EJISDC (2004) 16, 5, 1-18

ICT Clusters as a Way to Materialize a National System of Innovation: Malaysia's Multimedia Super Corridor Flagships

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ABSTRACT:
Developing countries have realised the need to develop the Information and Communication Technology (ICT) sector to compete in an environment of increasing globalisation and also the emergence of the knowledge based economy. But given the limited resources, one approach seems to be popular among many countries is the 'cluster' based approach for industrial development This paper seeks to highlight one such effort viz. Malaysia's Multimedia Super Corridor (MSC) Cluster with its Flagships approach. The MSC is presented in the paper as a physical manifestation of the NSI, to illustrate how a policy driven - cluster based regional development approach has helped to further national innovative performance and competitiveness

Key Words – Malaysia, Vision 2020, Multimedia Super Corridor (MSC), national system of innovation (NSI), knowledge economy, Clusters.

1. INTRODUCTION

As the wave of globalisation washes over geographical boundaries, the world steps into the era of a new knowledge-based economy with governments striving to encourage innovation in industry especially through national systems of innovation. A national system of innovation (NSI) is considered important because, how a nation utilises and exploits its NSI will determine whether it can compete and ride the wave of globalisation or be carried by it and thrashed onto the shores of the new economy. This paper highlights the efforts of the Malaysian government to form a new economic sector using a cluster-oriented approach. The focus is on the Multimedia Super Corridor cluster, in which the elements of the NSI are manifested, which is being developed to kick start the transition of the nation into an information society with the economy focussed on 'knowledge-based activities.

Being a developing country with ambitions of attaining a developed country status by transitioning to a knowledge-based economy, it is absolutely imperative for Malaysia to comprehend the outcomes of its NSI towards achieving technological and innovative development. As a result, better understanding of the concept of NSI and its physical manifestations can lead to sound government policies, ultimate economic performance and outstanding innovations.

The study of NSI focuses on flows of knowledge. *Knowledge-based economies* – economies which are directly based on the production, distribution and use of knowledge and information (OECD, 1997) – are perceived to be highly evident in the analysis of growth of high-technology industries and the augmenting exigency for highly skilled manpower. Attention can subsequently be directed to the bonds of interchange within the overall technology development process. Policy makers can then accost possibilities on ways to embellish innovative exploits in the knowledge-based economies of today by understanding these systems. The smoothness of knowledge flows – among enterprises, universities and research institutions – relies firmly on the

graceful execution of innovation systems. The implements for knowledge flows can include joint industry research, public/private sector partnerships, technology diffusion and movement of personnel (OECD, 1997).

A significant and growing number of institutions with various fields of expertise are now involved in the generation and dissemination of knowledge, as conveyed by the fact that economic activities are becoming more knowledge-intensive. Enterprises, and national economies as a whole, need to scrutinise on their methods of effectiveness in gathering and employing knowledge from institutions – albeit in the private or public sector, or the academia – in order to succeed. This act becomes distinctively intricate when each country has its own institutional profile depending on the governance regime for enterprises, the organisation of the education sector and the level and orientation of government-funded research.

According to Freeman (1997), the importance of national and regional systems of innovation derives from the networks of relationships, which are necessary for any firm to innovate. *"Whilst external international connections are certainly of growing importance, the influence of the national education system, industrial relations, technical and scientific institutions, government policies, cultural traditions and many other national institutions is fundamental"*.

While an NSI is considered important for the development of institutions and the relationships between them to increase national innovative capacity, many authors have also discussed that a nation's culture is another factor that plays an important role in developing innovative capacity. Dunphy and Herbig (1994) claim that 30% to 50% of a society's innovative capacity would be influenced by national culture. Much of the remaining vicissitude among countries can be traced to structural differences, such as ease and acceptance of free entrepreneurship, size of the market and flexibility of the bureaucracy and social system. *"The interrelationship of innovation, culture, globalisation, strategy, and communication is unmistakable and becomes more visible with time. Each new start-up company, regardless of location, will view these forces as supportive components of a larger scheme"* (Ulijn et al., 2000).

All this brings up the issue of the need to ascertain the links and relationships among industry, government and academia in the evolvement of science and technology. To this effect, governments across the world are developing NSI with support institutions and relationships among the various components. An analysis of the components and their relationships can ultimately lead to the ability to measure the knowledge distribution power of an NSI, which is considered as one of the determinants of growth and competitiveness.

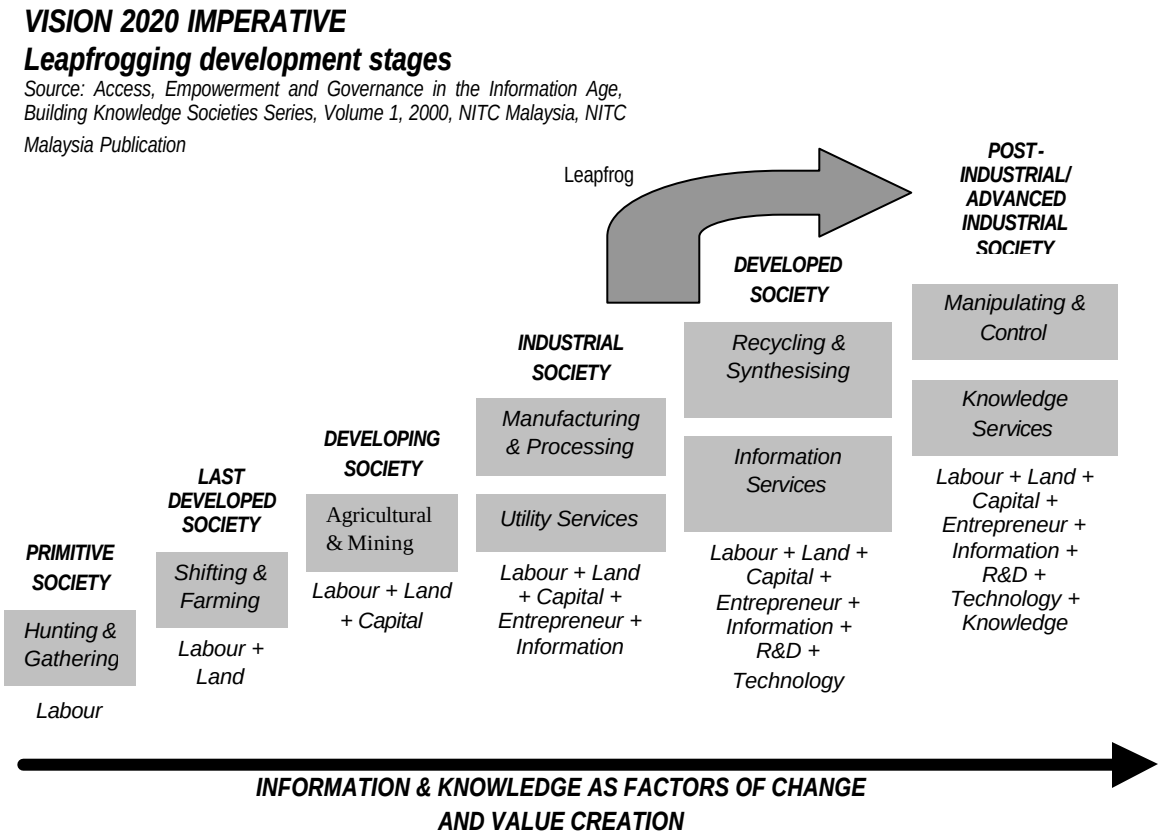
The main aim of this paper is to analyse the Multimedia Super Corridor (MSC) Cluster, through the foundations of the Malaysian NSI framework, and show the potential of a cluster oriented approach in forming a knowledge based economic sector and aid in the process of beginning the transformation of Malaysia from a predominantly skills-oriented industrial nation to a knowledge-oriented one.

At the outset, a brief note on Malaysia and its National Vision is presented. An elaboration of each of the five main components of the NSI and how they manifest in the MSC, a policy-driven ICT Cluster, follows this. The study looks at the results brought about by the MSC Cluster using the NSI Framework developed by the authors in an earlier paper (Aziz and Omar, 2001). Data from secondary sources are used to analyse the outcome viz. the development of an ICT sector to aid in the transition of the country to a knowledge-oriented economy.

2. A MULTIRACIAL SOCIETY: MALAYSIA AND ITS NATIONAL VISION

The success story of Malaysia becoming a "tiger" nation is largely due to the government's determined effort to transform the society from a predominantly agrarian one where the economy focused on rubber, palm oil, and petroleum to an industrial one with a significant manufacturing sector, focused on electrical, electronic and other sectors. Now the shift is being planned to transition to an information society and that to a knowledge-based economy with a focus on the ICT sector. The Vision 2020 was introduced for becoming a developed country by the year 2020 and this has influenced all aspects of governmental activities and policies. Vision 2020 can actually be seen as a catalyst towards better utilisation and exploitation of the nation's NSI.

Figure 1: The Planned Cultural Shift



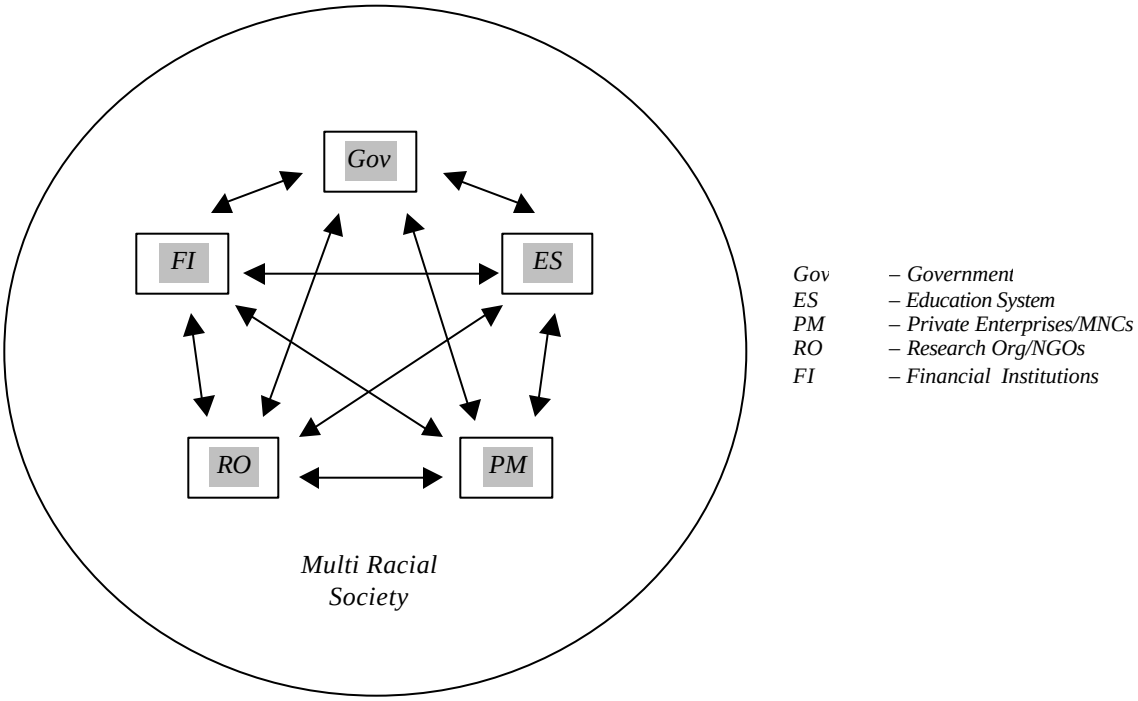
A series of elaborate development plans was implemented in 1970 known as the New Economic Policy (NEP). It had two main prongs: first, the elimination of poverty, meant to remove an important source of the ethnic strife; and second, the removal of the association of ethnicity and occupation. Today, the New Development Policy (NDP), an extension of the NEP, emphasises on balanced development, stable growth, ethnic harmony and the removal of social and economic inequalities in society.

It has long been argued that the shift to a knowledge-based economy will not be achieved unless Malaysia retains her social and economic values with the desires of all the Malaysian people. However, unlike Malaysia's previous periods of economic transition like the NEP, which basically incorporated affirmative action for ethnic Malays into a programme of industrialisation, this current transition, is being attempted without any ethnic distinction. It is the aim of the government to ensure that knowledge can be purposefully transferred, or occurred as an outcome of other activities through processes of socialisation, education, learning and practice. It is in this context, that the NSI coupled with the MSC, endeavours to provide a good platform for knowledge diffusion in Malaysia.

3. THE MALAYSIAN NSI AND ITS COMPONENTS: A BRIEF NOTE ON THE NSI FRAMEWORK

Without denouncing the role and importance of the other actors, we have identified the government, financial institutions, the education system, research organisations and NGOs, private enterprises and MNCs (multinational corporations) , and the cultural traditions of a multi-ethnic society, all existing within an interactive sphere, to be the key components of the Malaysian NSI. Malaysia is a multi-ethnic society with each race having its own distinctive culture ushered by bountiful traditions. Anything that takes place in a country is within the societal sphere. Thus, the aspects of its multi-ethnic society influence these building blocks of the Malaysian NSI in one way or another.

Figure 2: The Components of Malaysian NSI



The following section presents a discussion on how the five key components of the NSI aid in the transition to a knowledge-based economy.

3.1 The Malaysian Government

In the context of NSI, the Malaysian government's role is to act as the main policy maker that shapes and directs technological evolution and adoption of innovative activities in the country. The *Industrial Master Plan*, the *Seventh Malaysia Plan* and the *Eighth Malaysia Plan*, are all examples of the government's policy-making activities that have had significant impacts on the nation's industrial, technological and innovative environment.

In the current environment characterised by rapid advance in ICT, globalisation, liberalisation, and greater reliance on knowledge for value creation, it has become the government's belief that the future economic prosperity of Malaysia no longer rests on the export of primary products but on the fruits of high technology. Her plans to leapfrog into the post-industrial age by leveraging ICT as a strategic lever for national development and global positioning is what that led to the birth of the MSC.

Another facet of the Malaysian government's role as policy maker is as the governing body of the national legislative institution. Through the *Intellectual Property Division*, of the *Ministry of Domestic Trade and Consumer Affairs*, the Government provides intellectual property protection in line with international standard requirements. Protection comes to place via the *Trademarks Act 1976*, the *Patent (Amendment) Act 1995*, the *Designs (Protection) Act 1949* and *the Copyright (Amendment) Act 1990*. This underlines the fact that within the Malaysian NSI, there are, already in existence, mechanisms for appropriation and protection for the fruits of innovative activities.

The government also acts as collaborator/partner to the industries through their incentives-giving activities. However, the government is more of a guiding force, offering incentives in areas where they have identified as important. Through such collaborative and direction giving activities, the government has brought in new technologies, created developmental activities of various technologies in the country, and fast-tracked the ICT diffusion in the country.

3.2 The Education System

The education system of a nation is a key part of a NSI. The Malaysian education system is dedicated to provide comprehensive, thorough and high quality level of education. However, as a result of a previous effort to confront the issues of multi-ethnicity, the present curriculum caters to the 3 basic types of schools: the national school, the Chinese national-type school and the Tamil national-type school. However, in a move quite contrary to the norm, the Malaysian government is seen now to be restructuring the education system into one which aims to educate students to achieve all knowledge and skills necessary to function in an ethnically diverse world. The evidence is seen in the new Smart School system, eventually described in this paper as an MSC flagship application. This singular school system has been conceptualised to prepare future generations for the challenges of the knowledge-based economy.

3.3 Focus on Tertiary Institutions

The high number of enrolment in tertiary institutions shows Malaysia has a large pool of skilled workforce capable of innovative activities. There has been a growth of institutions of higher learning from 170 in 1996 to 623 in 2000. The enrolment ratio, which is the percentage of 18-21

years entering tertiary level education institutions, also shows an increase from 11.9 percent to 13.9 percent. The setting-up of local universities shows signs of such motives but targeted towards specific sectors. For example, *University Putra Malaysia* (UPM) was initially for the agriculture sector; *University Science Malaysia* and *University Technology Malaysia* provides scientific, technological and engineering programmes. A more recent example, *Multimedia University* (MMU) was set up to provide knowledge workers for the MSC project.

Another significant trend is the creation of specialised *knowledge centres* near leading universities and oriented towards research and development of particular technologies, e.g. computer software, biotechnology, communications etc. High-technology companies, both domestic and foreign, and research institutes tend to gather in these locales to gain access to formal and informal technical networks. In Malaysia, there are *technology parks* or *incubators* located next to universities such as *University Technology Malaysia* (UTM) in Skudai, Johor; *University Putra Malaysia* (UPM) in Serdang, Selangor; *and Multimedia University* (MMU) in Cyberjaya, Selangor.

3.4 Private Enterprises/MNCs

Industrial activities are the major users of high technologies and the major participants in R&D activities. Special mention is given to multinational corporations (MNCs) because of their significant role in the Malaysian industrial sector. Characteristically, MNCs have significantly large financial resources, which are needed to use, purchase and develop high technology. The presence of an MNC in a country will, in effect, bring into the country various technologies. Though indirect, through interaction with the MNC, a local firm can reap benefits from the foreign knowledge and technology imported by the MNC.

Furthermore, R&D collaborations between firms and strategic technical alliances are a current trend and they are in vogue. This is especially apparent in new fields such as *biotechnology* and *information technologies*, where development costs are exceptionally high. In case of MNCs, it is not uncommon for them to form collaborative alliances with local firms of the host country. Malaysia plays host to numerous numbers of MNCs such as *IBM*, *Microsoft*, *Motorola*, *NTT*, *Siemens* and *Sony*.

3.5 Research Organisation/NGOs

The quality of public and private research organisations and its links to industry may be one of the most important national assets for supporting innovation. Knowledge flows between the public and private sectors can be measured in a variety of ways; they can include joint research activities and co-patenting and co-publications. Malaysia has a wealth of research organisations and NGOs that make positive contribution towards the nation's NSI. For example, the *Malaysian Agricultural Research and Development Institute* (MARDI) is assuming the pioneering role in the field of biotechnology in the country. The *Institute of Strategic and International Studies* (ISIS) conducts strategic independent studies and market research that helps towards the nation's formulation of policies. The *Research Institute of Investment Analysts Malaysia* (RIIAM) conducts studies and research targeted for the KLSE Group of Companies and the Malaysian securities industry. Such activities by these organisations help to enrich the nation's knowledge bank.

3.6 Financial Institutions

The financial institutions include venture capitalists, which can significantly affect the innovation process in Malaysia. Government financing activities also supplement these efforts. The

Malaysian banking system (comprising of commercial banks, merchant banks and finance companies) and the industrial finance institutions are the major institutional sources of credit to the industrial sector in Malaysia. The development finance institutions in the country are made up of the *Malaysian Industrial Development Finance Berhad* (MIDF) and its subsidiary, *Malaysian Industrial Estates Sendirian Berhad* (MIEL), *Bank Pembangunan dan Infrastruktur Malaysia Berhad, Bank Industri dan Teknologi Malaysia Berhad* (BITM), *Sabah Development Bank Berhad, Borneo Development Corporation (Sabah), Borneo Development Corporation (Sarawak)* and *Export-Import Bank of Malaysia* (Exim Bank). *While the above section outlined the elements of the Malaysian NSI – the following section describes the MSC, a policy driven ICT cluster project executed by the Malaysian government to bring about the transition into a knowledge society.*

4. NSI ELEMENTS MANIFESTED IN THE MSC

The MSC aims to create an integrated environment with elements and attributes of a global multimedia climate that encourages innovation, that helps companies (both Malaysian and international) to reach new technological frontiers, partnering global IT players, and providing the opportunities for mutual enrichment and success. The idea is of a world where information, ideas, people, goods and services move across borders effortlessly in the most cost-effective and liberal ways.

4.1 The Government

The government plays a key role in the inception and development of the project concept towards its actual implementation. Its presence is made visible through *Multimedia Development Corporation* (MDC) to ensure that the MSC project achieves success. MDC is a unique, performance-oriented, client-focused corporation possessing all the necessary implementation powers to ensure the necessary conditions are in place to meet the needs of each company interested in joining the MSC. It will also drive the rapid development of the MSC and the Flagship Applications.

The MDC can be seen as playing the role of champion, facilitator, and partner of companies choosing to operate in the MSC. The MDC markets the MSC globally, shape MSC-specific laws and policies by advising the Malaysian government, and set standards for the MSC's information infrastructure and urban development.

The governmental role in the MSC is made more pronounced through the establishment of Putrajaya and the Electronic Government flagship application initiatives. Putrajaya is the new seat of Government and Administration designed as a paperless environment in a bold experiment at electronic government, Putrajaya also houses the office of the Prime Minister of Malaysia. The Malaysian Government's legislative activities are also at the pioneering level. Since 1997, it has passed a number of acts and legislatures aimed to create the right environment for the development of the communications and multimedia industry and to position Malaysia as a major hub for the communications and multimedia information and content services. They have been termed as *cyberlaws.*

The Government's role as a financier is apparent where substantial financial incentives are made available to those companies given MSC status, including 0 per cent income tax for up to 10 years or a 100 per cent investment tax allowance, and no duties on multimedia equipment. All companies that create, distribute, integrate, or use multimedia products and services can apply for MSC Status. Once given the status, they do not only enjoy the above mentioned financial

incentives but they also get exclusive rights to bid for flagship applications implementation tenders.

4.2 The Education System

The MSC's Smart School initiative, one of the seven flagship applications, responds to the need for Malaysia to make the critical transition from an industrial economy to a knowledge-based one. The objective is to produce a technologically literate and thinking workforce, which is well able to perform in a global environment and use information-age tools and technology to improve productivity. This highlights the fact that the education system, which is one of the five key components of the Malaysian NSI, as being an integral part of the MSC.

Six of the nation's public and private universities are located within or near the vicinity of the "Greenfield" corridor. These institutions provide skilled workforce for the development of MSC and for the companies operating in the MSC. The institutions are also research hubs with high levels of knowledge creation and sharing activities, which will, in effect, further enhance the innovative environment of the MSC. The universities are also natural collaborative/strategic alliance counterparts for the companies in MSC. . Industries' realisation of owning an advantage towards a cheaper and effective way of conducting R&D activities, in the past few years, have seen an increasing trend in the formation of collaborative agreements between industries and universities. In the MSC, ample examples of this phenomenon are occurring, such as the signing of *Memorandums of Understanding* (MoUs), and the initiation of numerous programmes of research funding between various industrial organisations with the local educational institutions.

The Multimedia University in Cyberjaya is one such example and has already established collaborative linkages with 37 companies and 29 universities from all over the world. The linkages are in various forms such as scholarships, research grants, setting of laboratory facilities, sponsorships (equipment, visiting staff, etc), and joint R&D activities as well as ventures.

Owned by the privatised Telekom Malaysia, the Multimedia University is a twin campus University located in Cyberjaya (which is part of MSC) and a branch campus in the town of Melaka . The Cyberjaya campus comprises of four faculties: Creative Multimedia, Engineering, Management and Information Technology. Its joint ventures in research and development with firms in the MSC is an example of the type of co-operation that the Government hopes will enable Malaysia to benefit its transformation into a high-tech society.

In addition to the example of the Multimedia University supplying manpower, a study done by MDC on the net supply of ICT/engineering graduates in 1999, shows that the supply will increase from 18 000 in 1999 to 137 000 in the year 2001.

Figure 3: MMU Collaborations
Source: www.mmu.edu.my

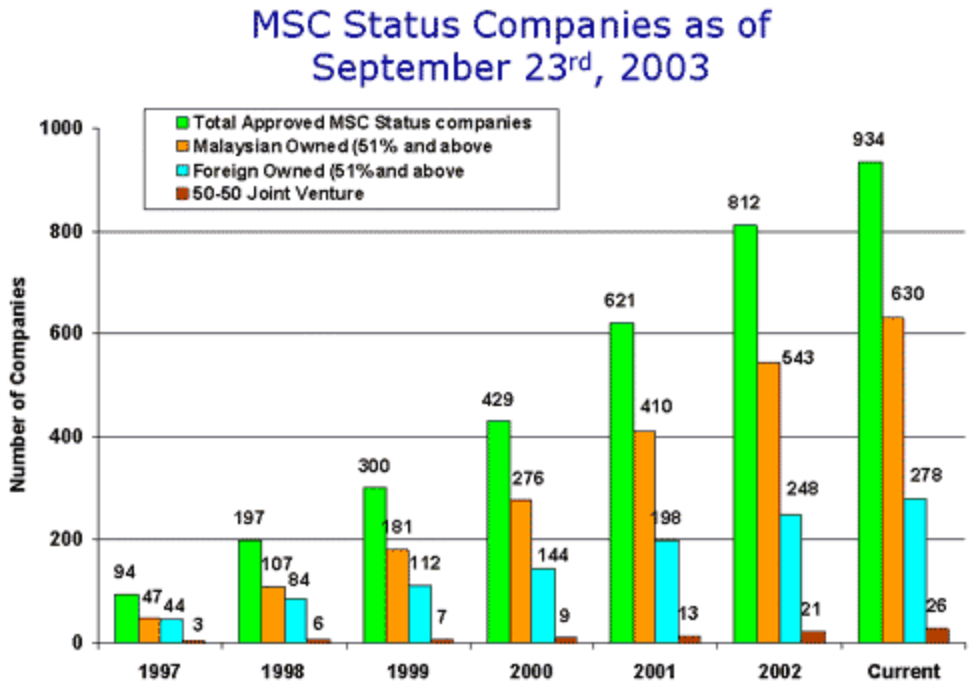
Collaborators	Scholarships	Research Grants	Laboratories	Sponsorships	Joint R&D / Ventures
NTT	*	*	*	*	*
Microsoft	*	*	*	*	*
SUN			*	*	
Lotus			*	*	
Lucent Technologies				*	*
Siemens	*			*	*
Fujitsu				*	*
Intel	*	*	*	*	
Marconi			*	*	
Optidigit			*	*	*
MIMOS (TEMAN)					*
Hewlett Packard	*			*	*
National Semiconductor	*			*	*
Alcatel	*		*	*	*
Lensa			*	*	*
Marconi	*		*		*
Ericsson					*
MACRES		*	*	*	
MIMCED					*
Cisco	*		*	*	
Fore			*		
Aonix/Lexical					*
Nortel					*
Motorola	*	*	*	*	*
Likom	*	*		*	
Digital			*	*	
Waterloo Maple					*
Bates			*	*	*
Anderson Consulting			*	*	*
Comscape	*				*
Autodesk			*	*	*
Fakespace			*	*	*
SGI			*	*	*
Avid					*
Compaq	*		*	*	
Neuronet					*
Transtel			*	*	*
	8	**6**	**22**	**26**	**27**

4.3 Private Enterprises/MNCs

The aim of MSC is to create a cluster of ICT firms and one of the ways envisaged is to attract the world's leading companies to locate their multimedia industries in Malaysia and use it as a base to undertake research, to develop new products and technologies and to export. For IT companies, MSC is be used as a global test bed for multimedia applications and as a hub for their regional operations in Asia. While in the past it was common among for Malaysian ICT industries to be import-oriented and reliant on foreign-based technologies, in the MSC, an emergence of innovations by local technopreneurs has arisen to spawn a critical mass of local

ICT enterprises and nurture potential world class companies in the "high tech" corridor. Given the importance of such identities, MDC has implemented several initiatives including providing incubator facilities, business support services, seed capital/R&D grants, talent development and training, venture capital and market access to cater to their needs. As of the September 2003, there are more than 900 registered MSC-status companies.

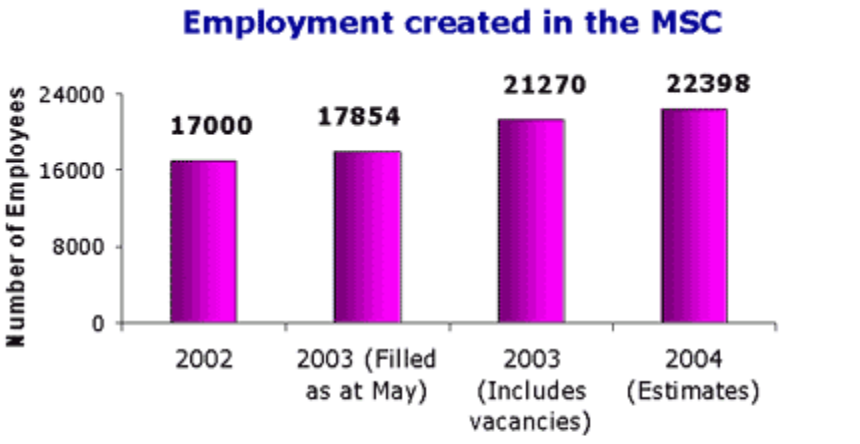
Figure 4: Growth of ICT firms in the MSC
Source: http://www.mdc.com.my/xtras/fact_figures/msc.asp



An annual survey done by the MDC called the 'impact study' of companies in the MSC shows more then 17000 jobs created of which more then 80% were new knowledge-based jobs. The new jobs were created across ICT occupational groupings and were filled by mainly by Malaysians. Another projection was done in the survey shows an estimation of 35,000 employment opportunities by year 2005 (Fig. 5).

The effects of private enterprises/MNCs are much more significant in the MSC from the NSI perspective. This is because they are the major building blocks towards the realisation of the MSC vision. The implementation of the flagship applications brought in numerous MNCs and private enterprises. This, in effect, has made MSC an area with a high concentration of ICT companies involved in various high technology usage and development as reflected in figures 4 and 6 .

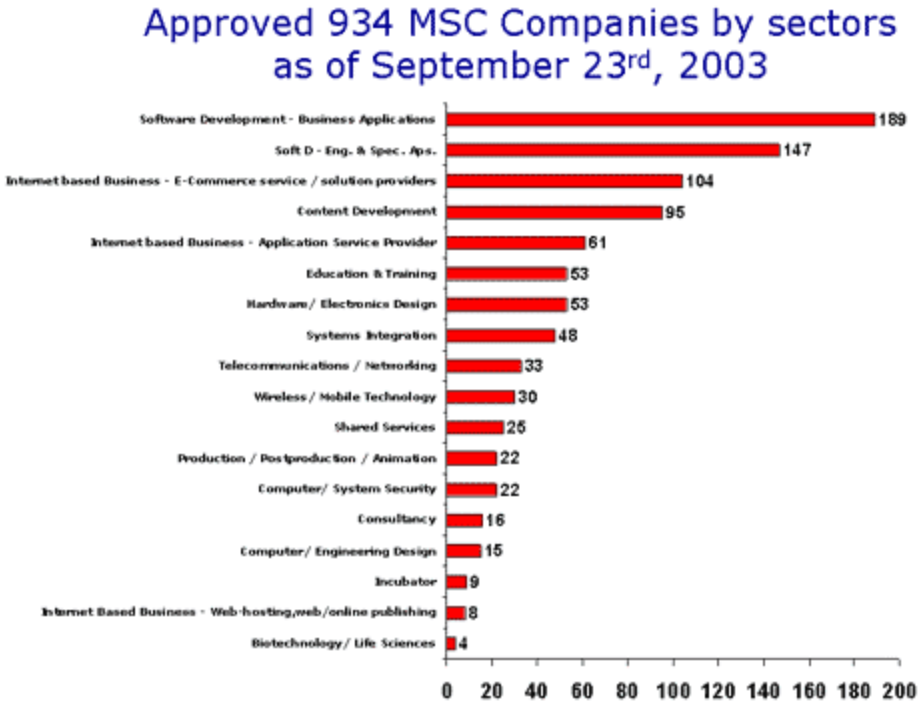
Figure 5 (Source: http://www.mdc.com.my/xtras/fact_figures/msc.asp)



Knowledge Workers	2002	2003 (Filled)	2003 (Includes Vacancies)	2004*
% of KWs	86	86	86	88

Source: 2003 Impact Survey:
2004: Estimates

Figure 6 (Source: http://www.mdc.com.my/xtras/fact_figures/msc.asp)



4.4 Financial Institutions

In the business involving new technology, both development and applications, traditional finance alone cannot help spur development of technology. In the MSC more options have been allowed like the allowing of free flow of finance from outside Malaysia for MNCs. Venture Capital from MDC for creating tech-entrepreneurial culture in addition, to other VCs. The MDC also provides Special Grants for developing risk taking culture to help in developing an R&D culture. The changes taking place can be seen from the following figures.

Figure 7: Equity Structure of MSC companies
Source: http://www.mdc.com.my

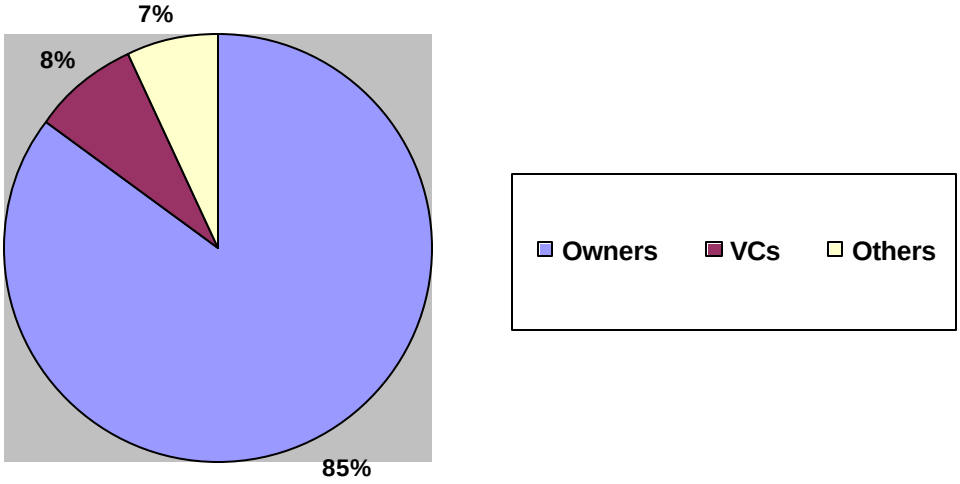


Figure 8: Types of Financing Options
Source: http://www.mdc.com.my

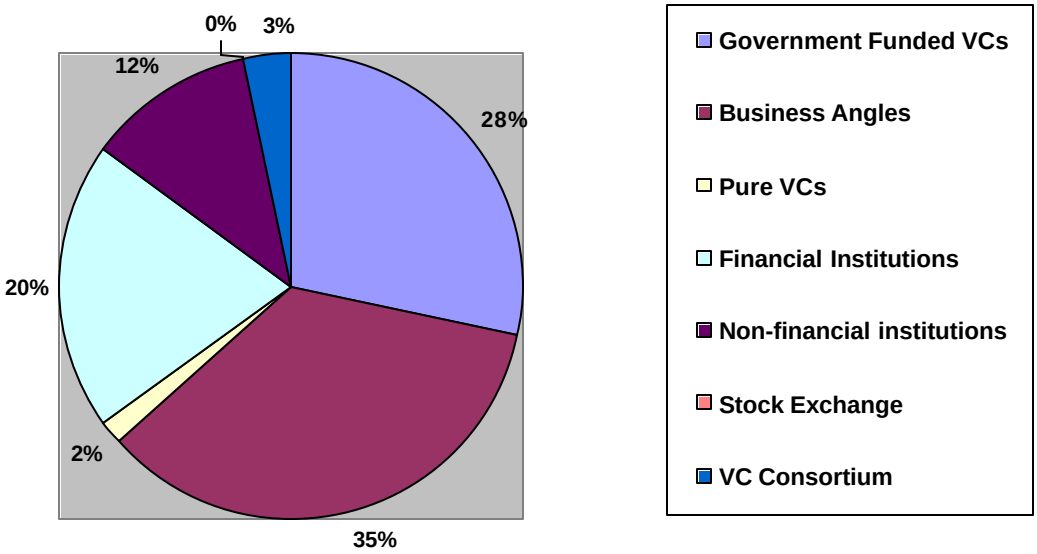
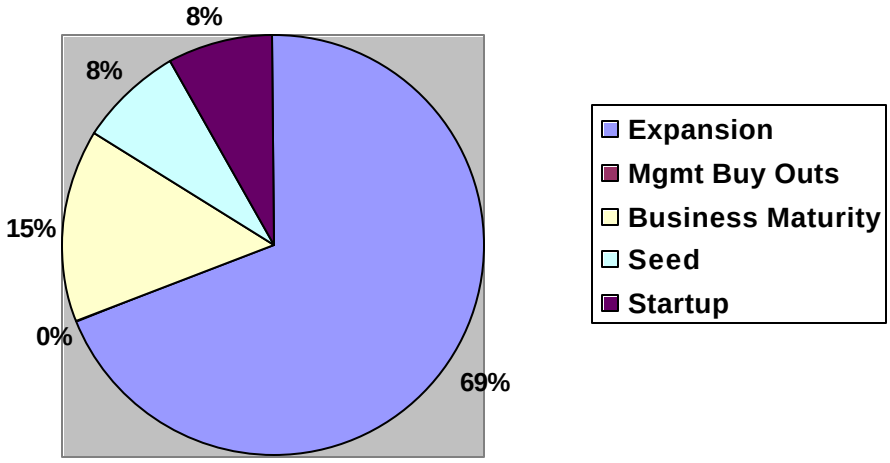


Figure 9: Venture Capital at different business growth stages for ICT enterprises
Source: http://www.mdc.com.my



In addition to the above, in September 2000, it was announced that Malaysia would lead the formulation of a RM570 million (US$150 million) venture capital company together with investors in the US, Saudi Arabia, and Bahrain with the stated purpose of investing in the IT sector in Silicon Valley. The firm, American Pacific Venture Capital Inc. (AMPVC) would invest in to conduct research and development activities in Silicon Valley. Meanwhile, manufacturing activities would take place in the MSC. This provides opportunities for the local industries to bridge the technological gap with those of the Silicon Valley citizens.

Another venture capital company, MSC Venture Corporation Sdn Bhd (MSCVC) - the venture capital arm of MDC – aggressively identifies innovative, potential high-growth SMEs in this sector for investment. MSCVC is a wholly owned subsidiary of MDC. It was established to provide venture capital financing to innovative and emerging IT and multimedia companies at the start-up, growth and pre-IPO stages. The company manages the RM120 million MSC Venture One Sdn. Bhd. (MV1) fund, which was established through investments by MDC and Khazanah Nasional Berhad, which is the investment arm of the Malaysian Government.

4.5 Research Organisations/NGOs

The MSC guarantees an environment where the necessary infrastructure is in place, where creative and risk-taking activities are promoted and shared, and where experts find living conditions attractive. In order to bring in the culture risk taking among Malaysian entrepreneurs and corporate alike the MSC has a flagship cluster called the R&D Cluster. This cluster is driven by the vision for MSC to lead Asia's R&D initiative into the Information Age. It aims to achieve this by developing a cluster of collaboration and network world-class corporate R&D centres, universities and public research institutes.

To this effect – the MSC has ushered in corporate R&D – with some of the major players are Telekom Malaysia, NTT, Nokia, etc. The Multimedia University has started 21 Centres of Excellence performing R&D. In addition through the provisions of grants for research activities

(as mentioned in the earlier section), MSC has attracted 22 firms to do research and development in the ICT and biotech fields in the R&D cluster.

Table 1: R&D Expenditure and Full time R&D Personnel in MSC Companies
Source: Impact Survey 2003

Year	R&D Expenditure	Total in-house full time R&D Personnel
2002	RM 258 Mil (309 companiess)	3,349 (311 companiess)
2003	RM 542 Mil (409 companiess)	4,679 (315 companiess)
2004 (Estimates)	RM 657 Mil (391 companiess)	--------

In addition to the research activities done by the industries and the higher education institutions, there are also other research organisations practising in the MSC. One example is MARDI, of which their pioneering work in the agricultural sector and, more recently in biotechnology has further enriched the technological mix in the MSC.

5. MSC FLAGSHIP APPLICATION CLUSTER – LINKING DIFFERENT PLAYERS IN THE MSC

The objectives of the MSC flagships are to jumpstart the MSC as a new engine of economic growth, make the MSC a global test bed, increase Malaysia's productivity and competitiveness by fast-tracking the infrastructure for electronic business, and help overcome the digital divide between the IT haves and have-nots. The MSC flagship applications are not just for a selected few but for everybody; ICT acts as the enabler to result in better interaction between the government, people and business community in a digital economy.

Between December 1996 and June 1997, government-private sector collaborative teams formulated proposals for each flagship application. These close partnerships between governmental agencies and with leading international and Malaysian multimedia companies had been formed to ensure the concepts developed were clarified and detailed implementation plans created. The implementation plans have been put into action since July 1997. Driving the development of the flagship applications are government ministries and agencies that report directly to the MSC Implementation Council, chaired by the Prime Minister of Malaysia and his Deputy. MDC, as a government-appointed, government-backed corporation, monitors the development.

Through the flagship applications, the government extends an open invitation to the multimedia community in Malaysia and throughout the world to participate in MSC. These flagship applications contain an unprecedented and attractive opportunity for local and international business - in their variety and scope, and in the manner in which they are being offered to the global community. Companies that take up the offer will be able to create value for themselves and their shareholders in an environment uniquely suited to their needs, and at the same time have the opportunity to help transform Malaysia and the region. The MSC flagship applications are divided into two distinct categories

5.1 Multimedia Development Flagships

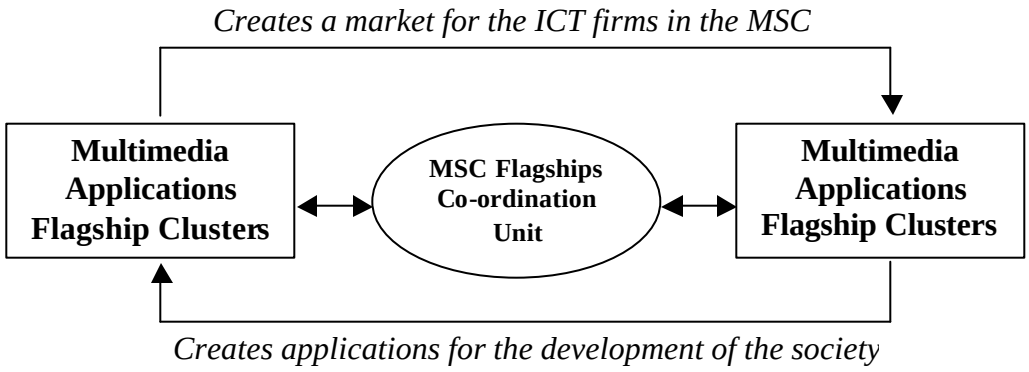
This comprises of flagship applications offering concrete business opportunities to facilitate the development of society and government. The four identified applications are Electronic Government, Multi-Purpose Cards, Smart Schools and Telehealth. The MSC companies involved in this cluster work with the respective ministries in charge of the flagship. For example, the Ministry for Education oversees the Smart Schools flagship and co-ordinates efforts of the firms developing multimedia products and applications in this area and similarly Ministry of Health for the Telehealth Cluster.

Through the development of these flagships the MSC aims to transform the society with better governance and health and also provide the education at school level to equip it for a knowledge society with able citizens capable of knowledge processing

5.2 Multimedia Environment Flagships

The main aim of this flagship is to aid the above flagship – by developing these flagships – support for the above and development of the ICT sector. This category consists of Flagship Applications with the aim of providing specific support to companies in developing multimedia products and applications. The co-ordinating unit seeks to provide an optimal environment to support multimedia companies entering the MSC in the following areas. The applications are classified under R&D Cluster, E-Business Cluster (combining the Worldwide Manufacturing Web and Borderless Marketing Flagships), Creative Multimedia Cluster and most recently the Technopreneur Cluster. Currently, in planning is the Biotech Cluster.

Figure 10: The MSC Flagships and Co-ordination Units



5.3 Flagships Co-ordination

There is a unit under MDC called the Flagships Co-ordination Unit, which makes sure there is *communication* between the firms in the different clusters. This is to ensure that there is cross fertilisation of ideas for innovation and also to help companies find markets or technical support from one another.

6. MSC: CURRENT STATUS AND FUTURE PLANS

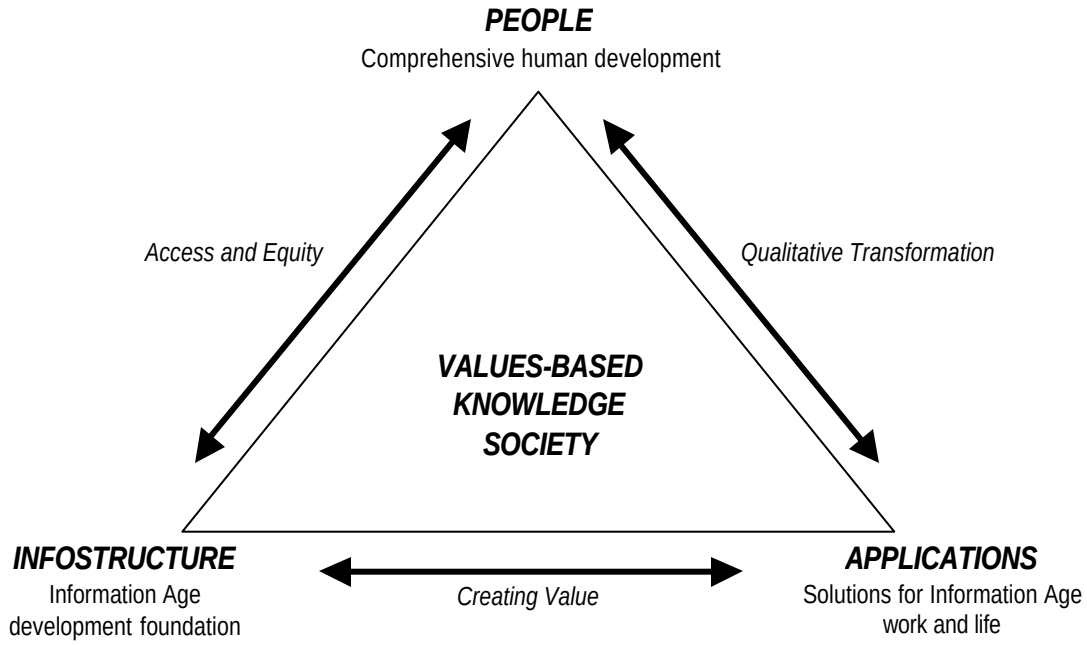
The MSC is coming to the end of its first phase. In the second phase, the MDC plans to link the MSC to other cybercities in Malaysia and the world, thus establishing a number of intelligent globally linked cities. It will create a web of corridors and establish a second cluster of world-class companies. It will also set global standards in the areas of the flagship applications, and champion cyberlaws within the global society.

During the final phase, it is expected that Malaysia will be transformed into a knowledge-based society. It will have a cluster of intelligent cities linked to the global information super highway, and it will become the platform for the International Cybercourt of Justice.

6.1 The MSC and the Malaysian NSI

The MSC project consists of both infrastructure and infostructure development activities, with a strong emphasis on forming an environment conducive for R&D efforts, and having collaborations/strategic alliances play a significant role throughout the project. Simply put, the MSC can be seen as a system of interactions. In this essence, the MSC project stands as a true manifestation of the Malaysian NSI.

Figure 11: Malaysia's vision of a knowledge society (Source: http://www.nitc.gov.org)



Source: Access, Empowerment and Governance in the Information Age, Building Knowledge Societies Series, Volume 1, 2000, NITC Malaysia, NITC Malaysia Publication

"I was very impressed by the way that education, venture capital and infrastructure work together, not only to attract world class companies but also to be able to merge that with new breed of start-up companies, here in Malaysia, and to really engineer it in a way that you get clusters of technology and clusters of capabilities" (Verwaayen, 2001).

7. CONCLUSION

"What I see is something created in 5 short years, this collapses what took us in Silicon Valley 30 years" (Gage, 2001).

Summarising, it can be seen from the paper that, in the MSC, all the identified NSI elements appear to have succeeded in creating a diverse hub of multimedia and communications firms, both local and global, working together (Figure 4). The government of Malaysia plays a key role in the flagships, through policy measures and supportive initiatives like funding government projects like e-government initiative etc. The education system is being implemented through the smart schools initiatives and new universities working in collaboration with industry. The government and private firms - MNCs and entrepreneurs – come together in the different flagship clusters to intensify entrepreneurial and R&D activities in the ICT sector. More options of finance in addition to the traditional ones have been made available through policies. All this has led to the transition of the education, finance and industry elements, which in turn, bring about a culture of risk taking behaviour among entrepreneurs in the country.

The use of the flagship-oriented approach helps create linkages among the NSI elements, between and among them, by providing formal communication channels. In one flagship i.e. the Multimedia Development Flagships, the different players like the government, private firms, education, financial and R&D institutions are brought together to transition their culture via pilot projects such as e-government, telehealth, and smart schools initiatives. Similarly, in the case of the second flagship group - the Multimedia Environment Flagships, firms developing ICT technology, products and applications, designed for enabling the Multimedia Development Flagships applications, carry out their activities within interactive clusters. Furthermore, the use of the flagship integration mechanism provides the linkages allowing for communication between the two groups of players, as can be seen in Figure 10.

While its been possible to create an economic sector using a policy driven cluster approach which embodies the elements of the NSI, what happens from now is to be seen. The cluster has taken more time than expected to start off – one of the main reasons being the impact of the Asian Economic Crisis. Also the success of an NSI and a Cluster hinge on collaborations within and outside the cluster or region, but more specifically linkages among the NSI elements is key. While there is evidence to show there are linkages – these linkages have been possible due to the "flagships" which hinge on government funded projects. A lot more linkages are required along the elements to make the MSC cluster thrive even after the government funded projects end.

But nevertheless, the quintessence of it all is that there are many channels through which knowledge can flow between institutions. While communication flows among the NSI elements are already in existence within the system that is geared for transitioning the country from the agrarian mode to the industrial mode, the government of Malaysia, through the MSC cluster has created new communication mechanisms between the NSI elements in the "flagships" that are being utilised to start off a knowledge-oriented industry sector. This is significant as earlier NSI efforts were towards poverty alleviation and bringing about an industrial culture, with an emphasis on creating a balance among racial inequalities and poverty. Now, the NSI elements in the MSC are geared towards ushering in a global ICT sector where local firms (and people) work along with foreign ones. What needs to be furthered is the ability to capitalise the resources that are already in place.

In conclusion, it is clear that the identified five key components of the Malaysian NSI in the MSC and the linkages between them made possible with the flagship-oriented approach, have been the significant factors towards achieving the objective of starting off a cluster of ICT firms, both foreign and local. Henceforth, it can be said that coupled with the effect of cultural factors of Malaysia's multi-ethnic society, which is made more international due to the high concentration of foreign investors in the area, the Multimedia Super Corridor is a truly a physical manifestation of the Malaysian NSI.

As the saying goes - technology revolution begins at home – yet no country will reap the benefits of the work age by waiting for them to fall out of the sky. Today's technological transformations hinge on each country's ability to unleash the creativity of its people, enabling them to understand and master technology, to innovate and to adapt technology to their own needs and opportunities. Nurturing creativity requires flexible, competitive, dynamic economic environments. For most developing countries, this means building on reforms that emphasise openness – to new ideas, new products and new investments. The key is to create an environment that mobilises people's creative potential to use and develop technological innovations.

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