

INCUBATORS AND GOVERNMENT POLICY FOR DEVELOPING IT INDUSTRY AND REGION IN EMERGING ECONOMIES

**Mohd Fuaad Said¹, Khairul Akmaliah Adham^{2*}, Nur Atiqah Abdullah³,
Seppo Hänninen⁴ and Steven T. Walsh⁵**

¹*Faculty of Economics and Management, Universiti Putra Malaysia, Serdang, Selangor*

²*UKM-Graduate School of Business, ³Faculty of Economics and Management, Universiti
Kebangsaan Malaysia, Bangi, Selangor*

⁴*Department of Industrial Engineering and Management, Aalto University, 02015 TKK,
Finland*

⁵*The Anderson School of Management, University of New Mexico, Albuquerque, NM
87131-0001 USA*

*Corresponding author: ka@ukm.my

ABSTRACT

Incubation, a concept supported by a variety of economic cluster theories, is a vital element in economic development in developed countries. The entrepreneurial businesses that they house often improve the developed economies in terms of not only jobs but also wealth creation. The question that this article embraces is as follows: "Do incubators play the same vital role in economic development in developing regions of the world?" We use the case study methodology to develop this query in a focus area of regional development in an emerging economy. We examine the implementation of three incubators located in designated cybercities. The cybercity concept is one of the Malaysian government's initiatives to encourage the development of the IT industry within the Multimedia Super Corridor (MSC) Program. This study takes advantage of the 10-year development of cybercities by performing a longitudinal study. We found that these incubators did well in achieving their initial performance objectives, but they need to catch up with developed countries' continued rapid progress.

Keywords: incubators, IT industry development, technology entrepreneurship, government policy, regional development, cybercity, MSC Central Incubator, TPM Incubator, UPM-MTDC Incubator, MSC

INTRODUCTION

Generally, an incubator is described as an organisation that creates a favourable environment for nurturing fledgling ventures. Office space equipped with basic support services, in combination with professional business advice and links to potential suppliers and customers, is the essence of this environment (Bergek &

Norrman, 2008; Allen & Rahman, 1985). From the business perspective, an incubator's main purpose is to make money for its investors. Thus, its profitability and business sustainability become the central concern for operating an incubator (Lalkaka, 2002). In developed countries, such as the US and Finland, however, incubators serve mainly as tools to sustain a country's economic development (Allen & McCluskey, 1990; Benchmarking of Business Incubators, 2002; Abetti, 2004). Yet, in the case of Malaysia, incubators are used as a part of a strategy to achieve rapid economic growth, that is, to achieve its long-term vision of transforming the country from an underdeveloped to a developed state. This objective is mainly pursued under the Multimedia Super Corridor (MSC) Program, which was launched in 1996.

The MSC Program involves four main implementation initiatives: the development of information technology and multimedia (IT) applications and technologies, the development of IT firms, the development of the IT industry, and the development of the MSC region. The program is to be implemented in three phases over a period of 25 years. Phase 1 aims to successfully create an environment conducive to the development of an IT industry within a 15 × 50 km region called the MSC region (1996 to 2004), with the intention to entice leading global IT companies, as well as small and medium-sized Malaysian IT firms, to establish offices in this region. The anticipated clustering of IT firms within the region is expected to enable them to operate efficiently, thus generating a strong clustering effect. Indicative of the MSC Program, the IT industry is dependent on the development of the region, and vice versa. The first phase of the MSC Program's implementation was completed in 2004, and the subsequent development was to be expanded to other areas in the country through 2010 as part of Phase 2 (2005 to 2010). During the third phase, from 2011 to 2020, the entire country is expected to be transformed into a conducive environment for IT businesses (MOSTI, MSCTC, & IBM, 2007).

One of the most important strategies for promoting the clustering of firms within the MSC region is the designation of cybercities, which are selected areas for firms to gather within the MSC region. Cybercities are areas that accorded companies with the MSC 10 Bills of Guarantee, which includes tax advantages and other special privileges. Since 1998, 3 incubators have been built and operated within the designated cybercity areas: (a) the MSC Central Incubator (MCI), which is located in Cyberjaya, (b) the Technology Park Malaysia (TPM) Incubator, which is situated within the TPM Science Park vicinity, and (c) Universiti Putra Malaysia-Malaysian Technology Development Corporation (UPM-MTDC) Incubator, which is operated within the UPM main campus in Serdang (MSC Malaysia Cybercities Department, 2007). By 2008, the cybercity concept had been extended to many areas in Malaysia, some of which operated

incubators; however, only the three above-mentioned incubators were located within the initial designated MSC region.

Using the extant regional development literature and incubating concepts as its theoretical lens and the case method as its research methodology, this study examines the implementation of the three cybercity incubators and their link to the planned IT industry and the regional development. Specifically, this study's goal is to examine the applicability of the extant theory in explaining the implementation of incubating concepts in emerging regions. For this purpose, the study assesses the incubator type and purpose, its management and operational policies, as well as its accomplishment as measured against its stated reason for existence.

A CONCEPTUAL FRAMEWORK FOR ANALYSING INCUBATORS, TECHNOLOGY-BASED INDUSTRY AND REGIONAL DEVELOPMENT

We utilise different regional development theories and incubator applications that have been previously applied in various regions of the world. We highlight Abetti's (2004) findings on regional innovation system (RIS) theory and its great assistance to the economic development of the Helsinki region in Finland. We examined the Sophia Antipolis in France (Lafitte, 1988, as cited in Abetti, 2004) and the Italian region of Emilia-Romagna (Porter, 1998), which have used technopolis and cluster theories, respectively. We analysed the work on incubators as sources of regional development in converging (advanced developing countries) economies such as Portugal (Ratinho & Henriques, 2010). We reviewed the use of regional microelectromechanical (MEMS) and nano competence centres as anchors for economic development and incubation in over 80 regions throughout the world (Kautt, Walsh, & Bittner, 2007). The following sections describe the above three theories that the research supports, highlighting their differences and similarities. The section then discusses the concept of regional development in relation to incubators, which is then followed by a discussion on incubator performance measures and lifecycles.

Cluster Concept

There are a variety of cluster perspectives on regional economic development. One such concept is the triple helix culture, which supports the economic and social growth in the developing economy of Brazil (Etzkowitz & de Mello, 2004). Another cluster theory of interest to developing regions is that of the creative class (Florida, 2002), which states that to improve its economic growth, a region must attract creative people (Florida, 2002). Furthermore, Florida (2005) states that developed and developing regions will vie for these talented creative

people who will embrace new ecosystems that support exploitation of economic opportunities. The earliest cluster perspective was developed by Birch (1987) and Kirchoff (1994) who emphasised that universities are the anchor clusters for generating knowledge and developing knowledge workers. Finally, Porter (1998) suggests a cluster perspective centred around regional markets. But what exactly is a regional cluster?

A cluster is a geographical grouping of related firms and institutions of either one industry or aggregated-related industries. These firms include manufacturers that produce specialised types of goods or services, such as medical equipment, leather goods, or computers, their customers and those that supply the equipment, raw materials and other services to the firms. A cluster also has the industry-specific governmental, trade, research and educational institutions that provide training, information and technical support to the business entities within the cluster (Porter, 1998). The synergistic relationship between a business and its supporting entities within this geographical group generates what is termed a clustering effect. Generally, the effect helps to reduce the transaction costs and, hence, the overall costs of doing business for entities within the cluster (Porter, 2000). Moreover, a cluster can grow with or without proper planning and thus has characteristics of either planned or unplanned development (Chiaroni & Chiesa, 2006; Etzkowitz & de Mello, 2004).

Examples of clusters are Silicon Valley (U.S.), Boston's Route 128 (U.S.) and Emilia-Romagna (Italy). Operating within a cluster is beneficial to a business entity because it allows the entity to: (a) be in close proximity to potential employees and suppliers, (b) have easy access to industrial information, (c) receive complementary business support from others within the cluster, and (d) obtain, with less effort, services provided by governmental, research and training institutions that are located in close proximity. Being in a cluster allows a firm to be physically close to its suppliers and customers; however, the firm will also be in close proximity to its competitors. Thus, another benefit for a firm to be located in a cluster is that it provides motivation for it to be more innovative and competitive as rivals are sited "just around the corner". A cluster may also serve customers in distant locations, as in the case of an *exporting cluster*. In such a case, however, familiarity with customers and the market is still required, as in any high performing clusters (Porter, 1998).

While researchers normally analyse the concept of clustering by focusing on the firms within a cluster, many researchers seem to ignore the internal network of people within a cluster. A cluster thrives on relationships among the people within it; whether the relationships thrive depends on the types of businesses that are operated, the processes that are performed and the products that are manufactured within the area. Clustering promotes efficiency in businesses in

which the operation processes and the end products are "divisible" while the end products are characterised as easily transportable. Additionally, the production of the end product, which has high uncertainty, will make clustering important to the groups of firms that serve it, as the clustering process requires co-operation among the different specialist producers within the market (Steinle & Schiele, 2002). While the concept of clustering emphasises local interactions, extending the networks of a particular cluster beyond its location becomes important if such relationships are required by the members of the cluster community. Regardless, any relationships that provide new sources of input to the cluster community help support its sustainability (Koh, Koh, & Tschang, 2005).

Regional Innovation System Concept

The concept of an innovation system refers to the process of innovation with regard to the activities of creating, developing, and commercialising innovation as a system. This system includes firms that are directly involved in these innovation processes (production-firms) and those that support them (infrastructure-firms). To be recognised as an innovation system, these firms collectively operate in a highly effective and efficient manner (Asheim & Coenen, 2005). The regional innovation system (RIS) theory focuses on region, and thus, RIS refers to the system of innovation that functions within a particular region. Therefore, RIS may transcend national boundaries. As an RIS could comprise several clusters, with each focusing on a specific industry, it could also exist across several industries. Thus, an RIS, in a sense, is a large collection of several clusters. It is a group of business entities from several different industries that interact and share resources with each other (Asheim & Coenen, 2005). They, in turn, are supported by other institutions, such as universities, research centres, and governmental councils that provide assistance in terms of technologies, training, and physical infrastructures. In fact, the role of institutions is important in influencing the potential of an RIS (Doloreux & Saeed, 2005). Examples of an RIS, given by Asheim and Coenen (2005), include Baden-Wurttemberg (Germany), North Jutland (Denmark) and Scania (Sweden).

While an RIS can emerge naturally, its development can also be planned. A planned RIS concept requires centralised and consensual government at the regional level, with the ultimate aim of developing the region as a whole. Knowledge is central to an RIS; thus, its development not only requires the existence of all the relevant entities, such as research institutions and entrepreneurial companies, along with their supportive units but also necessitates that these entities operations are highly cohesive. Moreover, in creating an RIS, adequate funding in the initial stage of its formation and entrepreneurship is also vital (Abetti, 2004). Above all, an integrated strategy involving all related

institutions and firms is needed to ensure future sustainability of any RIS, either planned or unplanned (Saxenian, 1990).

The Technopolis Concept

A technopolis can be described as a type of cluster. It contains all the features associated with a cluster, such as having large companies and their related customers and suppliers. It also encompasses supporting entities, such as governmental and research institutions and related agencies that provide regulatory, research and educational assistance to the businesses. However, a technopolis has two distinctive characteristics that differentiate it from a cluster or an RIS. First, there is the existence of a city that becomes the centre of government and business for this cluster (Smilor, Gibson, & Kozmetsky, 1989). The second is the establishment of a large research university within its city limits that acts as the source of innovation and technology for business entities within its designated area (Steffensen, Rogers, & Speakman, 2000). A few examples of technopolises are Austin (Texas, U.S.), Goteborg (Sweden), Cambridge (England, U.K.), and Sophia-Antipolis (France) (Steffensen et al., 2000; Lafitte, 1988).

However, the three abovementioned regional development concepts thrive on the existence and success of entrepreneurs within their systems. Thus, their survival depends on having all the elements necessary to create and develop innovation and promote growth of new and existing companies (Saxenian, 1990; Venkataraman, 2003). An important concept in achieving that purpose is through the incubator mechanism. For example, within the Helsinki RIS, entrepreneurs took the initiative to form new companies and moved into incubators while helping to commercialise university technologies. Collectively, these efforts resulted in more companies and more jobs, a lower unemployment rate, and increased sales growth among the incubated firms (Abetti, 2004).

Incubators and Regional Development Concepts

An incubator, which is implemented to help develop new companies and generate growth among them, can strengthen an innovation system within a region, a cluster or a technopolis. For example, a study of the ITRI Incubator, which is located within the dense Hsinchu business cluster, has shown that robust companies that graduated from the incubator moved into the Hsinchu Science Park (HSP) and other areas within Hsinchu. These new companies generate new sources of growth for the cluster by creating new jobs, attracting venture capital and highly skilled personnel into the geographical area, and, perhaps, bringing in new international partnerships (Hsu, Shyu, Yu, You, & Lo, 2003; Koh et al., 2005). These added characteristics enhance the clustering effect within the area.

In turn, the incubator's tenants, or incubatees, operate in a protected environment as a result of their own as well as their incubator's connections with the community in the cluster. This, consequently, increase their chances of survival (in this paper, the term tenant and incubatee is used interchangeably). Thus, the relationship between an incubator and the development of its surrounding area is highly reciprocal. A similar relationship is also observed for university-based incubators located within Hsinchu (Khairul Akmaliah, 2008).

As a particular cluster becomes more successful because of the existence of the incubator, the benefits of this success spill over into the region, thus strengthening the RIS, which may comprise several clusters. Abetti (2004) shows how a group of incubators that is governed centrally can support RIS development in Helsinki, Finland. The incubator concept can also support the development of a technopolis. As the technopolis concept includes a research university as the main source of innovation and technology, incubators can be used as tools by the university to further stimulate this innovation process. A similar concept can also be employed by large businesses within a technopolis to achieve a more rapid product commercialisation process.

Incubator Performance Measures and Life-cycles

It can be noted that incubators appear to evolve through a life-cycle of three important stages. These include the start-up, business development and maturity stages. Different stages of the incubator life-cycle require its management to focus on solving different problems, and once these problems are resolved, the incubator is ready to move to the next stage. It is worth noting that incubators seem to perform better as they mature (Allen & McCluskey, 1990). This phased development is similar to the stages in the new venture life-cycle conceptualisation (Timmons, 1994).

As different incubators may have different goals, the literature suggests analysing incubator performance with measures that address the needs of the stakeholders that they serve (Allen & McCluskey, 1990; Bergek & Norrman, 2008; Mian, 1996a; 1996b; 1997; Phan, Siegel, & Wright, 2005; Markman, Phan, Balkin, & Gianiodis, 2005; Phillips, 2002). Therefore, an incubator that is implemented as a policy tool for economic development—as with the incubators that are included in this study—may have many stakeholders; thus, its performance measures may include the following measures:

1. The degree of consistency between the incubator's stated objectives and operating policies with its achievements (Bergek & Norrman, 2008; Mian, 1996a; 1996b; 1997; Phan et al., 2005; Markman et al., 2005; Phillips, 2002).

2. The extent to which its programs help its incubatee firms grow into successful companies (Hansen, Chesbrough, Nohria, & Sull, 2000), which is an important measure of an incubator's contribution towards supporting the development of its incubatees. This is also the universal goal of the incubatee firms (Hackett & Dilts, 2004).
3. The number of profitable and graduated companies and their survival rates (Mian, 1994; 1996b; 1997), which is an important measure for cybercity incubators as their function is to support the MSC charter by developing IT companies.
4. Its level of profitability (Lalkaka, 2002) as it is important for the incubator to be self-sufficient and to continue its operations.
5. Its potential for growth and sustainability, which determine the continuity of the incubator operations in supporting the growth of new companies under its care as well as its ability to sustain its operations.
6. Its reciprocal contributions to the locational contexts, which refers to the general impact of the incubator on the larger community in which it operates (Mian, 1996b; 1997; Phan et al., 2005). This can be measured by the incubator's contribution towards making the MSC area a conducive location for business.
7. Particularly in the case of a university-based incubator, (i) its reciprocal contributions to the host university, in terms of the number of host-university graduates that its incubatee firms are employing; the number of university students that its incubatee firms have accepted as interns; the number of incubatees that have benefited from links with the host university; and (ii) the number of technology commercialisation cases by its incubatee firms, which involve technologies developed within the university labs of the incubator host (Markman et al., 2005; Mian, 1996a; Phillips, 2002).

BACKGROUND—BUSINESS INCUBATORS AS PART OF THE MSC PROGRAM

Malaysia – Its Economic Background and the Decision to Move into Technology-based Industries (1957 to Mid-1990s)

Since Malaysia achieved its independence from Britain in 1957 until the early 1970s, the country's economy has relied heavily on commodities. During that time, with little interference from the government, the economy could be classified as a free-market economy. However, starting in the early 1970s, for the first time, the Malaysian government intervened significantly in the economic policy by introducing a new economic policy that focused on *manufacturing-based industrialisation* (Economic Planning Unit, 2008). In the first phase, the government implemented an *import-substitution industrialisation* program, and in the second phase, it introduced the *export orientation program*. In 1985/1986, Malaysia experienced an economic downturn, which, among others results, led to the government's privatisation of many state projects. The period between the mid-1980s and the mid-1990s, however, saw a surge in globalisation and the opening up of new markets in many parts of the world, which, in turn, resulted in many foreign direct investments into Malaysia. These factors along with, perhaps, some other factors, resulted in economic prosperity for Malaysia until the mid-1990s.

In the early 1990s, the Malaysian government identified IT as a strategic industry with the potential to generate new sources of wealth for the country's long-term goals, that is, to achieve a fully developed status by the year 2020 (Government of Malaysia, 2001; 2006). By the mid-1990s, the Malaysian government began to encourage the development of knowledge- and technology-based industries and identified IT and multimedia industries as their new sources of growth. Accordingly, it established the National IT Council (NITC) to monitor these industries, and in December 1996, the government launched the 25-year National IT Agenda (NITA) (NITC, 2009). The policy was later operationalised via the development and implementation of the MSC Program, which aims to transform the entire country into a conducive environment for conducting IT businesses.

Infrastructures and Support Services for the Development of Technology-based Industries (Mid-1990s to Present)

In fulfilling the MSC's charter to create an environment favourable for IT business in an MSC area, two strategies are implemented: to attract the world's leading IT companies to locate their industries within the MSC area, undertake research, develop new products and technologies, export from this base, and choose MSC as the hub for their regional operations in Asia; and to encourage

the creation and development of Malaysian IT SMEs and transform them into world-class companies (Abu Talib, 2007).

Under this MSC project, the MSC region, which was equipped with infrastructure and other support services, was designated as the initial platform as it had an environment conducive for businesses (Abu Talib, 2007). The identified MSC area already had some of the requisite infrastructure and support services as there were a number of research institutions and universities, both publicly and privately sponsored; government-based think tanks; and large pools of skilled workers from the universities and the research institutes located in the area. Moreover, as the area includes the capital city, Kuala Lumpur, it has an established financial community. First, the MSC was designed to capitalise on these existing infrastructures and to develop other support services and infrastructures, with the aim of creating a cluster of IT companies along with all necessary supporting agencies and businesses. Special cyberlaws and policies were also implemented to help it operate within a clear legal boundary (Ramasamy, Chakrabarty, & Cheah, 2003). Second, in the mid-1990s, the construction of Putrajaya, which serves as the new administration city for the Malaysian government, and Cyberjaya, which acts as the new administrative centre for MSC, commenced. By the late 1990s, Putrajaya and Cyberjaya began to perform their respective functions.

Third, the Multimedia Development Corporation (MDeC), a Malaysian government regional development agency, was created and given the responsibility to oversee much of the progress and achievement of the MSC objectives. Among others, MDeC was to help manage the infrastructure and help develop and manage incentives and other support services within the MSC area. Fourth, as a way to encourage the creation and development of Malaysian IT SMEs into large companies, the Malaysian government launched four major projects to create markets for IT companies' output, including e-government, a multipurpose card, a smart school, and tele-health.

Perhaps the most important part of creating a positive environment within the MSC area was the establishment of cybercities and cybercentres within the area, which started in 1998. The purpose of these developments is to allow the specified areas to become densely populated with IT companies, that is, to build a critical mass of IT companies in the region. All companies, local and foreign, that are given MSC-status are to be located in one of the designated cybercities or cybercentres within six months of receiving their MSC-status to allow them to be eligible for the MSC 10 Bills of Guarantee. The bills entitle the companies to receive tax advantages on their income and import duties, to employ unrestricted numbers of foreign-knowledge workers, to have a flexible ownership basis and financing options, and to receive privilege to government-contract businesses—

which is an important advantage (MSC Malaysia Cybercities Department, 2007). MDeC is responsible for evaluating the applications and for the granting of MSC-status as well as for facilitating companies with MSC-status to relocate within the MSC area. MSC status is given to local or foreign companies that have a unique innovation concept (MSC Malaysia, 2008).

By 2008, 9 locations had been designated as cybercities/cybercentres, including 5 in the MSC area and 4 in other sites in Malaysia. The 5 in the MSC area are Cyberjaya Flagship Zone (CFZ), Technology Park Malaysia (TPM) and UPM-MTDC, Kuala Lumpur City Centre (KLCC), and KL Sentral. The first 4 were awarded MSC-status in 1998, and the last one was awarded MSC-status in 2006. Out of these 5 areas, 3 of them are hosting business incubators. The incubators are the MSC Central Incubator (MCI), which is located in Cyberjaya; the TPM Incubator, which is situated in the TPM vicinity; and the UPM-MTDC Incubator, which operates within the UPM main campus in Serdang (MSC Malaysia Cybercities Department, 2007).

Not only are all 3 incubators created to support the MSC initiative, they are also connected to each other via their parent company and ownership. Both MDeC, under which MCI is operated, and TPM, under which the TPM Incubator is operated, are government-owned companies, operated under and sponsored by the Ministry of Science, Technology, and Innovation (MOSTI). Thus, they are sister entities along with their other sister companies, which are SIRIM Berhad, MIMOS Berhad, and Astronautic Technology (M) Sdn. Bhd. MTDC is a subsidiary of the MOSTI, and its shareholders include both private and government agencies (Krishna, 2008; Malaysian Industry-Group for High Technology [MIGHT], October 2004).

RESEARCH METHODOLOGY

We employed a case study methodology to generate an understanding of the different imperatives and the nature of incubator use in an emerging economy in comparison to incubators in converging countries (Ratinho & Henriques, 2010) and developed countries. We adopted Yin (1994, 2009) and Eisenhardt and Graebner's (2007) case study techniques to interview and analyse the three facilities. We further our case study by administering a structured survey method to all three firms (Fowler, 2009). The survey probed each incubator's processes and results and provided structure for our face-to-face and telephone interviews.

We used the structured surveys to conduct in-depth, face-to-face and/or telephone interviews with the incubators' managers as well as with the managers of the incubatee firms. We followed up with e-mail communications when necessary.

The information provided by the managers during the interviews was corroborated and supplemented by other corporate units and/or the sister units of the incubators. Additionally, we checked the statements of the interviewees by actual interviewer observations during visits to the incubators. Finally, we enriched the study by utilising secondary information on the incubators. The research process utilised is longitudinal in nature. We conducted our first data collection in 2002. This process was followed up in 2006 and finalised in 2008.

In conducting the case studies, we utilised Eisenhardt's (1989) and Eisenhardt and Graebner's (2007) analysis techniques. First, we developed a written case for each of our three incubators. We developed each case in a three-step [2002, 2006, 2008] order. We analysed each incubator in this manner to capture the richness and relative progression of each incubator's developmental processes. Finally, we performed a cross-comparison of our three incubators to highlight their differences and similarities. The resultant analysis is a robust case method study that links broader theory to our findings.

FINDINGS

This section provides a detailed report on each of the incubator cases.

Case 1: MSC Central Incubator (MCI), in Cyberjaya

The MSC Central Incubator (MCI), which began its operation in 1999, was first established as a unit of the MDeC. The MDeC is a Malaysian government agency under the MOSTI, created in 1999, and is responsible for overseeing the attainment of the MSC Program's objectives. Specifically, the MDeC objectives are to create a critical mass of IT/multimedia companies. The MCI is managed by the Technopreneur and Enterprise Development Unit under the Industry Development Division of MDeC. Its objectives are to develop new ventures into companies that can compete on a global level, and it mandates that all potential tenants, as MSC-status companies, focus on the ICT/multimedia areas.

The MCI operated in a building on a site that belonged to the Multimedia University and that was within the university campus in Cyberjaya. The Multimedia University leased the land to MCI to encourage and expose their students to "technopreneurship". The incubator building was a gift to MDeC from Setia Haruman, the major developer of Cyberjaya, which is an area that achieved cybercity status in 1998 (MSC Malaysia Cybercities Department, 2007). The incubator initially operated as a landlord, providing office spaces to firms to set up businesses, though it offered very few other support facilities. However, since 2003, MCI has been implementing what it refers to as a business acceleration

incubator model and, as such, has changed its operation mode to offer more comprehensive support to IT related businesses. This support comprises, first, technology, marketing, and funding facilities, and second, basic business and operations support. For the first category of support, in 2004, the incubator jointly established computing labs with Microsoft and Sun Microsystems. These labs can be used by the tenants to develop their proof of concepts and/or prototypes. The tenants can also seek advice on technology from the staff members of these two lab partners. Additionally, the partners sponsor or subsidise the training of the tenants' employees at their facilities. Once a tenant develops a proof of concept, the incubator helps match it with potential customers. Furthermore, the tenant is granted MSC-endorsements on its products. Although the incubator does not provide funding directly to its tenants, it aids them in securing financing. In doing so, the MCI invites potential venture capitalists and high net-worth individuals to meet with its tenants. In the second category of support, the incubator provides certain assistance to satisfy the basic operation needs of its tenants, such as business plan preparation, individual/CEO profiling, and venture/business profiling.

Since 2004, MCI has been inviting experts from various industries to serve as mentors who advise the tenants on technical and business matters. It extensively searches for potential mentors, selects suitable ones according to pre-defined requirements, and inputs profiles of each selected mentor into its databank. Thus, the mentor's expertise can be properly matched with the needs of the tenant. The selection process for its potential mentors is very stringent and is performed by MCI's own personnel. Its mentors are required to have some personal experience in building their own companies to a certain level of earnings.

In 2008, MCI was headed by a senior manager who was assisted by an executive and an administrative assistant. The senior manager was responsible for managing MCI's overall operations, though the incubator management did not maintain records on the number of ventures/companies that it hosted since 1999. By 2008, incubator services that could be accessed by its tenants were expanded with the support of its other sister divisions. This expanded support allows its tenants to have easy access to other technopreneur development programs under the MDeC's Technopreneur and Enterprise Development program portfolios. The tenants, for example, can receive trainings in basic business management as well as in advanced financial and marketing planning; they can also obtain basic legal services, when needs arise, for free or at discounted rates. MDeC also has an MSC Management Services Division that offers incubator tenants many types of services at subsidised rates. For example, MDeC offers a business assessment service where the tenants can present their ideas to a group of experts, such as representatives from a consulting firm affiliated with MDeC, technology experts, and venture capitalists, to determine the marketability of their concepts. The

incubator also offers the use of its labs to several entrepreneurs who are under its sister technopreneur development program but who are not tenants. An exchange platform for the sharing of ideas among tenants through various programs that have been organised by the incubator are available and are sometimes conducted in collaboration with its sister divisions/units.

MCI tenants also have preferred access to grants offered by the MOSTI, the parent body of MDeC, and to funding communities related to the MOSTI and to other government agencies. Through the incubator and the MDeC programs, tenants are assisted in identifying other useful programs that are organised by related agencies and institutions, such as the Technopreneur Association of Malaysia (TeAM). Tenants can attend these programs at subsidised rates or for free. Moreover, the MCI acts as a reference site for the country's Incubator Development Program for which the staffs of MCI and MDeC provide consulting and advisory services to potential and existing incubators.

By 2008, the MCI had a total office space of 50,000 square feet, including space for shared facilities such as conference, board, meeting, and discussion rooms. Other spaces were available for rent at rates that ranged from RM2.50 to RM4.50 per square foot. Operating at full capacity, the MCI hosted 51 tenants who rented offices of various sizes depending on their needs. These tenants were involved in at least one of the following businesses: software development, internet-based business, hardware design, creative multimedia content, and shared services and manufacturing. Tenant selection was performed by the incubator manager and his assistant manager, and their recommendation was forwarded to the head of the Technopreneur and Enterprise Development unit. The tenancy period ranged from a six-month minimum to a two-year maximum. The incubator manager and his assistant also conducted a tenant review every six months to determine if the tenant had achieved its milestones. To date, the incubator has never removed a tenant because of poor performance as the poor performers have moved out voluntarily.

From the tenant's perspective, they have, in general, benefited from being a part of the MCI. Benefits include the extensive interactions that occur among the incubator tenants as some tenants' programmers/product developers discuss their product development problems and seek advice from each other, particularly from those who use a similar lab facility. There are those who have established business collaborations with each other where, for example, one tenant becomes a back-end technology supplier to another tenant. Many tenants have also benefited from the lab facilities at the incubator, thus significantly reducing some of their operating costs. The incubator's collaboration with the labs also enables the tenants' programmers to be trained at either a subsidised rate or at no charge. The tenants are also able to make use of the neighbouring Multimedia University

internship students, as MDeC assists in negotiating the recruitment of Multimedia University internship students for the tenants. Being located within the Multimedia University main campus makes the arrangement a win-win situation as the students can live on campus if they have an internship attachment at one of the incubator tenant companies while gaining work experience. In addition, as giving allowances to these students is optional, the tenants can reduce their costs even further. By the end of 2008, however, there was no plan to extend the incubator's space to accommodate more tenants. The number of companies that the incubator had developed that qualify as globally competitive, thus, remains very small.

Case 2: The Technology Park Malaysia (TPM) Incubator

The Technology Park Malaysia Corporation Sdn Bhd (TPM) began its operation in September 1993 and started to offer incubating services in 1996. It is a government-owned business entity under the MOSTI that has a lease on a 750-acre plot of land from the federal government, which makes up the TPM area. The area received cybercity status in 1998 (MSC Malaysia Cybercities Department, 2007). The TPM Incubator operates in five divisions, which include (a) Business Development & Special Projects, (b) Corporate Services, (c) Finance, (d) Centre for Technology Commercialisation, and (e) Park Management & Services. The Business Development & Special Projects Division is responsible for business collaborations and for bringing any outside businesses to the TPM Incubator. The Centre for Technology Commercialisation is responsible for managing the allocation of the Techno Fund, an operation monitored by the MOSTI. The TPM Park Management & Services Division manages the operations of the park's enterprise complex, incubator and innovation house.

TPM also operates four subsidiaries that began operations in 2003/2004. These subsidiaries include TPM IT Sdn Bhd, TPM Biotech Sdn Bhd, TPM Engineering Sdn Bhd, and TPM College Sdn Bhd (TPM, 2010). The TPM divisions, along with these subsidiaries, enable the provision of a comprehensive service within the park. As a comprehensive business park operator, the TPM's objectives are to build a sustainable business community and create a conducive business environment for this community within its park. It plans to achieve these objectives by providing infrastructure and services that facilitate R&D, innovation and commercialisation activities. It is also to serve as a platform for linkages and partnerships between the industry and government agencies to encourage innovation and technology-based industry growth (TPM, 2010).

TPM's business activities include renting business housing areas/facilities and leasing land to local and foreign high-tech and R&D companies. TPM offers

various sizes of space plots that have the necessary infrastructure and facilities for technology companies and that allows them to sublease and construct their own buildings. Moreover, the TPM subsidiary companies provide laboratory services, product development assistance, contract research aids and commercialisation support for nutraceutical and biopharmaceutical products (TPM Biotech), engineering design and solution aids (TPM Engineering), and broadband and data centre maintenance (TPM IT). Its TPM college is a training platform that supports the development of human resources in the technical fields.

TPM offers three types of housing facilities for entrepreneurs and companies: the enterprise complex, the incubator building, and the innovation house. The enterprise complex premises are designed for medium-sized companies while the incubator building and innovation house are essentially office spaces for small companies, specifically for those that are at the business development and idea development stages, respectively. The innovation house is designed to cater to the needs of entrepreneurs who have yet to form a company. TPM's first corporate objective perhaps summarises the objective of its incubation services: "To incubate and nurture knowledge-based enterprises by providing expertise and support services technically and commercially". The operations of these three housing facilities are managed by TPM's Park Management and Services Division. The division is also in charge of the facilities' marketing and tenant administration. By 2008, the total number of tenants in all its housing is 160 companies with 55 in the incubator house. Of the 160 companies, 77% were involved in IT business; 13%, in biotech; 6%, in engineering; and 4% operated support businesses within the park, such as restaurants and convenience stores (4%). Of the total number, 80% are local companies, and the remainder are multinational companies.

As the entire TPM area has cybercity status, it enables the TPM Incubator to attract MSC-status companies as tenants. The selection decision regarding its potential tenants is made by a panel committee comprising managers from the marketing, finance, and legal departments of the Marketing and Business Development unit of the Park Management and Services Division, as well as managers from the TPM subsidiaries, that is, TPM IT, TPM Engineering, and TPM Biotech, although their involvement depends on the nature of the prospective tenant's business. No expert outsiders are invited to serve as selection committee members.

Only potential tenants whose businesses are in ICT, biotechnology, or engineering are considered for evaluation to meet the incubator's cybercity-status requirements. TPM accepts tenancy from companies with or without the MSC-status, although it gives priority to those with MSC-status. The total office space

available for rent at its incubator is approximately 113,800 sq. ft., and the rental charge is RM 3/sq. ft. The TPM Incubator conducts tenant surveys annually, and the results, which serve as the tenant progress report, are submitted to the MOSTI. By early 2008, the TPM incubator, which was hosting 55 companies, had reached full capacity and had several potential clients on its waiting list.

The benefits that are provided to the tenants are many. The incubator tenants can access the lab equipment and other services of the TPM subsidiaries, and, depending on their collaborative arrangements, tenants can also receive the services at a discounted rate. Consequently, many of the incubator tenants collaborate with and make use of the facilities provided by the TPM subsidiaries. An example of this collaboration is when TPM Engineering produces equipment parts for one of the tenants.

When evaluating tenancy qualification, the incubator does not consider synergy among tenants one of its selection criteria, although it does provide information on present tenants to new ones. Nevertheless, there are some business collaborations among the tenants and between the incubator tenants and TPM's larger business tenants within the enterprise complex. For example, a small company in its incubator or innovation house is a customer to one of the large TPM tenants in the enterprise complex. Within the incubator, there are cases where one tenant is a supplier to another tenant or where one tenant is a buyer from another tenant.

The TPM incubator also helps tenants link with experts by organising business forums and discussions. It invites experts from the Small and Medium Industries Development Corporation (SMIDEC), MDeC, and Malaysia Debt Ventures Berhad (MDV, a government-based funds manager), to provide advice on grants and other financial support. The incubator also helps in linking tenants with grant providers, such as the MOSTI for Techno Fund. The TPM incubator staff members establish these links with outsiders on their own. However, thus far, no formal links with research institutes or universities have been provided to the tenants. Other benefits offered to the TPM incubator tenants are for recreational and health purposes. The TPM's vast vicinity includes a gymnasium, sauna, court game facilities, food outlets, convenience shops, bank branches, and clinics. While these facilities are also available for those outside the TPM community, the tenants are often given discounts.

The initial intent of establishing the three types of housing was to allow the enterprise complex to receive tenancy from the innovation house and the incubator and for the incubator to receive tenancy from those previously in the innovation house. However, by 2008, no information was available on the

number of migrations between the three houses. There is also no information on the accumulated number of tenants, to date.

Case 3: UPM-MTDC Technology Incubation Centre One

The UPM-MTDC Incubator is one of the three university-based incubators operated and managed by MTDC. The incubator received cybercity status in 1998 (MSC Malaysia Cybercities Department, 2007). MTDC initiated operations in 1992 with a charter to spearhead the development of technology businesses in Malaysia. Its initial role was to promote and commercialise local research and to invest in new ventures that would attract new technologies from abroad. It was created, initially, as a subsidiary of the Ministry of Science, Technology and Innovation (MOSTI), and its operation was supported by government grants. With the government as its majority shareholder, the remaining shareholders were private investors.

In 1996, it invested in the development of university-based business incubators, which began with establishing the UPM-MDTC incubator. During this time, MTDC was deemed the agency responsible for promoting the usage and application of advanced technologies among local industries. This activity was supported through two government grants, which were, the Technology Development Program and the Technology Development Cluster program. The Technology Development Program emphasises the promotion of high technology applications among local companies and the commercialisation of its R&D results through the grants available under the commercialisation of the R&D Fund and the Technology Acquisition Fund (Ministry of International Trade and Industry Malaysia [MITI], 2004).

The Technology Development Cluster Program, on the other hand, was introduced in 1996. This program, operationalised through the MTDC incubator programs, involves developing and managing technology incubation centres. The incubators are built within the confines of universities where technopreneurs would be permitted to rent space and take advantage of available R&D facilities within the universities. Their objectives are to provide a physical platform for technopreneurs to collaborate with local universities and research institutions in an effort to promote the commercialisation of technology. By 2004, MTDC operated three incubation centres: the UPM-MTDC Technology Incubation Centre One in Serdang, which focuses on IT and multimedia development; the UKM-MTDC Smart Technology Centre at the Universiti Kebangsaan Malaysia campus in Bangi, which concentrates on biotechnology; and the UTM-MTDC Technovation Centre at the Universiti Teknologi Malaysia campus in Skudai, which emphasises IT and electronics.

By 2008, MTDC had further evolved to become an integrated venture capital solutions provider that provided financing to firms in all stages, from those at the laboratory idea stage to those at the commercialisation stage. By this time, the MTDC had approved grants totalling RM143.4 million to 95 local technology-based companies. It also took up equity stakes amounting to more than RM350 million in more than 50 local and international companies (MDV, 2010). The company's structure is divided into two divisions: the Investment Division and the Technology Development Division. The Investment Division is responsible for venture capital decisions while the Technology Development Division operates the following three units: (1) Grant management; (2) Incubator management; (3) Value-added services. The Grant Management Unit is responsible for the evaluation and distribution of the Technology Acquisition Fund (TAF) and the Commercialisation of Research and Development Fund (CRDF) to qualified entrepreneurs and business owners. These grants can be applied for by entrepreneurs who meet the criteria, including those who are MTDC incubator tenants as well as outsiders. The Value-added Services unit is responsible for providing required services to both MTDC incubator tenants and MTDC grant recipients (MTDC, 2008).

The Incubator Management Unit is responsible for the daily operations of all three MTDC incubators. The UPM-MTDC Incubator began its operations in 1996 with the UPM leasing it a parcel of land and the MTDC financing the building of its offices. The incubator is managed by the MTDC's Incubator Management Unit. Each incubator is formally assigned two staff members whose offices are in the respective incubators while the remaining staff members are located in an office in the UPM-MTDC, which serves as the centre for managing all three MTDC incubators. The stated objectives of the Incubator Management Unit are "to activate and promote the acceleration of the commercialisation activities of both the local universities and research institutions" (MTDC, 2008).

During its initial years of operations, the UPM-MTDC operated as a landlord incubator, providing only office space with no other types of services. However, this role changed in 2003 when it started to upgrade its incubator operations (National SME Development Council, 2006). By 2008, the UPM-MTDC Incubator had three types of housing facilities with a total build up area of approximately 150,000 sq. ft. The facilities included a technology garage (small premise with a maximum of 420 sq. ft.), an enterprise complex (a larger space with a minimum of 1,000 sq. ft.), and the server farms (especially for data centres). By that time, the UPM-MTDC was operating at a full capacity, supporting 33 tenants—9 in the technology garage, 19 in the enterprise complex and 2 in the data centre. Of these tenants, 95% were involved in the IT business, and the remaining 5% were engaged in life-sciences.

Three of the tenants are actually units of the UPM itself. In this case, the UPM rents the building for labs and research, one being a unit in collaboration with other research institutes, because space has become limited for the UPM at its main campus. In total, all three MTDC Incubators recorded approximately twelve collaborations with official documentations among its tenants and the universities/research institutes. The estimated number of collaborative agreements within the UPM-MTDC incubator is four, three of which involve the host university.

The UPM-MTDC incubator also assists tenants in recruiting student interns from the UPM, although it does not provide direct links between the tenants to the UPM labs. Rather, the management becomes the information gatherer and gives the information to the tenants. Thus, the tenants themselves must make the initiative to proceed. Some tenants also use UPM graduates as their manpower. Again, introductions and schedules are first provided to the tenants by the incubator, but the tenants must then take the initiative and deal directly with the graduates.

The UPM-MTDC Incubator mandates that all potential tenants either have collaborations with the host university, with another university or research institution or have plans for such collaboration. If they do not meet this criterion, their tenancy in the incubator is refused. All new tenants are given six months to establish this collaboration, and failure to do so will result in their eviction from the incubator. In promoting links with the host university (UPM), the incubator management regularly meets with the university management and helps to link the tenants to the Industrial Relations unit of the host university in an effort to encourage the tenants to engage student interns. The management of the incubator also helps establish links with other universities and research institutions while its sister unit, which is the value-added services unit, helps link the tenants to industry experts and provides other services beyond those offered by the incubator management.

The incubator's tenant selection decision is made at the MTDC corporate head office. The decision process involves a committee that is composed of the heads of the MTDC Investment Division, the Technology Development Division, and the Corporate Services Division. The committee also includes the heads of units under these divisions, depending on the nature of the potential tenant's business and various other factors. No expert outsiders are involved in the tenant selection decision. Rather than actually monitoring the performance of the tenants, a tenant performance review is performed as a part of the tenancy renewal routine. The incubator manager evaluates the tenant performance and then makes recommendations with respect to the final decision to the Steering Committee.

The incubator does not keep a record on the number of accumulated tenants or monitor the progress of the graduated companies.

The incubator's rental rates are per square foot. For the technology garage, the rate is RM2.70; for the enterprise complex, it is RM2.50; and for the server farm, the rate ranges from RM3 to RM3.50. The tenancy period for each contract is two years for the technology garage and three years for the enterprise complex. However, the tenancy agreements are renewable upon re-evaluation and approval by the incubator management. There are some anchor tenants that have been in the incubator for a considerably long time, and at least two have their data centre operations in the server farms. MTDC did not invest in any of the UPM-MTDC incubator tenant companies or in either of its two incubator tenants. Thus, the incubator still has a considerable amount of leased land available for future expansion.

DISCUSSION

All three cybercity incubators' corporate units (MDeC, TPM and MTDC) are government agencies that are specifically created to provide direct support to the implementation of the MSC Program. Thus, they directly support the development of the Malaysian IT industry and its planned MSC regional development. Their projects, including their incubators' operations, are aligned with the MSC Program. All three incubators play important roles in supporting the MSC charter, as they are established to support the growth of IT companies by developing the IT industry, attaining cybercity status, and contributing directly to the transformation of the MSC region into an environment conducive for IT business. All three organisations are MOSTI arms and subsidiaries, which indicates that MOSTI is a key player in the MSC initiative and that it plays a substantial government role in the MSC Program.

Two cybercity incubator's corporate units (TPM and MCI) are created specifically as integral parts of the MSC initiatives while UPM-MTDC's corporate unit (MTDC), which was formed in 1992, was refocused to serve the MSC charter. MDeC is perhaps the most essential vehicle for the MSC implementation as it is the regional development agency for the MSC program and is, therefore, responsible for achieving many of the MSC's objectives, including the development of the MSC-status companies and the growth of the region. Both TPM and MTDC are, perhaps, the second most important entities of all the institutions/agencies designated to support the MSC Program implementation. Therefore, while all the incubators' objectives are directly coherent with their corporate office unit objectives, they are also consistent with

the MSC objectives, though in all cases, the achievement of their objectives occurs incrementally.

Each of the cybercity incubator's corporate units differs in their implementation concept as MDeC is a regional development agency, TPM is a science park, and MTDC is a venture capital agency and technology commercialisation arm that supports technology and firm development. With respect to their incubator concept, each incubator uses a different method of nurturing its tenants with each playing a specific role in contributing to the objectives of the MSC project. MCI utilises the *business development acceleration* concept, TPM uses the *comprehensive science park concept*, and UPM-MTDC utilises the *university technology transfer/commercialisation concept*. All of these are important conceptual elements in supporting and creating an environment that is conducive to innovation and business growth, as envisioned by the MSC initiative.

The MCI directly supports the MSC charter, as the MCI objectives are to develop new companies that can compete on a global level; thus, the MCI directly serves MDeC's overall charter to create a critical mass of ICT/multimedia companies. Also consistent with the MSC charter to develop the IT industry, the MCI requires that all its potential tenants have MSC-status and their business focus is in the ICT/multimedia fields. Among the three cybercity incubators included in the study, the TPM Incubator corporate operation, given its comprehensive science park concept, has the most extensive objectives. The TPM Incubator, which intends to facilitate the development of companies in telecommunications, biotechnology and IT, supports only one part of the overall TPM corporate objective. Other TPM corporate objectives include facilitating and promoting R&D, innovation and commercialisation activities by providing the necessary facilities. It also pledged to create a tight community within its park, thus providing all the necessary facilities for that purpose. Similar to the UPM-MTDC incubator, it also aims to become a platform for developing and commercialising research results from universities and research institutions and facilitating the creation of links with the finance community and industry players. However, unlike the UPM-MTDC incubator, university and research institute collaboration is not compulsory for TPM Incubator tenants. Thus, there are very few, if any, cases of university technology transfer occurring among its tenants.

The objectives of the UPM-MTDC incubator are more focused on supporting the acceleration of research commercialisation from universities and research institutions, which mainly focuses on ICT/multimedia companies. Perhaps the creators of the UPM-MTDC incubator recognise the importance of commercialising the research of universities and research institutions in helping realise the developed state of technology-based industry. In addition, the UPM-MTDC incubator is located on the main campus of the UPM, which implies an

emphasis on close proximity for facilitating the transfer of technology from the university labs to the incubator. In its charter, MTDC has positioned itself as a comprehensive venture capitalist; thus, it would be more likely to invest in companies that are already in the growth stage rather than those in the start-up stage, which are most likely to be its incubator tenants. Until 2008, MTDC did not directly invest in any of its incubator tenant companies. However, MTDC's involvement in the UPM-MTDC incubator and its other two university-based incubators, as well as its responsibility for dispensing commercialisation and technology development grants, demonstrates that it is, indeed, a comprehensive commercialisation arm.

Additionally, each of the incubator's parents operates as a self-sufficient entity with supporting units dedicated to serving their clients, including the respective incubator's tenants. In this sense, while they help nurture their tenants, these corporate parents act as incubators to the incubators and their tenants. The incubators receive human resource support from their sister units in fulfilling their tenants' needs and requirements. This support contributes toward a higher survival rate of their tenants. There is substantial involvement of all three incubators' sister units in helping the incubators provide services to their respective tenants. In fact, some of the sister units were specifically established as a part of the support structure for the incubators. These developments have occurred incrementally over time.

All three cybercity incubators have received considerable support from the federal government. In terms of financing, they were all initially sponsored by the government. The incubators' clients were also provided access to extensive financing and technical and managerial assistance by various government agencies and units. The cybercity incubator corporate parents also work closely with other Malaysian governmental agencies in carrying out the implementation activities. One example of a corporate parent is the Malaysian Institute of Microelectronic Systems (MIMOS), an entity under MOSTI. MIMOS offers grants to the incubators' tenants that are eligible for financial support. Other agencies that offer grants to the tenants include the Small and Medium Industries Development Corporation (SMIDeC), the Malaysia External Trade Development Corporation (MATRADE), which operates under MITI, as well as Malaysia Venture Capital (MAVCAP) and its subsidiary, the Cradle Fund Sdn Bhd (both operate under the Ministry of Finance). The number of agencies further affirms the substantial role played by the government in operating these three incubators. In contrast, the help that these incubators receive from private companies is minimal, and the participation of local government in their activities is almost nonexistent. The involvement of the private sector is limited to offering some complementary support, such as computer labs and basic business services to the incubator tenants in the MCI. Perhaps these weak links with the private sector

and local government are the main reason the corporate units form sister units as important parts of the support system for the incubators' tenants. Or perhaps each of these corporate units has a plan to be a comprehensive service provider in its own right. These weak links, however, indicate a rather weak innovation system and suggest a weakness in the IT cluster within the MSC area.

While their objectives to support the MSC project have remained unchanged over the years, during the initial stage of their operations, the respective incubator management and operations policies of all three incubators acted as landlords, which were inconsistent with their respective stated objectives. However, since 2003, all three incubators had begun to strive towards achieving their originally stated goals. By 2008, the UPM-MTDC incubator had become more successful in its pledge to be the commercialisation arm of the university research. By then, its tenants had recorded more formalised university collaborations, with many tenants actively seeking UPM students as interns and UPM graduates as human resources. This was a significant improvement in comparison to previous study findings, in which the incubator neither functioned as a technology-commercialisation unit for its host or other universities' technologies nor did it serve as a training ground for host university students (Khairul Akmaliah & Maisarah, 2004).

When analysed, the contribution of the MCI, hosting approximately 60 companies, to MDeC's overall objective of creating a critical mass of ICT/multimedia entrepreneurs in the country is rather low. However, when viewed as a whole, the MDeC has been somewhat successful, as it has supported many more teams of entrepreneurs through its comprehensive entrepreneur support programs than other incubators. When the TPM incubator outcome is analysed, it scores well in supporting the development of companies and creating a community, but it scores quite low in supporting its TPM corporate unit to link the park community to the university and research institution communities, thereby supporting the commercialising of university research results. Collectively, however, the three incubators have successfully increased the number of entrepreneurs involved in the IT businesses, thus partially helping to meet the entrepreneur number requirements of the MSC charter. The high interaction among the tenants in all incubators indicates the existence of the micro-clustering of firms within the respective incubators.

As they progress, these incubators further increase and improve the services provided to their tenant firms, potentially because of the learning curve experienced by the managerial teams that has taken place over time. The findings confirm a previous study by Allen and McCluskey (1990) who found that incubators, initially, would focus on estate development but that they would, later, concentrate on providing services. However, the growth into services-

incubators is, perhaps, also influenced by the extra allocation provided to them by the government as the MSC moved further in its implementation, and the incubators' operations moved towards a phase of stabilisation.

By 2008, all of the incubators were presumably operating at a profit as indicated by the number of tenants that they hosted. Because of the available captive market of MSC-status companies and their competitive operation costs, it could be expected that the operations of the incubators could be sustained. However, as their service proposition is tightly attached to MSC-status markets, their operations will continue to exist only as long as companies perceive the viability of the MSC-status and the attractiveness of the locations. Otherwise, the businesses of all three incubators will become less viable, which could serve as a major motivation among the operators of the incubators to do everything that they can to encourage the MSC to create a conducive environment in their location so that businesses would want to relocate within or near them regardless of the MSC-status guarantees. Nevertheless, as the availability of current incubating spaces is limited, it may be difficult to fully realise the government's ambitious goals of creating a critical mass of successful companies operating within the MSC.

As the number of new companies created and developed within these incubators has been low, as a group, the contributions of these incubators towards the intended economic development under the MSC Program have also been minimal. The total number of MSC-status companies, that is, the companies certified to own an innovation, increased exponentially in 2008 to 2,173, and their contribution to Malaysia's GDP for 2007 was approximately 1.2%, increasing from 0.6% in 2003 (MSC Malaysia Client Contact Centre, 2008). The estimated numbers of companies that are related to the three incubators' services are approximately 10% to 15% of the total 2,173 MSC-status companies. It could be expected that the constraints on space would further limit the incubators' future contributions to the country's economic development. Moreover, the link with the private sectors must be developed to further expand the necessary clustering effect within the area. Perhaps the extension of the cybercities and cybercentres into other areas in Malaysia will serve to accelerate the development of more firms, which, as a group, offers a greater contribution to the overall economic development of the country.

CONCLUSIONS

The development of the IT industry in Malaysia, within the designated MSC area, reflects some elements of a cluster and an RIS. Indicative of an RIS, the MSC Program has a centralised management concept whereby the federal government

assumes the leadership role and sponsors the effort. The MSC Program also involves considerable efforts in encouraging new venture formation and supporting their development through various agencies. However, contrary to with an RIS, local and state governments, as well as industry (private businesses), play very limited roles. The MSC also have other characteristics that are not standard for an RIS. For example, the main emphasis of the MSC is on developing the IT cluster exclusively rather than on developing more comprehensive businesses and industries within the region.

There are instances of clustering characteristics, though these are not fully developed. For example, as the specific emphasis of the MSC Program is on the development of the IT industry, it is receptive to the presence of both local and multinational IT producers. It also promotes the grouping of IT firms within a geographical area as its aim is to create synergy between a customer and a producer by locating them in close proximity of each other, while simultaneously developing an export hub for companies that are located there. These characteristics reflect an emphasis on developing the MSC region into an exporting cluster in addition to serving the local markets. This emphasis not only creates an important clustering strategy for Malaysia's small IT market, but it also takes advantage of Malaysia's capabilities in the export markets.

While reciprocal relationships are observed in TPM among large firms in the enterprise complex and small firms in the incubator, such large-small firm links are not obvious among MCI and UPM-MTDC tenants, as their focus is only on the SMEs. However, in the MCI and UPM-MTDC incubators, some synergistic relationships are observed among the tenants. Therefore, there is indeed clustering among the tenant firms. These micro-clustering functions, which serve as the nucleus for the clustering effect within the cybercities, have the possibility of spilling over into the greater MSC region. The anticipated clustering within the MSC region, however, has not yet gained full strength as cohesive operations involving the private sectors, universities, and local and state governments are required. Achieving cohesiveness among these important elements is vital to enable the cybercity incubators and their tenants to fully function as a high performing cluster that contributes to the efficiency of the innovation system within the region and thus strengthens the RIS as envisioned by the MSC Program.

All three incubation operations have evolved over time from being landlords to becoming fully integrated incubating systems. This evolution further affirms that incubators proceeded through lifecycle processes (Allen & McCluskey, 1990; Hackett & Dilts, 2004) and that these processes are influenced by a number of factors including, most important, the availability of resources (especially money), an increase in managerial capability, and, perhaps, an increase in the

quality of their tenant firms. In providing their services to their tenant firms, the corporate units of the incubators employ both internalisation techniques, in which their own subsidiaries and/or departments provide services directly to the tenants, and outsourcing, in which the incubators act as platforms to link the tenants to the outside service providers. The use of internalisation by the incubators as an approach at their end can be explained by the transaction costs economics theory as they aim to reduce their costs of operations in delivering services to their customers (Porter, 2000). Such an approach may be pursued because the cyberville area is still underdeveloped as a cluster, and thus, many vital supporting entities are still unavailable. It is also possible that some of these entities, while they exist, are not properly linked to the incubators.

Moreover, it is possible that such an approach is undertaken to further institute their own legitimacy as well as that of their respective corporate units. As explained by the institutionalisation theory, as anchor agencies in the MSC Program, the three corporate units of the incubators have a high need for legitimacy (Dacin, Goodstein, & Scott, 2002; Daft, 2010; Meyer & Rowan, 1990). In ensuring enduring legitimacy, conforming to the demands of their tenant firms is required of the incubators. Moreover, serving the overall IT industry and regional development policies and making their objectives consistent with that of the MSC Program are important. As these steps are achieved, the incubators continue to contribute to the institutionalising of the MSC Program. Furthermore, perhaps to overcome the limitations of this underdevelopment of the cluster area, in that the closed linked is yet to be fully developed, the incubators serve as aggregators/brokers of networks to their tenant firms (network theory, see Hansen et al., 2000). Therefore, on the whole, transaction costs economics, network theory and institutionalisation are three important constructs in support of incubator and cluster development in emerging regions.

After ten years of operation, their incubating services have turned into systems that closely resemble that of their stated objectives. Collectively, this transformation enables them as a group, to move closer towards contributing directly to the MSC initiatives, that is, to develop a community of IT firms and support the development of the region. Such processes reflect the incremental evolution and the support provided by the incubators towards the planned development of an efficient and effective innovation system within the MSC region. Thus, the contributions of effective incubators towards the industry and development of the MSC region require time and resources. Their developmental trajectory seems to follow the life-cycle of their respective corporate units. That is, as the corporate units reach stability in their operations, the development of their incubators follows. This development is also influenced by the industrial policy under which they operate as well as by the level of maturity of their

targeted entrepreneur groups. As the MSC Program matures into its second and final phase of implementation (by the end of 2008), it appears that the corporate units, as well as the incubator operations, have further advanced towards achieving their stated objectives.

This incremental development process supports Venkataraman (2003) and Saxenian's (1994) arguments that while sites can be designated and buildings can be quickly constructed, a longer period is needed to develop the important soft components, such as the relationships and the networks between people, and, more important, the development of knowledge components necessary within a particular region (Asheim & Coenen, 2005; Abetti, 2004). Moreover, in promoting the growth of a region, the development of the managerial capabilities of businesses is necessary (Teece, 2007). In this regard, as the incubator business reaches maturity, and while their business environment continues to be volatile, the incubator's management capabilities need to be continuously enhanced. This enhancement would help to sustain the growth and the profitability of the incubators.

The next question then is whether the current incremental development of its innovation system is appropriate or whether Malaysia needs a more aggressive *catch up* strategy to enable it to achieve its desired developed status in the next 10 years. This question is an important concern as the overall contribution of the MSC Program to economic development is still minimal. Addressing this question however, is beyond the scope of this research. Additionally, the countries that Malaysia is trying to emulate and the overall global business environment have experienced rapid development in the last 10 years. The process can, perhaps, be accelerated by hiring more local and foreign experts within the country and by expediting research within local institutions and their transfers to the industry (Nelson, 2007). Research that focuses on accelerating this *catch up* process, such as venture capital management and technology transfer activities, are important considerations for future research and the development of a comprehensive regional and national innovation policy. The most important precondition, however, is to consider the desired outcomes against the current strategies and situations.

ACKNOWLEDGEMENTS

The authors acknowledge the financial support received from the following two research grants in conducting this study: The UKM Research University Grant, code UKM-GUP-EP-07-18-028, entitled "Growth of Entrepreneurial Tech-Based Firms" and the Finnish Cultural Foundation Grant, code GSB-003-2009, entitled "Innovation Commercialization Process in Finland, Austria and Malaysia".

REFERENCES

- Abetti, P. (2004). Government-supported incubators in the Helsinki Region, Finland: Infrastructure, results, and best practices. *Journal of Technology Transfer*, 29(1), 19–40.
- Abu Talib, B. (2007). *Fostering innovation @ MSC Malaysia*. Retrieved 17 December 2008, from http://www.eurosoutheastasiaict.org/events/engage/Malaysia/1_at_MSC-DatoAbuTalibBachik.pdf
- Allen, D. N., & McCluskey, R. (1990). Structure, policy, services and performance in the business incubator industry. *Entrepreneurship Theory and Practice*, 15(2), 61–77.
- Allen, D. N., & Rahman, S. (1985). Small business incubators: A positive environment for entrepreneurship. *Journal of Small Business Management*, 23(3), 12–22.
- Asheim, B. T., & Coenen, L. (2005). Knowledge bases and regional innovation systems: Comparing Nordic clusters. *Research Policy*, 34(8), 1173–1190.
- Benchmarking of Business Incubators. (2002). *European commission enterprise directorate-general*. Retrieved 15 December 2008, from http://ec.europa.eu/enterprise/entrepreneurship/support_measures/incubators/benchmarking_bi_part_two_2002.pdf
- Bergek, A., & Norrman, C. (2008). Incubator best practice: A framework. *Technovation*, 28(1–2), 20–28.
- Birch, D. L. (1987). *Job creation in America: How our smallest companies put the most people to work*. New York/London: Free Press & Collier Macmillan.
- Chiaroni, D., & Chiesa, V. (2006). Forms of creation of industrial clusters in biotechnology. *Technovation*, 26(9), 1064–1076.
- Dacin, M. T., Goodstein, J., & Scott, W. R. (2002). Institutional theory and institutional change: Introduction to the special research forum. *Academy of Management Journal*, 45(1), 45–47.
- Daft, R. L. (2010). *Understanding the theory and design of organizations*, (10th ed). Canada: South-Western Cengage Learning.
- Doloreux, D. & Saeed, P. (2005). Regional innovation systems: Current discourse and unresolved issues. *Technology in Society*, 27(2), 133–153.
- Economic Planning Unit. (2008). *New economic policy*. Retrieved 28 December 2008, from <http://www.epu.jpm.my/new%20folder/development%20policies/cont%20key%20policies/NEP.htm>
- Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, 14(4), 532–550.
- Eisenhardt, K. M., & Graebner, M. E. (2007). Theory building from cases: Opportunities and challenges. *Academy of Management Journal*, 50(1), 25–32.
- Etzkowitz, H., & de Mello, J. (2004). The rise of a triple helix culture: Innovation in Brazilian economic and social development. *International Journal of Technology Management & Sustainable Development*, 2(3), 159–171.
- Florida, R. (2002). *The rise of the creative class: And how it's transforming work, leisure, community and everyday life*. New York: Basic Books.
- Florida, R. (2005). *The flight of the creative class: The new global competition for talent*. New York: Harper Business Books.

- Fowler, F. J. (2009). *Survey research methods*, (5th ed.). Thousand Oaks, CA: Sage Publication.
- Government of Malaysia. (2001). *Rancangan Malaysia ke-8, 2001–2005*. Kuala Lumpur: Percetakan Nasional Malaysia Berhad.
- Government of Malaysia. (2006). *Rancangan Malaysia ke-9, 2006–2010*. Kuala Lumpur: Percetakan Nasional Malaysia Berhad.
- Hackett, S. M., & Dilts, D. M. (2004). A systematic review of business incubation research. *Journal of Technology Transfer*, 29(1), 55–82.
- Hansen, M. T., Chesbrough, H. W., Nohria, N., & Sull, D. N. (2000). Networked incubators: Hothouses of the new economy. *Harvard Business Review*, 78(5), 74–83.
- Hsu, P., Shyu, J. Z., Yu, H., Yuo, C., & Lo, T. (2003). Exploring the interaction between incubators and industrial clusters: The case of the ITRI Incubator in Taiwan. *R&D Management*, 33(1), 79–90.
- Kautt, M., Walsh, S., & Bittner, K. (2007). Global distribution of micro–nano technology and fabrication centers: A portfolio analysis approach. *Technology Forecasting and Social Change*, 74, 1697–1717.
- Khairul Akmaliah, A. (2008). Incubators within university and clustered contexts: Cases of NCTU and NTHU Incubators in Hsinchu, Taiwan. *Asian Academy of Management Journal*, 13(1), 65–92.
- Khairul Akmaliah, A., & Maisarah, A. (2004). Characteristics of firms and profile of entrepreneurs of UPM-MTDC Technology Incubation Center. *Jurnal Pengurusan*, 23, 15–31.
- Kirchhoff, B. A. (1994). *Entrepreneurship and Dynamic Capitalism: the Economics of Business Firm Formation and Growth*. Westport, CT: Praeger.
- Koh, F., Koh, W., & Tschang, F. T. (2005). An analytical framework for science parks and technology districts with an application to Singapore. *Journal of Business Venturing*, 20(2), 217–239.
- Krishna, V. V. (2008). *The science and technology system in Malaysia*. Retrieved 14 December 2008, from <http://portal.unesco.org/education/en/files/55597/11999609765MALAYSIA.pdf>
- Lalkaka, R. (2002). Technology business incubators to help build an innovation-based economy. *Journal of Change Management*, 3(2), 167–176.
- Malaysian Industry-Group for High Technology [MIGHT]. (2004). Retrieved 17 December 2008, from <http://www.might.org.my/publications/Fusion8.pdf>
- Markman, G. D., Phan, P. H., Balkin, D. B., & Gianiodis, P. T. (2005). Entrepreneurship and university-based technology transfer. *Journal of Business Venturing*, 20(2), 241–263.
- Ministry of International Trade and Industry Malaysia [MITI]. (2004). Retrieved 14 December 2008, from <http://portaluat.miti.gov.my/cms/content.jsp?id=com.tms.cms.article.15754ddc-7f000010-5e095e09-5c5c4b64&paging=0>
- Mian, S. A. (1994). US university-sponsored technology incubators: An overview of management, policies and performance. *Technovation*, 14(8), 515–528.
- Mian, S. A. (1996a). Assessing value-added contributions of university technology business incubators to tenant firms. *Research Policy*, 25(3), 325–335.

- Mian, S. A. (1996b). The university business incubator: A strategy for developing new research/technology-based firms. *The Journal of High Technology Management Research*, 7(2), 191–208.
- Mian, S. A. (1997). Assessing and managing the university technology business incubator: An integrative framework. *Journal of Business Venturing*, 12(4), 251–285.
- Malaysia Debt Ventures Berhad [MDV]. (2010). *Our alliances*. Retrieved 24 July 2010, from <http://www.mdv.com.my/v2/about-us/our-alliances>
- Ministry of Science, Technology and Innovation [MOSTI], MSC Technology Centre Sdn. Bhd. [MSCTC], & IBM Corporation [IBM]. (2007). *National strategic ICT roadmap*. Retrieved 27 September 2009, from http://www.nitc.org.my/view_file.cfm?fileid=7
- MSC Malaysia. (2008). *About MDeC*. Retrieved 14 December 2008, from <http://www.msomalaysia.my/topic/About+MDeC>
- MSC Malaysia Client Contact Centre. (2008). *MSC impact survey 2008*. Cyberjaya: MDeC.
- MSC Malaysia Cybercities Department. (2007). *MSC Malaysia cybercities & cybercentres: Facts and figures* (2nd ed.). Cyberjaya: MDeC.
- Malaysian Technology Development Corporation [MTDC]. (2008). *Malaysian technology development corporation*. Retrieved 1 June 2008, from <http://www.mtdc.com.my>
- Meyer, J., & Rowan, B. (1990). Institutionalized organization: Formal structure as myth and ceremony. *American Journal of Sociology*, 83, 340–363.
- National SME Development Council. (2006). *SME Annual Report 2006: Chapter 6*. Retrieved 17 December 2008, from http://www.bnm.gov.my/files/publication/sme/en/2006/chap_6.pdf
- Nelson, R. R. (2007). The changing institutional requirements for technological and economic catch up. *International Journal of Technological Learning, Innovation and Development*, 1(1), 4–12.
- National IT Council (NITC). (2009). *About NITC; National IT Agenda-NITA*. Retrieved 30 August 2009, from <http://www.nitc.my/index.cfm>
- Phan, P. H., Siegel, D. S., & Wright, M. (2005). Science parks and incubators: Observations, synthesis and future research. *Journal of Business Venturing*, 20(2), 165–182.
- Phillips, R. G. (2002). Technology business incubators: How effective as technology transfer mechanisms? *Technology in Society*, 24(3), 299–316.
- Porter, M. E. (1998). Clusters and the new economics of competition. *Harvard Business Review*, 76(6), 77–90.
- Porter, M. E. (2000). Location, competition and economic development: Local clusters in a global economy. *Economic Development Quarterly*, 14(1), 15–34.
- Ramasamy, B. Chakrabarty, A., & Cheah, M. (2003). Malaysia's leap into the future: An evaluation of the Multimedia Super Corridor. *Technovation*, 24(11), 871–883.
- Ratinho, T., & Henriques, E. (2010). The role of science parks and business incubators in converging countries: Evidence from Portugal. *Technovation*, 30(4), 278–290.
- Saxenian, A. (1990). Regional networks and the resurgence of Silicon Valley. *California Management Review*, 33(1), 89–112.

- Saxenian, A. (1994). *Regional advantage: Culture and competition in Silicon Valley and Route 128, U.S.* Cambridge, MA: Harvard University Press.
- Smilor, R. W., Gibson, D. V., & Kozmetsky, G. (1989). Creating the technopolis: High-technology development in Austin, Texas. *Journal of Business Venturing*, 4(1), 49–67.
- Steffensen, M., Rogers, E. M., & Speakman, K. (2000). Spin-offs from research centers at a research university. *Journal of Business Venturing*, 15(1–2), 93–111.
- Steinle, C., & Schiele, H. (2002). When do industries cluster? A proposal on how to assess an industry's propensity to concentrate at a single region or nation. *Research Policy*, 31(6), 849–858.
- Teece, D. J. (2007). The role of managers, entrepreneurs and the literati in enterprise performance and economic growth. *International Journal of Technological Learning, Innovation and Development*, 1(1), 43–64.
- Timmons, J. A. (1994). *New venture creation: Entrepreneurship for the 21st century* (4th ed): Irwin, Press.
- Technology Park Malaysia (TPM). (2010). *Technology Park Malaysia*. Retrieved 22 May 2010, from <http://www.tpm.com.my/> and http://www.tpm.com.my/index.php?option=com_content&task=view&id=239&Itemid=200
- Venkataraman, S. (2003). Regional transformation through technological entrepreneurship. *Journal of Business Venturing*, 19(1), 153–167.
- Yin, R. K. (1994). *Case study research: Design and methods*. Thousand Oaks, CA: Sage Publications.
- Yin, R. K. (2009). *Case study research: Design and methods* (4th ed.). Thousand Oaks, CA: Sage Publications.