate**: "We must work actively with an open eye, keen sense, and ready understanding, indefatigably and not a moment stopping .... There is no reason why the Europeans shall be so supreme in everything. As you say, ... We shall... beat those *yattya bottya* (pompous) people in ***science*** in the course of ten or twenty years." (Abdus Salam, 1986). Twenty six years later, Japan had proved of its technological and scientific capability to build battle ships and fighter planes and weaponries and other hardware to engage in WW1 and later, WW2. After WW2, the skills and knowledge of technology and science of the surviving population have enabled Japan (and Germany) to attain developed nation status very quickly.

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